ONTOLOGY OF ACCESSIBILITY IN THE CONTEXT OF WAYFINDING FOR PEOPLE WITH DISABILITIES

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There is evidence that objects in and of the built environment function as barriers or facilitators to accessibility for people with disabilities. Although there are many existing sources of information about accessibility, they often lack clear criteria to describe accessibility, explanations of barriers and facilitators to mobility, and coverage of multiple physical environments. Researchers have argued that wayfinding services (e.g., Google Maps) can help people with disabilities prepare to travel through the built environment, yet current wayfinding services include little to no information about accessibility. This dissertation aims to study accessibility, in the context of wayfinding, in indoor, outdoor and transitional environments for people who travel in wheelchairs and people with low to no vision. To this end, a qualitative ontological analysis of multiple sources of information regarding accessibility was conducted including analyses of important categories associated with accessible wayfinding; different information providers' views on accessibility; and specific barriers and facilitators to accessibility. The results indicate that (1) people with low to no vision and people who travel in wheelchairs have different core wayfinding information needs, (2) a gap exists between the information people with disabilities and researchers provide on accessibility and that provided by standard guidelines, and (3) conceptualizing accessibility requires capturing actions performed by people with disabilities during every day travel along with characteristics of environmental objects. The resulting ontology could be leveraged to generate new criteria describing

accessibility, new routing algorithms, or to attach provenance to existing accessibility criteria. The findings have implications for people who design wayfinding services and collaborative maps and people collaboratively collecting data on the accessibility of specific places.

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PREFACE

Completing a dissertation is a large endeavor that takes much time and effort. Although it was an often a solitary process, there are many people who contributed in large and small ways towards enabling me to achieve my goal of obtaining a PhD. I cannot thank everyone in these few pages but I want to highlight a few people to whom I am truly grateful.

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I would like to thank the members of my dissertation committee and other professors who provided helpful feedback that ultimately made my project better. Professor Sheila Corrall provided consistent support and encouragement throughout my studies and helped me draw more insights on my work than I could see at the time. Dr. Hassan Karimi helped spawn my dissertation through my work with him on the Personalized Accessibility Map project. Dr. Jung Sun Oh encouraged me to take ownership of my dissertation. Dr. Bambang Parmanto served on the committee and asked useful questions. To you all, Thank you.

Over the years, I have accumulated many colleagues who are now friends. Dr. Rosta Farzan fostered many of these friendships by providing a forum for female PhD students to gather, learn from and support each other. As a member of the Women in Information Sciences group, I grew from a fledgling student into a confident academic. Rosta has also provided a wonderful example of how an academic can be successful yet still have fun. Thank you, Rosta. You are a superb mentor and friend. Thank you fellow WISers, you've shown me that I am not alone.

I spent many hours with my labmates in the Geoinformatics and IRIS labs and other students eating lunch in the PAWS lab, rehearsing for various exams and other presentations, celebrating exam victories, meeting up at the coffee machine, WAM!ing, hanging out at a picnic and just plain having fun. I will cherish these memories for the rest of my life. Thank you to all of my colleagues, you helped make my PhD experience bearable, informative and worth it. I want to give special thanks to Dr. Wei Jeng for giving me her confidence and reminding me of my value; to Dr. Michael Widdersheim for his quiet insights and the coding; to Dr. Cristina Robles Bahm for making me laugh and the opportunity to collaborate; and to Dr. Claudia Lopez for sharing parts of this 'unique moment' in my life in our little blue hole.

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1.0 INTRODUCTION

"Much, if not most, of the built environment is designed and constructed to a form that excludes all but the "temporarily able bodied"". (Green 2011, 219)

Disability is a growing phenomenon magnified by lack of access to components of the built environment. Worldwide one billion people live with a disability (WHO 2011). In the U.S., 56.7 million people (18.7%) report having a disability (Brault 2012). Green (2011, 220) reports that 70% of people with disabilities in developing countries experience "serious difficulties moving outside their homes". In this dissertation, ***mobility*** is the ability to move through space given the affordances to interact with or pass through the built environment. Barriers and facilitators within the built environment affect mobility. Fougeyrollas et al. (1999, 14) define an obstacle (i.e., barrier) as an environmental factor that "hinders the accomplishment of life habits" and a facilitator as "an environmental factor that contributes to the accomplishment of life habits when interacting with personal factors". Others classify barriers as inhibiting (Gray et al. 2003; Thapar et al. 2004) or constraining (Reid 2004) and facilitators as facilitating (Thapar et al. 2004), supporting (Gray et al. 2003) or enabling (Reid 2004) environmental factors. In this dissertation, a ***barrier*** is a component of the built environment that hinders mobility (i.e., lacks affordance), and a ***facilitator*** is a component of the built environment that enables mobility.

The first worldwide report on disability (WHO 2011) identified several disabling barriers for people worldwide. These barriers are societal and physical in nature and occur in employment, education, urban travel, and transportation, among other life areas. One of these barriers is a 'lack of accessibility' (WHO 2011). In the report, accessibility is defined in two ways: (1) "in common language – the ability to reach, understand, or approach something or someone"; and (2) "in laws and standards on accessibility – it refers to what the law requires for compliance" (WHO 2011). Furthermore, accessibility refers to physical access to the built environment, transportation systems and information. Researchers have also highlighted how barriers indoor and outdoor restrict the mobility of people who use wheelchairs (Matthews et al. 2003; Bromley et al. 2007; Kasemsuppakorn and Karimi 2008), people with low to no vision (Laakso et al. 2013; Yaagoubi et al. 2012a), and people of advanced age (Kurihara et al. 2004; Reid 2004), among other groups. Mobility in the built environment is often unpredictable for people with disabilities due to older city infrastructure (Andrade and Bins Ely 2012) and the individual nature of accessibility.

Since the 1960s, standard guidelines for the design and construction of accessible environments have been implemented in many countries (Bromley et al. 2007); however, physical barriers like those in Figure 1 remain. Guidelines based on these laws are intended to ensure that new buildings and construction comply with minimum accessibility requirements, but they do not cover the built environment that already exists. This older infrastructure poses challenges for people with disabilities as they travel to work, school, the doctor's office, and many other common destinations. Images A-C depict sidewalk obstructions, improper placement of detectable warnings, and lack of curb ramps on the sidewalk, respectively. Images D and F highlight a narrow hallway and the presence of a built-in obstacle in a hallway. Image F highlights the presence of stairs at the entrance to a bus and Image G shows an audio/visual banner on a bus that could be disabled by the driver. Images H-I show two common barriers when entering a building, the presence of stairs and a round doorknob. Image J depicts a narrow doorway that prevents a person who travels in a wheelchair to access the restroom of a building.

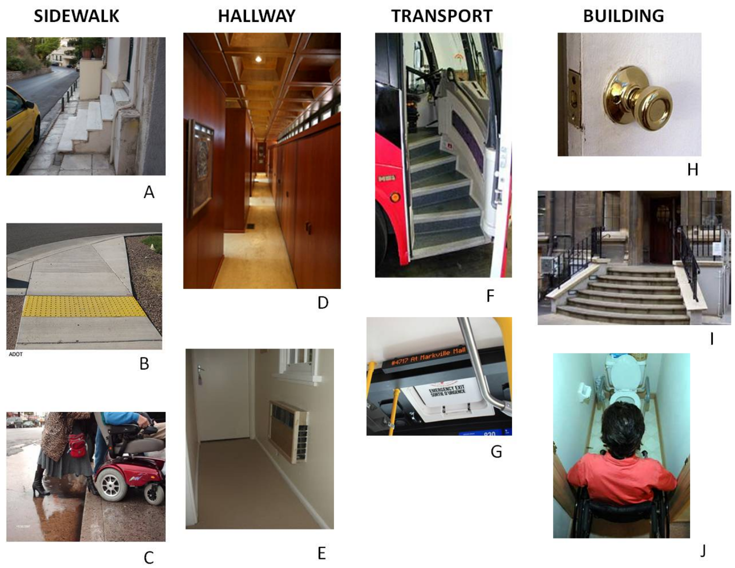

Figure 1 Example barriers[1]

On the other hand, researchers have identified cases in which objects that operate as physical barriers for some people function as facilitators of accessibility for others (Golledge 1993; Rosenberg 2012). For example, the curb ramp is a facilitator of accessibility for people

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1

A: Obstacle on Sidewalk: http://rabidgood.blogspot.com/2013_08_01_archive.html
B: Misplaced Detectable Warning: http://www.fhwa.dot.gov/publications/publicroads/09septoct/04.cfm
C: Lack of Curb Ramp: http://archive.constantcontact.com/fs008/1102761961410/archive/1109217550893.html
D: Narrow Hallway: http://news.cincinnati.com/slideshows/TonkensHouse/
E: Obstacle in Hallway: http://3.bp.blogspot.com/-dBbu_aDM6bo/T643xmBcETI/AAAAAAAAA44/1tGoFsMIXYc/s320/014.JPG
F: Bus entrance: http://preferredcharters.com/coaches.htm
G: Bus announcement: http://www.yorkregiontransit.com/en/aboutus/ourtechnology.asp
H: Door knob: http://en.wikipedia.org/wiki/Door_handle
I: Stairs at entrance: http://www.gen.cam.ac.uk/department/disabledaccess
J: Toilet: http://www.udll.com/media-room/articles/simple-steps-to-make-your-bathroom-wheelchair-accessible/

who use wheelchairs by allowing them to transition from the sidewalk to the street. At the same time, a person with low to no vision who travels with a white cane may perceive the curb ramp as a barrier because they cannot detect where the sidewalk ends and the road begins. Each person with a disability has unique interactions with the built environment that impact accessibility including both barriers and facilitators to mobility.

1.1 PROBLEM STATEMENT

Researchers have found positive correlations between the removal of barriers in the environment and the autonomy of people with disabilities (Green 2011). In lieu of the total removal of barriers, which may never be achieved, some information tools, such as wayfinding services, may help with feelings of independence (Sobek and Miller, 2006). Some researchers (e.g., Eichhorn et al. 2008) claim that access to information about the environment is even more important than removing physical barriers.

Wayfinding is a complex activity that includes the planning of actions and operations performed during the activity of navigation. Timpf (2002) considers that simple wayfinding consists of three stages: planning, route instructions, and moving. Golledge (1999) defines wayfinding as “the process of determining and following a path or route between an origin and destination”. Wiener et al.’s (2009) taxonomy describes wayfinding as a sub-category of navigation that entails moving toward distant, non-visible space using reasoning, planning, decision-making, and representations. Each of these definitions acknowledges two distinct activities: planning a trip and going on the trip. In this dissertation, *wayfinding* is the activity of determining and planning a trip via actions such as location searching and route finding ahead of time and engaging in decision making in a planning mode; in other words, planning the trip. The wayfinding activity is provoked by a need to move purposefully through space and requires the wayfinder to make an informed choice among alternatives. Naumer and Fisher (2009, 2457) note that an information need "represents the starting point and motivation that brings a user to engage in the process of information seeking." A *wayfinding information need* is the information required by a navigator in order to make an informed choice about how they can purposefully move through the built environment.

In addition to the uncertainty surrounding accessibility of the built environment, the task of wayfinding itself presents certain challenges. Many people rely on wayfinding services, such as Google Maps, to plan their trips. While these services are not a perfect solution, due to limited data about the pedestrian environment (Corona and Winter 2001) and limited support for indoor environments (Vanclooster and DeMaeyer 2012), they are widely accepted solutions (Karimi et al. 2014b) for aiding the complex task of wayfinding. While people with disabilities can and do use these same services, information about the accessibility of both the destination and path to reach that destination is not available to them, if such information is collected at all. It is unclear why mainstream wayfinding services do not include even a minimal amount of accessibility information; however, some (Neis and Zielstra 2014) argue that the high cost of data collection and maintenance plays a role. Research has shown a lack of awareness of the realities of inaccessibility by building designers (Gray et al. 2003) and policy makers (Green 2011); however, similar research has not been conducted with developers of wayfinding services. The fact that the wayfinding needs of people with disabilities are still largely unknown has been highlighted in a recent symposium on "Accessible Way-finding using Web Technologies" (WAI

2014) and by researchers of indoor navigation systems (Wise et al. 2012) and tourism information schemes (Eichhorn et al. 2008).

Even though there is a lack of knowledge about the wayfinding needs of people with disabilities, researchers have studied accessibility from various viewpoints. Some have contributed towards knowledge of requirements for information platforms, such as wayfinding services (Laakso et al. 2013, 2011; Yaagoubi et al. 2012a; Mehigan and Pitt 2012; Ding et al. 2007; Kammoun et al. 2010; Swobodzinski and Raubal 2008; Matthews et al. 2003; Beale et al. 2006; Sobek and Miller 2006; Kasemsuppakorn and Karimi 2008; Neis and Zielstra 2014; Prandi et al. 2014), collaborative mapping (Kurihara et al. 2004; Palazzi et al. 2010; Goh et al. 2007; Rashid et al. 2010; Völkel et al. 2008; Völkel and Weber 2008; Kulyukin et al. 2008; Holone et al. 2008), and tourism information systems (Cavinato and Cuckovich 1992; Garncarz et al. 1998; Israeli 2002; Richards et al. 2010), while others focus on understanding the relationship between environmental barriers and participation in society (Pusch 2003; Rosenberg et al. 2012; Perle 1968; Lawlor et al. 2006; Rantakokko et al. 2013; Bromley et al. 2007; Thapar et al. 2004; Reid 2004; Andrade and Bins Ely 2012).

As the studies above highlight, there is a large set of research literature about accessibility in the built environment. Additionally, there are publicly available sources of information about accessibility – accessibility standards, accessibility information schemes, and collaborative maps. Governments, tourism organizations, developers and collaborative mappers create these sources of information. Unfortunately, even with all of the research on accessibility and publicly available information, a comprehensive understanding of accessibility for people who travel in wheelchairs and people with low to no vision traveling through indoor and outdoor environments is missing. To date, each of these sources of information about accessibility lacks one or more of the following: (1) clear criteria to describe accessibility, (2) clear designations of whose accessibility is described, (3) information about accessibility for both indoor and outdoor environments, and (4) clear explanations of barriers and facilitators for people who travel in wheelchairs and people with low to no vision.

So far, it is clear that accessibility information is essential for people with disabilities to plan a trip, existing services do not adequately provide such accessibility information, and while dispersed sources of information about accessibility exist, they are not in the form that can be effectively incorporated into wayfinding services. Thus, we posit that a lack of awareness of wayfinding needs of people with disabilities and a gap in knowledge about the specific aspects of accessibility (e.g., barriers and facilitators to mobility) are the main contributing factors that have led to the inadequate or insufficient support for people with disabilities in existing wayfinding services.

1.2 MULTIDISCIPLINARY NATURE OF THE PROBLEM

The design and study of wayfinding and navigation systems/services is of interest to multiple disciplines of study. The lack of knowledge regarding the wayfinding information needs of people with disabilities has been highlighted by scholars of tourism (Eichhorn et al. 2008) and computer science/information science (Wise et al. 2012, WAI 2014). Wayfinding/navigation systems have been designed from different angles and for different purposes by scholars in urban studies, engineering, geography, computer science, information science and various sub-disciplines (see Chapter 2.0). These disciplines utilize different methods to collect user requirements for building new systems/services: some scholars use interviews and surveys to collect requirements while others prefer to follow potential users as they move through the environment or rely solely on governmental standards. The designed system can be implemented using the approach taken in conventional navigation systems, the web-based approach which has become the new trend, or the collaborative approach which requires participation of users. Because of these varying disciplinary practices, an understanding of wayfinding information needs requires interacting with literature and datasets from each of these disciplines and an understanding of the different research methods used by each discipline.

The second aspect of the problem is to understand the barriers and facilitators to mobility that people with disabilities face during real-world travel. The collection of wayfinding information needs, mentioned above, includes barriers and facilitators to mobility implicitly, but these designs/studies do not often investigate the need for a piece of information in relation to its impact on mobility. To understand 'why' a piece of information is required, studies of barriers in the environment and the ability of people with disabilities to participate in society are needed. These types of studies are typically conducted in schools of architecture, rehabilitation science, nursing, occupational and physical therapy and other health sciences (see Chapter 2.0).

Unfortunately, since these studies are not conducted with the design of a wayfinding information system in mind, they do not connect the barriers and facilitators they identify to the pieces of information that would be useful for wayfinding. Very few studies utilize the perspectives of both wayfinding information needs researchers and barriers and facilitators researchers. The methods used by researchers investigating barriers and facilitators mainly include interviews or surveys to understand the participant's experience, and the use of different reliable instruments (checklists) to measure the environmental conditions. Building an understanding of the findings from different barriers and facilitators studies requires an understanding of how barriers and facilitators are defined by each discipline and the different research methods used by these researchers.

Each discipline involved in studying wayfinding and barriers and facilitators to mobility contribute essential knowledge for understanding accessible wayfinding, thus, no research concerned with this concept can adequately investigate accessibility in the context of wayfinding without considering the evidence from these different types of studies.

1.3 RESEARCH SCOPE AND QUESTIONS

This dissertation studies accessibility in the context of wayfinding focusing on what accessibility means for people who travel in wheelchairs and people with low to no vision in indoor, outdoor and transitional built environments. In other words, the research is concerned with understanding the diversity of barriers and facilitators to movement that occur between a person with a disability and the built environment.

1.3.1 Scope of the Research

The scope of the dissertation work is captured by a wayfinding scenario drawn from Stern and Portugali (1999). Four components influence the decision-making and choice behavior of the wayfinder: the trip purpose, the traveler, the means of navigation, and the situation of travel (Stern and Portugali 1999).

1.3.1.1 Trip purpose 'Trip purpose' can be to a known destination or an unknown destination. In other words, the trip can be to a workplace in which the destination, path and most of its attributes are known or a special one, a visit to a new restaurant, in which very little about the destination, available paths and their attributes is known. It follows that the unknown trip purpose requires more information than the known trip purpose. Given the unpredictability of accessibility in the built environment, this dissertation focuses on the unknown 'trip purpose' assuming that people with disabilities will need more information about the environment, even for trips around their home city.

1.3.1.2 Traveler The 'traveler' (called navigator by Stern and Portugali (1999)) has personal characteristics that affect retrieval and processing of information, spatial knowledge and mobility (Stern and Portugali 1999). In this dissertation, we assume that the 'traveler' is a person with a disability, specifically a person who travels in a wheelchair or a person with low to no vision.

1.3.1.3 Means of navigation The 'means of navigation' could be by personal vehicle, pedestrian or public transit and constrains the available choices. This dissertation is concerned with pedestrian 'means of navigation'. Pedestrian means of navigation include moving along the sidewalk, through an entrance, down a hallway or around a room by walking with or without assistive devices or propelling a wheelchair. This also includes moving toward a public transit stop and, to some extent, riding public transit.

1.3.1.4 Situation of travel The 'situation' or environment is determined by location and time, which constrains available and feasible route choices. Pedestrian travel includes access to both indoor and outdoor environments and transitions between these environments (Vanclooster and

De Maeyer 2012). Indoor environments include rooms connected by hallways (Figure 2). Outdoor environments include points of interest (POIs) connected by pedestrian networks. Transition environments are entrances to rooms in indoor and POIs in outdoor. POIs have been defined in multiple ways. Kaamoun et al. (2010, 2224) define POIs as “places or objects that are potential destinations” and distinguish POI from landmarks, which are “locations that can be detected by the user in order to confirm [their] position within the itinerary (e.g., changes in ground texture, telephone poles, traffic lights, etc)”. Karimi and Ghafourian (2010, 302) define POIs for indoor space as “major points within a building that could be requested as destinations”. More recently, Prandi et al. (2014) defined the following classes of outdoor accessibility POIs (aPOIs): gap, cross, obstruction, parking, surface, and pathway.

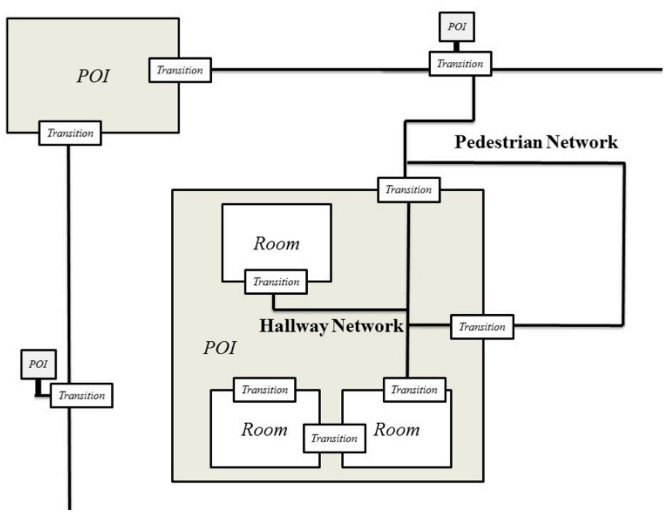


Figure 2 Built environment

In this dissertation, a *POI* is defined as a potential destination, either indoor or outdoor, that includes at least one entrance or is a public transit stop. This narrow definition of POI is adopted for simplicity. Other definitions include objects or characteristics that are more appropriate for representing the properties of POI or hallway and pedestrian networks or functioning as landmarks that support wayfinding. Thus, connecting all the previous threads, the 'situation of travel' is the *built environment* which in this dissertation includes indoor POIs (e.g., rooms) connected by a hallway network, outdoor POIs (e.g., building or transit stop) connected by a pedestrian network that are connected to each other via transitional spaces (e.g., entrances), and landmarks that assist in orientation.

1.3.2 Research questions

Wayfinding services have been heralded as a way to help people with disabilities to gain feelings of independence when they prepare to travel through the built environment, yet current wayfinding services do not include any information about accessibility. Researchers in multiple domains have indicated a lack of knowledge regarding the wayfinding needs of people with disabilities and specific aspects of mobility. This knowledge motivates the following research questions in this study:

(1) What are the important aspects of accessibility, in the context of wayfinding, for people who travel in wheelchairs and people with low to no vision?

(2) How do different information providers (i.e., researchers, people in participatory research or online, and standards bodies) describe accessibility?

(3) How can available information about accessibility in different physical environments, specifically barriers and facilitators to mobility, be organized to support the wayfinding needs and preferences of people who travel in wheelchairs and people with low to no vision?

In order to answer these research questions a textual and ontological analysis of multiple information sources is conducted. The research includes four phases that align with the lifecycle of an ontology. The first phase of the research is *Knowledge Acquisition*. This phase aims to answer research questions 1 and 2 using qualitative content analysis (QCA) to investigate accessibility in the context of wayfinding, specifically what kinds of barriers and facilitators to mobility and wayfinding information needs are reported in the text data (Section 5.2.3). Research question 1 will be addressed by examining the frequency of barriers and facilitators identified during the analysis with the assumption that a barrier or facilitator's frequent use in multiple datasets and multiple countries equates with importance. Research question 2 will be addressed using a second level comparative coding scheme designed to compare barriers and facilitators shared by the public and those codified by standards bodies.

Extracting wayfinding information needs, barriers, and facilitators from the extant text data and using these needs to design an ontology that can describe accessibility in the context of wayfinding will begin to address research question 3. The remaining phases of the research contribute to answering question 3. The second phase *Specification* utilizes the extracted wayfinding information needs, barriers, and facilitators to generate an ontology requirements specification document (ORSD). The ORSD and mobility information are then used as input for the third phase, *Conceptualization*. Conceptualization is predicated on a 'commonsense reality' (Smith and Mark 2001). Common sense reality is "the environment which we all share our everyday perceiving and acting" (Smith and Mark 2001, 482). The notion of common sense is divided into two types: primary theory and secondary theory (Horton 1982). Primary theory is the "total stock of basic theoretical beliefs which all humans need in order to perceive and act in ordinary everyday situations" (Smith and Mark 2001, 487). These are distinguished from secondary theory, which mainly consists of folk beliefs and legends. During Conceptualization, concepts identified in the textual analysis and the pre-glossary will be analyzed and defined. A set of properties, including relations, will be created based on evidence from analyzed texts. The theory of affordances (Gibson 1979) will be used to conceptualize mobility.

The fourth phase, *Verification*, is the first step in evaluating the resulting ontology and will use the set of requirements generated during Specification. The purpose of Verification is to ensure that the ontology is constructed correctly. The results of the Verification phase may trigger new iterations of Conceptualization and Knowledge Acquisition. Finally, the *Documentation* phase is continuous throughout the research. Each phase of the research, except this one, will be documented with an emphasis on documenting ontological decisions and the origin of ontological concepts and properties.

1.4 RESEARCH OBJECTIVES AND CONTRIBUTIONS

The goal of this dissertation is to conceptualize accessibility in the context of wayfinding, for people who travel in wheelchairs and people with low to no vision traveling in different environments, to enable the development of databases and services that can support wayfinding for these two groups.

The objectives of the research are to (1) synthesize known barriers and facilitators to mobility, in other words, a set of relationships between people with disabilities and the environment, in the context of wayfinding, from a variety of information sources; (2) identify a set of wayfinding information needs of people with disabilities, specifically people who use a wheelchair and people with low to no vision; (3) compare barriers and facilitators to mobility shared by researchers and people with those codified by standards bodies; and (4) conceptualize accessibility in the context of wayfinding in an ontology.

The work completed in the dissertation contributes to scholarship and wayfinding services in several ways. The discussion of the problem highlighted two major gaps, a lack of information about the wayfinding needs of people with disabilities and a lack of knowledge about specific aspects of accessibility for people with disabilities. The wayfinding needs identified in this research are an initial suggestion of the wayfinding needs of people who travel in a wheelchair and people with low to no vision. This is important for the future design of wayfinding services because the wayfinding needs provide a starting point for designing wayfinding services that can support these groups. The ontology developed as part of this work and in accordance with the identified wayfinding needs contributes a set of knowledge that could be leveraged in several ways. Developers of wayfinding services could design more accessible wayfinding services by generating accessibility criteria from the knowledge captured in the ontology or collecting key types of data related to accessibility. Stakeholders in collaborative mapping services (developers and data collectors) could use the knowledge in the ontology to attach provenance to the mapping criteria already in place and to design new mapping criteria. Creators of accessibility schemes could improve their coverage of information about pedestrian environments and the two target groups in this study.

Regarding scholarship, this work contributes to a deeper understanding of wayfinding needs and accessibility in the context of wayfinding and how various constituencies perceive it. It is hoped that this work will lead to increased information regarding accessibility of the built environment in existing wayfinding services or lead to the creation of wayfinding services in the future that meet the needs of all potential users.

1.5 RESEARCH CHALLENGES

This dissertation is challenging in several ways.

1.5.1 Accessibility is a Multifaceted Topic

Accessibility is not a one-size-fits-all topic. Disability is complex and multifaceted especially in relation to the built environment (Green 2011). Even within various groups (e.g., wheelchair users) there are a variety of different needs; Bromley et al. (2007) note that recognition of the diversity of needs of wheelchair users was a reoccurring topic in their study of city centre accessibility. Menkens et al. (2011) surveyed over 40 wheelchair users and found that one barrier free path is not suitable for all wheelchair users due to differing levels of fitness among wheelchair users. Similarly, Reid (2004) found that residential accessibility "is not experienced similarly by all old persons". Principles of universal design urge policy makers and designers to design buildings and information systems for all people. This is a necessary design principle to ensure that everyone can access physical environments and information systems. Holone et al. (2008) see the heterogeneity of the user group as a central challenge when creating navigational aids. In their assessment of accessibility information schemes, Eichhorn et al. (2008, 199) argue that "it is the level of detail provided that makes a difference for dissimilar user groups" (i.e., dissimilar groups of people with disabilities). On the other side, the experience of accessibility is a very individual situation. Consequently, to adequately identify a set of wayfinding needs across different groups of people with disabilities some assumptions based on physical condition, assistive devices used or some other characteristic may be required.

1.5.2 Variability of the Environment

The environment is not a uniform space. There are outdoor spaces and indoor spaces, each having unique characteristics. Outdoor space consists of both built and natural space while indoor space is solely enclosed built space (Walton and Worboys 2009). Conceptually, outdoor space is connected by networks but indoor space is connected by containment hierarchies (Walton and Worboys 2009). Similarly, objects in indoor and outdoor environments are not uniform. There is no guarantee that an object of one type in one environment will be the same in another environment even if both environments are indoor. This impacts the affordances of objects because it may change depending on both the person interacting with the object and its dimensions. Gray et al. (2003) conducted a set of focus groups (15 in total) and found early evidence that the built environment acts as both a facilitator to people's participation in society and as a barrier to their full participation. Studies have identified many objects in the environment that impact mobility. Fewer studies have confirmed the role that these objects play in accessibility. As of 2005, "there has been little evidence that identifies which environmental factors either facilitate or restrict a person's level of participation" (Keysor et al. 2005). Thus, the treatment of the environment in this dissertation may require taking a narrow definition or more uniform view that may not represent every environmental context.

1.6 INTERDISCIPLINARY PERSPECTIVE OF THE RESEARCHER

The problem under study, accessibility in the context of wayfinding, includes many perspectives on accessibility and wayfinding from a large set of disciplines. The topic of wayfinding information needs is a key driver of the research and the target groups of the research are people with low to no vision and people who travel in wheelchairs, two groups of people with disabilities. My training in the field of library and information science at the masters and doctoral levels provided a user-centered understanding of information systems that enabled me to evaluate wayfinding information systems from a user's point of view and included an understanding of information needs that was critical for identifying a set of wayfinding information needs to support the two target groups. The user-centered orientation of library and information science My training in geographic information systems at the masters level and as a member of the Geoinformatics Laboratory during my doctoral study prepared me for understanding geographic spaces and wayfinding systems and services. These studies and my undergraduate studies were in conducted in interdisciplinary settings which prepared me to understand and appreciate the different perspectives on research and practice within the scope of accessible wayfinding.

I have also conducted research during my doctoral studies that introduced me to different sources of information related to wayfinding and accessibility. My work on geocrowdsourcing (Benner and Karimi 2013) informed my understanding of collaborative maps and my work on the PAM project (Karimi et al. 2014) informed my understanding of standard guidelines for accessibility. As I began to research the topic, I recognized a need for further training in ontology design and the study of accessibility by multiple disciplines. I built this knowledge throughout the dissertation work by incorporating these topics into my doctoral exams and by reading large sets of accessibility related literature. In summary, my academic training, research work and interest enabled me to integrate multiple perspectives on accessibility in the context of wayfinding and organize the results into an ontology.

1.7 ORGANIZATION OF THE CHAPTERS

The dissertation is organized as follows. Chapter 2.0 reviews current practice surrounding pre-trip planning, wayfinding services and existing information sources, and research concerned with studying and modelling accessibility in the environment. Chapter 3.0 introduces the methodology used for ontology design and Chapter 4.0 introduces the methodology used for text analysis used in the ontology design. Chapter 5.0 , the first results chapter, offers a set important aspects of accessibility. Chapter 6.0 discusses identified gaps and similarities between barriers and facilitators expressed by people, standards bodies, and researchers. Chapter 7.0 presents the designed ‘ontology of accessibility in the context of wayfinding’. Chapter 8.0 puts the findings of the dissertation in context and discusses the methodology in detail. Finally, Chapter 9.0 concludes the dissertation, summarizes its contributions and outlines future work.

2.0 CURRENT PRACTICE AND RESEARCH

This chapter discusses current practice and research relevant to wayfinding and mobility in the built environment. In practice, people with disabilities need information about the built environment ahead of travel. The first part of this chapter reviews practical support for people with disabilities in wayfinding services, and public sources of information about accessibility of the built environment. Research on wayfinding and mobility is generally conducted by researchers designing wayfinding and tourism services while studies of mobility in the built environment are conducted by researchers in rehabilitation and medical sciences or architecture. The second part of this chapter reviews relevant literature from two perspectives: how accessibility of the built environment has been studied, and how it has been modeled.

2.1 THE NEED FOR PLANNING

People with disabilities require information about the accessibility of the built environment (transportation systems, pedestrian networks and buildings) because access to the built environment is often unpredictable. This is important because inaccessibility has been associated with decreased participation and independence of people with disabilities.

Several examples of physical barriers were presented in Chapter 1.0 The World Health Organization (WHO) notes a relationship between barriers to public accommodation and transportation, among other areas, and increased isolation and dependency for people with disabilities (WHO 2011). Perle (1968, 23) emphasized that this “dependency is usually not desired; it is necessary”. In a dissertation studying the independence of people who use wheelchairs, Pusch (2003, 29) was able to define independence using “two nonexclusive constructs: (1) the ability to perform their activities of daily living without any assistance and (2) having control over how they would live”. Clarke et al. (2011) found a negative association between several environmental factors (poor street conditions, heavy traffic, and low residential security) and everyday activities such as going outside of the home and into other buildings to talk with others, visit the doctor or a polling place. Other researchers presented the argument in a positive direction noting the relationship between increased access and increased participation and quality of life (Thapar et al. 2004). Regardless of the perspective, the point is clear that existing built environments have an impact on people with disabilities’ desire and ability to move around in the world independently. In fact, the idea of a disabling environment has been embedded within three existing models of disability: the WHO Model, the Institute of Medicine Model, and the Quebec Model (Whiteneck et al. 2004, 1324).

Foulke and Hatlen (1992, 44) reminded us that “most of the activities in which we engage require us to move through space purposefully.” Geographic space has been described as ‘multifaceted’, ‘dynamic’ and ‘complex’ (Jacobson and Kitchin 1997). Kulyukin et al. (2008, 1) argue, “the main functional barrier faced by people with visual impairments [is] the great difficulty of independently orienting to, and navigating through, dynamic and complex everyday environments”. Thus, evaluating the accessibility of routes is a common part of everyday life

(Yairi and Igi 2006). Whether the trip is long distance to an unknown place or around town, services that enable pre-planning are often required to minimize potential problems encountered in the environment (Yau et al. 2004). Researchers working on the HaptiMap project (Laakso et al. (2012, 50), a European project aimed at making map interfaces more accessible, call the route planner and route-oriented map 'indispensable'. Sobek and Miller (2006) found that wheelchair users and people who travel using aided mobility had to travel longer distances across the University of Utah campus to travel from the same origin and destination as a person with unaided mobility. This implies that the complexity of the task of wayfinding increases relative to barriers in the environment.

Cavinato and Cuckovich (1992) argued that the existence of information and its dissemination may be the greatest constraint to travel and tourism systems. Tourism researchers (e.g., Eichhorn et al. 2008), studying the implementation of accessibility information schemes, assert that information dissemination about accessible destinations is an immediate way to extend tourism opportunities for people with disabilities. They go on to posit that changing the physical environment may not be beneficial if the communication of the status of the physical environment is missing (Eichhorn et al. 2008). Regarding public transit and people with low to no vision, Hara et al. (2013, 3) found participants felt that "having [access to] information about landmarks would enable them to use transit more easily, [even those] who could sometimes read street signs". More recent work articulated that the organization of the 'necessary and diverse' information required for successful navigation by people who are blind should be considered carefully (Chen et al. 2015). Kalakou and Moura (2014) argued that wayfinding systems and environments that are well designed work together to improve the pedestrian experience. In summary, a route planner is an indispensable planning tool that may impact feelings of independence by helping people with disabilities understand the accessibility of their destination and the path to that destination. However, the developer of that route planner must know what kind of information is useful for people with disabilities and that information must be collected for each building and sidewalk segment within the boundary of that route planner's service area.

2.2 CURRENT WAYFINDING SERVICES

A route planner provides alternative routes between an origin and a destination and takes different criteria such as distance and time into account (Laakso et al. 2012). In addition to route planning, wayfinding services provide destination search, which allows a user to look up the location of points of interest (POIs). Each wayfinding service relies on a spatial (navigable) database. These navigable databases consist of both geospatial features (e.g., a transportation network and a set of POIs), and non-spatial attributes (e.g., the length of road segment or operating hours for a restaurant). Navigable databases for driving include road networks. Navigable databases for pedestrian movement outdoors include pedestrian networks (e.g., sidewalks). POIs have been used to represent almost any phenomena; for wayfinding tasks, this is often a building or parking lot for outdoor and a room for indoor. Existing navigable databases provide little support for wayfinding by people with disabilities; these limitations are discussed in this section.

Most existing navigable databases are for car travel and not usable for pedestrian travel (Corona and Winter 2001). Unlike car wayfinding services that rely on road network databases, pedestrian wayfinding services in outdoors must provide relevant and required operations on sidewalk networks. Researchers as early as 1997 criticized navigable databases describing the environment as unsuitable to support the mobility of people with low to no vision and argued for the capture of additional data (Jacobson and Kitchin 1997). Kasemsuppakorn and Karimi (2008) showed that road network databases used for car travel are inadequate for assisting people in wheelchairs. Others (Menkens et al. 2011) claimed that none of the modern systems/services (e.g., TomTom, Garmin, Nokia Maps, Google Maps) include features for wheelchair users. Similarly, Völkel et al. (2008) showed the inadequacy of road network databases for pedestrians with low to no vision. According to Neis and Zielstra (2014), commercial data providers such as NAVTEQ and TomTom do not provide the level of detail required for supporting wayfinding by people with disabilities and attribute this fact to the high costs of collection and maintenance. Pressl et al. (2010) list the following three reasons why more robust pedestrian and accessibility oriented information is not available in existing wayfinding services: (1) data about POIs or obstacles exist as text but are not geographically referenced, (2) transit information exists as time schedules with stops but the data is not routable, and (3) detailed data about accessibility are simply not available.

Vanclooster and De Maeyer (2012) evaluated support for indoor wayfinding in six wayfinding services (Bing, Google Maps, Mappy, Via Michelin, RouteNet, and OpenRouteService). They find that most services do not incorporate indoor data in route calculations due to a lack of available data, especially for underground structures. On the other hand, for those few services with indoor data, a lack of standardization has produced large diversity in terms of data structures, levels of completeness, availability, coverage, and level of detail (Vanclooster and De Maeyer 2012). Google Maps began soliciting floor plans from proprietors of POIs in 2014, and currently focuses on high density locations like airports, malls, stadiums and transit stations (Google Maps 2017). To date, they have indoor views in 25 countries with an average of 30 locations in each country (Google Maps Help 2017). Google Maps also has a street view for business called SeeInside™ which includes a 360 degree view of 34,000 businesses in 132 cities, and while this is encouraging, it represents only a minute amount of places in the world.

Currently, wayfinding services do not include information related to the accessibility of POIs or provide routes (pedestrian or otherwise) optimized on information related to accessibility. Many researchers (e.g., Helal et al. 2001; Pressl and Wieser 2006; Magnusson et al. 2009) have identified a need for a high level of detail to support navigation by people with low to no vision. Others (e.g., Chen et al. 2015) call for more accurate, comprehensive, and transient information. Laakso et al. (2011) evaluated 25 different ‘map sites and services’ in Finland and concluded that they all lack adequate information on accessibility. Representative, international wayfinding services, Google Maps and Bing Maps, do not provide any information about the accessibility of a location or use accessibility-based routing criteria. Example information includes the presence of steps at an entrance, the availability of an accessible restroom or the ambient levels of noise during open hours. Looking at an example location, a Starbucks Café in Pittsburgh, PA, neither Google Maps’ ‘more info’ nor Bing Maps’ location ‘details’ pages (shown in Figure 3) offer any description of the accessibility of the Starbucks location.

This lack of information makes it impossible for a person with a disability to evaluate if that location is accessible to them using a wayfinding service. Some (e.g., Mirri et al. 2014b; Karimi et al. 2014b) highlight that routes are computed using criteria for general users not people with differing abilities. Panou et al. (2007) report that, in Europe, useful route information such as accessibility of pavement, transportation means, bus stops or parking lots, point of origin and destination does not exist. Both Google Maps and Bing Maps provide routes from a chosen origin and destination pair based on common criteria, such as distance or travel time, and include specialized criteria for driving, walking and riding routes. However, none of these criteria are related to the accessibility of available parking lots for driving, sidewalk segments for walking, or transportation vehicles for riding. Thus, using these two common routing services, a traveler has no options for exploring accessibility before travel and may have to rely on friends, family, and others to assist them due to the lack of information about the accessibility of the environment. In summary, existing wayfinding services do not support the information requirements of people with disabilities mainly because their navigable databases do not include pedestrian or indoor data or *any* information about accessibility.

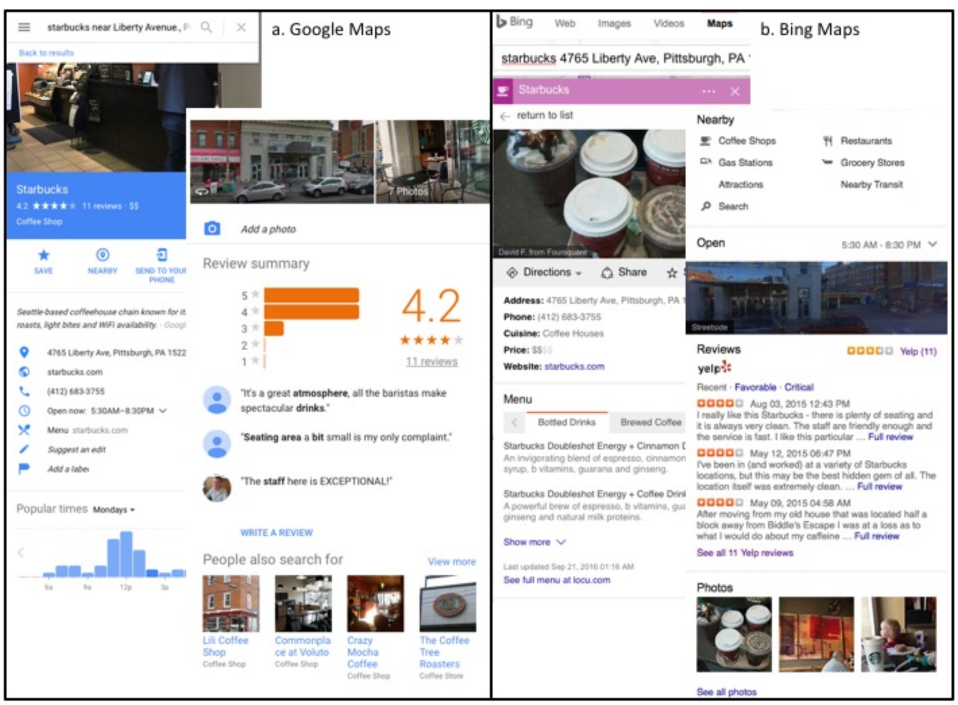


Figure 3 Location descriptions in Google Maps, Bing Maps

2.3 CURRENT ACCESSIBILITY INFORMATION SOURCES

There are several sources of information about accessibility available to the public: standard guidelines for accessible design, accessibility information schemes, and collaborative maps (e.g., OpenStreetMap). This section will discuss each of these sources of accessibility information.

2.3.1 Standard Guidelines for Accessibility

Accessibility legislation has been passed, and standard guidelines are available in, at least, the UK, US, Canada, Australia, New Zealand, Japan, China, India, Thailand (Bromley et al. 2007) Singapore (Goh et al. 2007) and Brazil (Andrade and Bins Ely 2012). The Americans with Disabilities Act (ADA) of 1990, the latest U.S. accessibility legislation enforced on the construction and rehabilitation of public and commercial facilities, has been called the most 'notable' and 'comprehensive' set of regulations on accessibility (Thapar et al. 2004). Table 1 identifies a sample set of legal acts and standard guidelines in different English speaking countries. These standard guidelines mainly focus on the built environment including buildings, sidewalks and transportation. Basic guidelines are already adopted while newer guidelines such as the Public Rights of Way (PROW) Guidelines, which proposes to extend the ADA's guidelines for sidewalks and other public rights of way, are still in the proposal stages. The oldest update for the guidelines listed in the table was in 2010; it is general practice to continually update these guidelines as society and the environment continue to change.

Thapar et al. (2004, 281) highlight that barriers to many life activities such as employment and education, among others, persist even though standards guidelines have been adopted. Even though these standard guidelines have led to major improvements on accessibility in the countries in which they have been adopted, their utility suffers from several limitations. First, most standards are enforced on new construction and rehabilitation of infrastructure which leaves a large amount of the built environment still inaccessible. The ADA requires alterations to existing facilities that are 'readily achievable' (Burnett and Bender Baker 2001), in other words, affordable. The former legislation in the UK, the Disability Discrimination Act, did "not directly require accessible environments to be provided for disabled people" but that they have access to the good, service, or facility not the building (Bromley et al. 2007, 231). This is remedied somewhat with the new Equality Act, but existing facilities are still not required to modify without new construction or rehabilitative construction.

Table 1 Sample accessibility guidelines

Legal Act	Standard Guidelines	Country	Application	Status	Last Updated
Americans with Disabilities Act, 1990	ADA Accessibility Guidelines, 1991, 2004	United States	Built Environment	Adopted	2010
	Public Rights of Way Guidelines, 2002, 2005	United States	Sidewalk, Streets	Proposed	2011
Equality Act, 2010	Code of Practice on Services, 2011	United Kingdom	Services	Adopted	2011
Accessibility for Ontarians with Disabilities Act, 2005	Design of Public Spaces Standards	Ontario, Canada	Built Environment	Adopted	2014
	Transportation Standard	Ontario, Canada	Transportation	Adopted	2014
Disability Discrimination Act, 1992	Access to Premises – buildings, 2010	Australia	Buildings	Adopted	2013
	Accessible Public Transport, 2002	Australia	Transportation	Adopted	2011

Second, even when standard guidelines are used, sometimes they are not implemented accurately. Andrade and Bins Ely (2012) performed a set of guided walks through a historic building in Brazil with a diverse group of people with disabilities and concluded that: (1) people with disabilities were still being excluded from common activities and (2) accessibility standards in Brazil were not being applied correctly. To further illustrate the second point, they find that only 10% of the problems identified in their study are not covered in existing standards, these standards were just not being applied (Andrade and Bins Ely 2012).

Lastly, standard guidelines present a problem due to their basis in universal design. The practice of universal design is used in standard guidelines because this is the most inclusive method for ensuring the built environment is accessible to the largest number of people. This universality presents a problem for wayfinding because route optimization requires specific criteria about the pathway. In the case of an accessible route, it should be accessible for the person submitting the query. Since accessibility is dependent on the affordance between the traveler and the environment, a universal approach may prioritize criteria that are less important to a particular traveler instead of personalizing the route to that individual. Using the ADA as an example, there are few designations in the guideline to indicate who the particular specification benefits. While this makes perfect sense in the case of constructing a universally accessible environment (which is the purpose of the standards), if that particular guideline were to be appropriated for use in a wayfinding service some classification of usefulness for particular users is necessary. Similarly, Whiteneck et al. (2004) criticizes the suite of checklists developed using the ADA guidelines for not indicating who will be impacted by the barriers.

2.3.2 Accessibility Information Schemes

Researchers studying tourism argued that since the 1960s much public attention and policy efforts had been given to barrier-free architectural design and local transportation access but the same attention had not been given to long-distance travel and tourism (Cavinato and Cuckovich 1992). Since then the European Union made accessible tourism a significant research area (Ding et al. 2014). Beginning around 2000, organizations in Europe began creating accessibility labeling schemes for the tourism industry. Tourism for All is a UK-based organization that promotes accessible tourism and works with the Europe Commission on accessible tourist accommodations. Their work includes the promotion of accessibility information schemes that tourism information providers (e.g., a hotel) can use to make the accessibility of accommodations known to travelers with disabilities.

Schemes such as this have been implemented in many countries across Europe (Toerisme Vlaanderen 2001) with the goal of creating a unified accessibility standard or scheme. One significant barrier to a unified scheme is the diversity of building regulations and accessibility standard guidelines across Europe. More recently, researchers began to evaluate such schemes. Eichhorn et al. (2008) evaluated surveys completed by 43 organizations who operated an accessibility information scheme. These organizations represent 19 different countries and are distributed over 9 governmental bodies (supporting all citizens) and 34 charitable, private, NGO bodies (focusing on people with disabilities). They report that accessibility criteria included in the schemes is dominated by information tailored to people with mobility impairments (90%) while other groups were less represented or missing. Surprisingly, only half of the schemes included descriptions of the pedestrian paths surrounding the destination. Lastly, less than 15% of the schemes allowed users to filter their search results based on disability type, facility type or a personal filter. These findings and those reported by Toerisme Vlaanderen (2001) indicate that, as an information source, accessibility information schemes are geographically sparse, non-standardized, and often lack information about the surrounding pedestrian environment.

2.3.3 Collaborative Mapping

Collaborative mapping is being promoted as an alternative to traditional mapping methods in many applications. Laakso et al. (2011) argue that collaborative mapping is an alternative method for creating pedestrian databases because the level of detail required is too high to achieve with traditional methods. Collaborative mapping is done via volunteer geographic information (VGI) practices (Goodchild 2007). A new group of collaborative mapping services oriented towards accessibility emerged in 2010; a listing of these sites can be found in Karimi et al. (2014a). Table 2 lists a subset of these services, their spatial coverage, support for groups of people with disabilities, source of accessibility criteria, and the number of criteria available in each.

Ding et al. (2014) note a lack of standardization for attributes describing the accessibility for public places or facilities. This is evident in the wide ranging number of criteria available in different services. Several of the services in Table 2 rely on coarse criteria (<5) while two include very detailed criteria (>30). The problem of too many criteria is that it may discourage mappers from collecting data and the problem of too few criteria is that the data may not provide an adequate picture of accessibility at that location. Ding et al. (2014) find a similar occurrence when trying to map criteria in Wheelmap with those in the National Rail dataset for the UK, which provides many more criteria (>50) than Wheelmap's tripartite rating. A related problem with these services is that they do not indicate how they derive their criteria and thus, it is not clear if the criteria are comparable. Another type of collaborative service, Yelp, is an urban city guide in which people can review local businesses. A Yelp user can find information about the 'wheelchair accessibility' of a location; however, the only users able to add this information are the owners of the business and the criteria used to determine the 'wheelchair access' are not public so an individual wheelchair user cannot determine if the location is actually accessible to them.

Table 2 Sample collaborative maps

Name	Coverage	Target Group	Accessibility Criteria	Number of Criteria
Access Together	U.S. and Canada	Mobility, Vision, Hearing, Sensory, Seniors	Detailed Questionnaire	34
AXSMap	U.S. (mainly New York)	Mobility, Hearing, Vision	One word descriptions with icon	8
planat	Global	Mobility, Vision, Hearing, Seniors	Detailed Questionnaire	81
Rollsquare	A few cities worldwide	Wheelchair Users	Text narrative, only accessible POIs	4
Wheelmap	Global	Wheelchair Users	Simple sentence descriptions	4

A common problem with all collaborative mapping services is sparcity of the collected data. Data in existing services are too sparse to support any real applications using their data. Two of the four limitations of existing sources of accessibility data, which include collaborative data, identified by Prandi et al. (2014) related to a lack of data. To illustrate this point, Table 3 compares the number of data points available in two collaborative mapping services, with an estimate of the total number of possible POIs in the U.S. in 2017[2]. The data in both collaborative maps composes less than 1% of the estimated number of locations that could be annotated with accessibility information in the U.S. Ding et al. (2014) evaluated four datasets that include accessibility information in the UK: Wheelmap (a part of OpenStreetMap (OSM)), Factual (a business and POI database), Step-free Access Guide (part of London Tube database), and National Rail (national railway stations database). They found that Wheelmap included

[2] Access Together is estimated from the published data fusion table (https://fusiontables.google.com/DataSource?docid=1zuRMjqvXx8gNz58R7vTNJL-iJV9XcqNsgTVR8_0&pli=1#rows:id=1). OSM wheelchair tags estimated using overpass turbo (https://overpass-turbo.eu/#). The number of POI in the US is estimated using the number of GNIS features listed in the National Map Gazetteer in Feb. 2017 (https://geonames.usgs.gov/apex/f?p=138:1:0).

wheelchair annotations for only 1.11% of the 421,666 nodes in the UK, in Factual 5% of the 210,613 restaurants included an accessibility designation, in Step-free Access Guide 50% of the stations (362) are annotated, and the National Rail database (the only non-collaborative database) contained the most information but still lacked specific attributes for roughly 50% of the stations.

Table 3 Estimated sparcity in collaborative maps

Service	Data Points	% coverage
GNIS	2,281,438	100%
OSM ('wheelchair' tag)	21,719	1%
Access Together	4,828	0.2%

Regarding collaborative mapping services that support accessible routing, a study of OSM data in 50 capital cities in Europe (Neis and Zielstra 2014) found that no city had more than 30% of the information required for sidewalks in the database and most had less than 10%. Of the three that included over 30% (Berlin, London and Riga), the support for identified accessibility features was inconsistent at best and absent at worst. The set of accessibility features or tags identified by Neis and Zielstra (2014) include the following categories: sidewalk, sidewalk width, sidewalk surface, sidewalk smoothness, sidewalk slope, sidewalk curb, lighting, tactile paving, steps, step height, ramp, handrail, crossing, general access. Tags within these categories, also from Neis and Zielstra (2014) are displayed in Table 4 along with the number of data points that have that tag (or tag family) in OSM as of February 2017. The number of data points with each tag is estimated using TagInfo, a website devoted to monitoring tag use in OSM. Tags with a double colon '::' between them have aggregated values based on 'left', 'right', 'both' and blank designators. Using the daily OSM stats report (OSM Stat 2017) from February 23, 2017, there are 3,765,524,760 nodes and 396,794,858 ways. Thus, it is clear from the values presented in the table that the coverage of these tags represents only a small amount of the data in OSM.

Table 4 Accessibility tag coverage in OSM

OSM Tag	Data Points	OSM Tag	Data Points
Footway	734,720	lit (Lighting)	2,037,938
Sidewalk	967,314	tactile_paving	136,239
sidewalk::width	3,339	ramp	19,015
sidewalk::surface	21,529	ramp:stroller	3,461
sidewalk::smoothness	1,419	ramp:wheelchair	4,157
sidewalk::incline	167	crossing	1,212,459
sidewalk::sloped_curb	982	traffic_signals	62,283
step_count	53,071	handrail	21,495
wheelchair:step_height	626	wheelchair	1,050,412

The ability for anyone to collect data about the environment is a great boon for the collection of a multitude of specialised data. Unfortunately, current collaborative mapping services lack provenance for their accessibility criteria, include criteria that are too coarse (and thus ambiguous) or too detailed, the amount of annotated data available to search is sparse, and the number of data with specialized tags describing accessibility represent a very small amount of the data that is stored in these services.

2.4 STUDYING ACCESSIBILITY OF THE BUILT ENVIRONMENT

Accessibility of the built environment is a pervasive phenomenon studied by many disciplines including Business, Architecture, Rehabilitation Science, Disability Studies, Public Health, Medicine, Geography, Computer Science, Information Science, various forms of Engineering, Geoinformatics, Occupational Therapy, Tourism Studies, and Health Informatics. These disciplines study accessibility from different perspectives each offering unique contributions to an understanding of what accessibility means for different people with disabilities in different environmental settings. Table 5 summarizes a set of general focus areas within which these disciplines study accessibility.

2.4.1 Urban and Disability Geography

Early studies of accessibility in urban and disability geography focused on bringing awareness to the lack of research concerning people with disabilities and extending existing spatial theories and measures to account for differences in ability. Perle's (1968) work on the urban mobility of people with disabilities lists many ways in which the urban environment – at the time – restricted options for people with disabilities. Other early work in urban geography by Kirby et al. (1983) highlighted the variations in accessibility among cities, using the relative accessibility of Berkeley, CA compared to London, UK as an example and offered an early discussion of 'dial-a-ride' systems – known today as paratransit.

Table 5 Research areas

Research Area	Goal of this type of research	Example Disciplines
Urban Geography, Disability Geography	Study the geography of disability and transit access and link spatial theory with disability studies.	Geography, Disability Studies, Psychology
Wayfinding and Navigation Services	Identify a set of requirements for navigation data and design algorithms for computing optimized routes and directions.	Computer science, Information science, Geography, Engineering
Accessible Tourism	Augment the tourist's information to improve decision making and purchasing power.	Business, Tourism studies, Recreation
Barriers and Participation in Everyday Life	Identify environmental barriers (among others, e.g., social barriers), understand how barriers in the environment affect people's ability to participate in society, and engineer advanced assistive devices.	Occupational therapy, Rehabilitation science, Health sciences, Nursing, Architecture

In the 1990s, urban geographers and psychologists published work related to the spatial cognition of people with low to no vision (Foulke and Hatlen 1992; Golledge 1993; Jacobson and Kitchin 1997) and began to articulate a new 'geography of disability' (Golledge 1993; Imrie 1996). Foulke and Hatlen (1992) articulate the application of existing theories on perception and cognition to understanding the mobility of people with low to no vision. Golledge (1993, 64) calls for a new type of 'geography of disability' by arguing that "geographers have the expertise to understand, perhaps better than any other discipline, the problems and processes of activity and interactions that take place between disabled populations and their environments". Imrie (1996) and others link disability in society with social oppression and argue that the removal of environmental barriers, in lieu of larger societal and policy changes, is not sufficient to solve issues of accessibility. Jacobson and Kitchin (1997) investigate the ability of GIS systems to support interaction with people with low to no vision and compare traditional (visual) GIS with non-visual alternatives.Accessibility is an important characteristic of geographic space (Church and Marston 2003) that has long influenced regional and urban planning (Thill et al. 2011). Accessibility in urban geography measures "the ease with which any land-use activity can be reached from a particular location, using a particular transport system", which is similar yet distinct from 'mobility', another common measure, which is "the ability of people to travel over distances" (O'Sullivan 2000, 86). Church and Marston (2003) criticize these measures because they do not account for differences among people. In their paper, they offer a framework that extends both traditional measures of accessibility in geography and the absolute access measures of standard guidelines such as the ADA Accessibility Guidelines. More recent work in urban geography extends Church and Marston's work into vertical space by modeling accessibility within a 3D model of an indoor environment (Thill et al. 2011).

In terms of their investigation of specific groups of people with disabilities, studies in urban and disability geography used the term of 'people with disabilities' as an umbrella (Perle 1968; Kirby et al. 1983; Golledge 1993; Church and Marston 2003), or specified the target group as 'people with visual impairments' (Jacobson and Kitchin 1997). Regarding their attention to the environmental setting, these studies do not commonly specify parts of the built environment in which their discussions are relevant. The more recent example (Thill et al. 2011) develops a 3D model that covers both indoor and outdoor environments.

2.4.2 Wayfinding and Navigation Services

Studies designing wayfinding and navigation services offer the design and/or implementation of a full system or one component of a system, such as an algorithm or data model (Table 6). The majority of studies design a full system that includes some of the following: requirements, a system architecture, a data model, a collaborative mapping method, an algorithm, an ontology, an implementation of all or part of the system, and an evaluation. Since requirements, data models, collaborative mapping criteria, and ontology are directly related to the work in this thesis, they will be covered in more detail. Requirements and collaborative mapping criteria are covered below and data models and ontologies are covered in Section 2.5. The studies that design a single component will be discussed alongside those that design entire systems.

2.4.2.1 Requirements Requirements analyses were conducted by many studies. Common data sources included: existing theory, existing literature, standard guidelines, interviews, surveys, and observation. Existing theories included orientation and mobility theories, e.g., Swobodzinski and Raubal (2008), and spatial and cognitive theories, e.g., Yaagoubi et al. (2012a and 2012b). Existing literature was a common source with some projects relying solely on literature (Pittarello and De Faveri 2006; Neis and Zielstra 2014; Chen et al. 2015) – one project utilized only one paper that was 11 years old at the time (Karimanzira et al. 2006) – and others combined literature with other sources of information (Helal et al. 2001; Sobek and Miller 2006; Ding et al. 2007; Kasemsuppakorn and Karimi 2008). Standard guidelines were another source of requirements including the ADA Accessibility Guidelines (Ding et al. 2007; Kasemsuppakorn and Karimi 2008; Dudas et al. 2009; Karimi and Ghafourian 2010), the International Classification on Functioning and Disability (ICF) (Vassilev et al. 2013), and governmental standards for accessibility in Singapore (Goh et al. 2007). In one project, it is claimed (Mirri et al. 2014b; Prandi et al. 2014) that categories of accessibility points of interest are derived from over 200 accessibility requirements, yet there are no citations and the source of these requirements is not mentioned.

The use of interviews to collect requirements was also common (Strothotte et al. 1996; Helal et al. 2001; Engelbrektsson et al. 2004; Yairi and Igi 2006; Ding et al. 2007; Kasemsuppakorn and Karimi 2008; Magnusson et al. 2009; Kammoun et al. 2010; Mehigan and Pitt 2012; Hara et al. 2013). Most of these studies focused on interviewing people with disabilities; however, some projects studying people with low to no vision conducted additional interviews with orientation & mobility instructors (Strothotte et al. 1996; Kammoun et al. 2010; Mehigan and Pitt 2012). Surveys, of varying designs, were also used to gather requirements (Matthews et al. 2003; Beale et al. 2006; Kulyukin et al. 2008; Völkel et al. 2008; Magnusson et al. 2009; Pressl et al. 2010; Menkens et al. 2011). Still other researchers chose to follow people with disabilities through the environment to observe their interactions (Matthews et al. 2003; Mehigan and Pitt 2012; Kasemsuppakorn et al. 2015). A final method used in a few cases was the focus group (Matthews et al. 2003; Magnusson et al. 2009; Menkens et al. 2011).

2.4.2.2 Collaborative mapping Since 2004, many of the studies designing wayfinding and navigation services have incorporated some aspect of collaborative data collection. Some studies perform analysis on or with collaborative data (Ding et al. 2014; Neis and Zielstra 2014) but most design collaborative mapping services for collecting data. These systems collect many kinds of data including: bus stop locations and landmarks (Hara et al. 2013), verbal route descriptions (Kulyukin et al. 2008), geo-tagged POIs (Goh et al. 2007; Holone et al. 2008; Menkens et al. 2011; Cardonha et al. 2013; Prandi et al. 2014), photographs (Goh et al. 2007;

Rashid et al. 2010; Menkens et al. 2011; Cardonha et al. 2013), free text (Goh et al. 2007; Menkens et al. 2011; Cardonha et al. 2013) and audio recordings (Rashid et al. 2010; Menkens et al. 2011).

Table 6 Wayfinding and navigation services projects

Study Outcome	Projects are listed in chronological order by publication date; Crowdsourcing project (**BOLD**)
System Design	*Personal Guidance System* (Loomis et al. 1994; 2005); *MoBIC* (Strothotte et al. 1996; Petrie et al. 1997); *Drishti* (Helal et al. 2001); *MAGUS* (Beale et al. 2001; Matthews et al. 2003; Beale et al. 2006); *PAM-AID* (Engelbrektsson et al. 2004); Jacquet et al. 2004; **Kurihara et al. 2004**; *OntoNav* (Anagnostopoulos et al. 2005; Kolomvatsos et al.2009); Pittarello and De Faveri 2006; PONTES (Pressl and Wieser 2006; Mayerhofer et al. 2008; Pressl et al. 2010); *U-Access* (Sobek and Miller 2006); *Mobility Support GIS* (Yairi and Igi 2006); Ding et al. 2007; **Goh et al. 2007**; ASK-IT (Panou et al. 2007); ***OurWay* (Holone et al. 2007; Holone et al. 2008)**; **Kulyukin et al. 2008**; ***RouteCheckr* (Völkel and Weber 2008; Völkel et al. 2008)**; *HaptiMap* (Magnusson et al. 2009; Laakso et al. 2012); ***Path 2.0* (Palazzi et al. 2010)**; *SmartGuide* (Tee et al. 2009); ***HealthProbe* (Rashid et al. 2010)**; ***EasyWheel* (Menkens et al. 2011)**; *Wayfinder* (Mehigan and Pitt 2012); ***Citizen Sensing* (Cardonha et al. 2013)**; **Hara et al. 2013**; Vassilev et al. 2013; ***mPASS* (Mirri et al. 2014a; Mirri et al. 2014b; Prandi et al. 2014)**
Components of a System	Karimanzira et al. 2006; Kasemsuppakorn and Karimi 2008; Swobodzinski and Raubal 2008; *ONALIN* (Dudas et al. 2009; Karimi and Ghafourian 2010); Kammoun et al. 2010; *AccessibilityMap model* (Laakso et al 2011, 2013); Yaagoubi et al. 2012a, 2012b; **Ding et al. 2014**; **Neis and Zielstra 2014**; Chen et al. 2015.

Neis and Zielstra (2014) identify useful tags related to accessible sidewalks in OSM. Ding et al. (2014) focus on linked open data and evaluate data schemas from several popular collaborative mapping sites and government agencies in the UK. Several studies designed services to sense data as people with disabilities move through the environment (Kurihara et al. 2004; Palazzi et al. 2010; Rashid et al. 2010; Cardonha et al. 2013; Prandi et al. 2014). Kurihara et al. (2004) and Palazzi et al. (2010) assume that if a person with a particular disability shares a trajectory, then that route is accessible for any other person with the same disability. Other systems are designed for user's direct interaction.

HealthProbe (Rashid et al. 2010) allows users to mark a location and complete a questionnaire of open-ended questions related to the surface, difficulty, asking for assistance and feeling about the experience. In EasyWheel, users can tag POIs (including streets and sidewalks) with accessibility information such as 'location, category, accessibility', but it is never made clear what 'accessibility' means (Menkens et al. 2011). Prandi et al. (2014) design a system that collects data via sensors, from the crowd and from experts. The categories of POIs, called 'accessibility Points Of Interest' or aPOIs, collected are gap, cross, obstruction, parking, surface, and pathway. In Cardonha et al. (2013) an observation about accessibility includes the tag: 'inaccessible place' and the ability to submit a photograph or free text or voice comment.

Goh et al (2007) design a digital library for accessibility information sharing that affords the ability to tag locations with accessibility information. They do not include any specific accessibility criteria, it is up to the user to tag and add text appropriately. One of the first systems to use OSM was OurWay (Holone et al. 2008). The criteria in OurWay are kept simple as 'good, uncomfortable, inaccessible' and are interpreted by the person making the rating. Kulyukin et al. (2008) aim to create a system for collaborative route sharing for people who have low or no vision. They collect and analyse a set of verbal route instructions and find four common components: environmental features, delimiters, verbs of movement, and state-of-being-verbs.

Hara et al. (2013) created a crowdsourcing tool using Google Street View for people to tag landmarks near bus stops to aid people who are blind in finding the bus stop. The categories of items tagged in the images were: bus stop signs, bus stop shelters, benches, trash/recycling bins, mailbox/news bins, traffic signs/other poles (Hara et al. 2013).

Many studies related to wayfinding and navigation services use the generic term 'people with disabilities' or 'people with special needs' as the target population with no distinctions (Engelbrektsson et al. 2004; Karimanzira et al. 2006; Yairi and Igi 2006; Goh et al. 2007; Laakso et al 2011 and 2013; Cardonha et al. 2013; Vassilev et al. 2013; Ding et al. 2014; Mirri et al. 2014a and 2014b; Neis and Zielstra 2014; Prandi et al. 2014). Others list 'people with disabilities' or 'people with special needs' as the target group but offer some differentiation (Völkel and Weber 2008; Völkel et al. 2008; Dudas et al. 2009; Kolomvatsos et al. 2009; Karimi and Ghafourian 2010). Some use the generic term 'people with disabilities' to mean a more specific group such as people who use wheelchairs (Helal et al. 2001; Palazzi et al. 2010).

A smaller set of studies focus on systems for people who use wheelchairs (Matthews et al. 2003; Beale et al. 2006; Sobek and Miller 2006; Ding et al. 2007; Holone et al. 2007 and 2008; Kasemsuppakorn and Karimi 2008; Rashid et al. 2010; Menkens et al. 2011). Some researchers have specified the type of wheelchair used as a power chair (Kurihara et al. 2004). Matthews et al. (2003) report barriers for manually assisted, self-propelled and motorized wheelchair users. People with low to no vision are another common target population for the design of wayfinding and navigation services. A growing number of studies focus specifically on people who are blind (Jacquet et al 2004; Pressl and Wieser 2006; Swobodzinski and Raubal 2008; Kammoun et al. 2010; Yaagoubi 2012a and 2012b; Hara et al. 2013; Chen et al. 2015). Some researchers have specified the use of a white cane as a qualifying attribute of their target population (Swobodzinski and Raubal 2008). Others use the broader term ‘people with visual impairments’ (Loomis et al. 1994 and 2005; Petrie et al. 1997; Kulyukin et al. 2008; Mayerhofer et al. 2008; Magnusson et al. 2009; Tee et al. 2009; Laakso et al. 2012; Mehigan and Pitt 2012). Other groups of interest were the elderly (Kurihara et al. 2004; Pittarello and De Faveri 2006; Magnusson et al. 2009; Laakso et al. 2012) and caregivers (Rashid et al. 2010; Vassilev et al. 2013). Several of the studies list multiple target populations (Helal et al. 2001; Kurihara et al. 2004; Magnusson et al. 2009; Karimi and Ghafourian 2010; Rashid et al. 2010; Laakso et al. 2012; Vassilev et al. 2013). A few studies designing wayfinding and navigation services focus on indoor environments but the majority focus on outdoor environments and almost none give attention to the transition between indoor and outdoor environments.

2.4.3 Accessible Tourism

Ding et al. (2014) highlight the significance of ‘accessible tourism’ as a research topic for the European Commission. Accessible tourism is “a form of tourism that … enables people with access requirements … to function independently and with equity and dignity through the delivery of universally designed tourism products, services and environments” (Buhalis and Darcy 2011, 10). A trend in papers about accessible tourism, and a practice common to all tourism research, is the market segment captured by people with disabilities. In fact, early articulations of the need to pay attention to people with disabilities were based on their significant market potential (Cavinato and Cuckovich 1992; Burnett and Bender Baker 2001). A recurring assertion (Cavinato and Cuckovich 1992) and finding (Burnett and Bender Baker 2001; Richards et al. 2010) in tourism literature is that tourists with disabilities display loyalty to companies that consider their needs. This argument coupled with the market segment potential is used to signify this group of travellers as worth designing services around.

The first taxonomy of barriers to leisure participation by Smith (1987) includes ‘environmental barriers’ as one category of barrier alongside ‘intrinsic’ and ‘interactive’ ones. Several studies have found supporting evidence for this classification (Yau et al. 2004; Richards et al. 2010). Yau et al. (2004) found that barriers to accessibility in tourism are not only physical barriers. Richards et al. (2010), conducting a study to understand the tourism experience holistically, found that participants discussed multiple barriers to tourism participation. Interestingly, much of the discussion circled back to issues of space and physical barriers, which provides some evidence that physical barriers do play an important, although not sole, role in accessible tourism.

Cavinato and Cuckovich (1992) claim that the subject of travel and tourism for people with disabilities is quite diverse. Smith (1987) notes that barriers to leisure participation are multifaceted. More recent work evaluating accessibility information schemes implemented across Europe asserts that “research has yet to provide a comprehensive account of the needs of people with disabilities in terms of accessibility information" (Eichorn et al. 2008, 190). While this is likely true, some tourism researchers have contributed useful requirements for accessible tourism. Methodologies used to study accessible tourism can be quantitative, aiming to model accessibility and tourism choices (Burnett and Bender Baker 2001; Israeli 2002), or qualitative, aiming to understand and communicate the experiences/narratives of people with disabilities in tourism (Garncarz et al. 1998; Packer et al. 2008; Richards et al. 2010). Specific methods include interviews (Cavinato and Cuckovich 1992; Israeli 2002; Yau et al. 2004; Packer et al. 2008), focus groups (Garncarz et al. 1998; Yau et al. 2004; Packer et al. 2008; Richards et al. 2010), and surveys (Cavinato and Cuckovish 1992; Burnett and Bender Baker 2001). These methods are often used in conjunction. Other sources of information on accessible tourism are research literature and standard guidelines (Israeli 2002). These studies have offered a systematic view of travel and tourism conditions including micro elements of travel (Cavinato and Cuckovich 1992), sets of accessibility factors (Israeli 2002), lessons learned and recommendations (Garncarz et al. 1998; Packer et al. 2008), narrative accounts (Yau et al. 2004) and critical analyses (Richards et al. 2010) of the accessible tourism experience.

Studies in tourism tend to be targeted towards multiple groups of people with disabilities (Cavinato and Cuckovich 1992), but some focus on people with mobility impairments (Israeli 2002), or people with vision impairments (Packer et al. 2008; Richards et al. 2010). None of the tourism studies focused exclusively on outdoor environments; most of the work focuses on indoor environments (Cavinato and Cuckovich 1992; Garncarz et al. 1998) or indoor and directly connected outdoor environments, like a walkway around a building (Israeli 2002; Packer et al. 2008; Richards et al. 2010).

2.4.4 Barriers and Participation

The study of barriers and facilitators to participation for people with disabilities is a diverse field of research that includes scholars in rehabilitation (e.g., Pusch 2003; Thapar et al. 2004), nursing (e.g., Rosenberg et al. 2012), architecture (e.g., Andrade and Bins Ely 2012), and occupational therapy (e.g., Reid 2004) and doctors and practitioners in clinical medical sciences (e.g., Lawlor et al. 2006), veterans affairs centers (e.g., Rosenberg et al. 2012) and gerontology (e.g., Rantakokko et al. 2013). Unsurprisingly, these studies are often collaborative efforts between scholars in academic institutions and practitioners in research centers and hospitals. These studies are conducted in one of two ways: observations, usually via guided walks, of people moving in the environment (Thapar et al. 2004; Andrade and Bins Ely 2012) or inquiries, usually via interviews or assessment tools, with people with disabilities about barriers and facilitators they experience in different areas of their life (Pusch 2003; Reid 2004; Lawlor et al. 2006; Bromley et al. 2007; Rosenberg et al. 2012) or a combination of the two (Rantakokko et al. 2013). A guided walk is a method in which a participant is given a task and then followed and questioned by a researcher (Andrade and Bins Ely 2012).

Similar to work done in tourism studies, both observations and inquiries aim to elicit barriers, and often facilitators, to participation – in everyday life (Pusch 2003; Gray et al. 2003; Lawlor et al. 2006), housing (Reid 2004; Rantakokko et al. 2013), public buildings (Thapar et al. 2004; Andrade and Bins Ely 2012), pedestrian infrastructure (Bromley et al. 2007), and physical activity (Rosenberg et al. 2012) – including environmental as well as attitudinal or social barriers from various groups of people with disabilities. Pusch's (2003) inquiry on environmental factors and independence resulted in the following facilitators of access: adapted environment, information, problem solving, money, and support. Similar to the findings of some tourism research, Pusch (2003) noted a large portion of the interview data revolved around the facilitator 'adapted environment'. This finding is further evidence that while environmental factors are not the sole barriers or facilitators to participation, they play a strong role. Thapar et al. (2004) were early advocates of not only investigating barriers to participation but to also eliciting facilitators to participation. They criticize previous observation studies because they focus on a limited population of study (usually wheelchair users), offer little to no mention of facilitators that improve access, lack consistent measures of access (relying solely on existing regulations), and lack transparency in communicating their building selection criteria. Since then, the research surrounding facilitators to participation has grown.

A much leveraged tool in studies identifying barriers and facilitators is the assessment instrument (e.g., a survey or checklist). Lawlor et al. (2006, 227) argue that "quantification of the environment [through assessment instruments] enables models to be developed to determine the optimal environment for maximum participation and these can then inform policy directed to alteration of the environment". Example instruments include the Usability in My Home Questionnaire (Fänge 2002, cited in Reid 2004), Craig Hospital Inventory of Environmental Factors (CHIEF) (Whiteneck et al. 2004), Home and Community Environment (HACE) instrument (Keysor et al. 2005), and Universal Mobility Index (UMI) (Green 2011). These instruments are a common data collection method and all but UMI have been vetted for validity and reliability. Given that much of this research is instrument driven, one could assume that many environmental barriers are listed in these instruments; however, Thapar et al. (2004, 282) argue that environmental assessments like CHIEF "are not designed for use at building sites and also do not record types of barriers and facilitators". On the other hand, checklists used to measure access to structures (e.g., buildings) have been criticized for not indicating which individuals will be impacted by barriers (Whiteneck et al. 2004) while those that implement them have been criticized for producing uncoordinated islands of information (Green 2011). Green (2011) argues for the inclusion of people with disabilities in audits as current practice relies solely on auditors who are not people with disabilities. On the other hand, when developing HACE, a self-report instrument for housing accessibility, Keysor et al. (2005) discovered that participants found the activity of characterizing 'community mobility' challenging; they believe this was due to the wide range of public buildings in the test area which resulted in vague or inconsistent responses or that participants were unfamiliar with the physical features of public buildings. These varying pieces of evidence highlight that more collaboration among researchers conducting audits, varying levels of government, and auditors and people with disabilities is perhaps required to effectively obtain a clear picture of the barriers and facilitators to accessibility in the real world.

It is common for observation studies of barriers to participation to include representatives from multiple groups of people with disabilities, for example Thapar et al. (2004) observed a person who uses a wheelchair, a person who uses a cane, a person with low to no vision, and a control with no stated impairments. Andrade and Bins Ely (2012) observed eight different people including 'people who use crutches or wheelchairs', a 'blind person', and a '[person] with a stroller'. On the other hand, inquiries on barriers and facilitators tend to concern highly specific groups of people with disabilities such as 'children with cerebral palsy' (Lawlor et al. 2006), 'seniors with stroke' (Reid 2004), mobility impaired individuals with spinal cord injury, cerebral palsy, multiple sclerosis, stroke, or polio (Gray et al. 2003), and midlife and older adults (Rosenberg et al. 2012). Observation studies of barriers and facilitators to participation are commonly conducted in indoor environments (Thapar et al. 2004; Andrade and Bins Ely 2012). One study that combined observation and inquiry studied the indoor, outdoor and entrance environments of elderly community dwellings (Rantakokko et al. 2013). Reid (2004) evaluated the housing environments of seniors, which included both indoor and outdoor aspects of the home. Bromley et al. (2007) studied outdoor environments in the city center of a large city. Rosenberg et al. (2012) also focused on barriers and facilitators to neighborhood-based activity in outdoor environments. Other studies related to barriers and participation (Gray et al. 2003;

Lawlor et al. 2006) conduct their studies with a wide scope that incorporates one type of environment, the entire environment or no aspect of the environment.

2.5 MODELING ACCESSIBILITY OF THE ENVIRONMENT

This section examines how accessibility of the environment is modelled. The section begins with a set of definitions and then discusses various models of accessibility of the environment that have been contributed in the literature.

Model. The Oxford English Dictionary (2015, *model, n. definition 8a*) defines a model as "a simplified or idealized description or conception of a particular system, situation, or process, often in mathematical terms, that is put forward as a basis for theoretical or empirical understanding, or for calculations, predictions, etc."

Empirical model. Empiricism is "a conclusion or piece of evidence derived from observation, investigation, or experiment" and more specifically, in science is "an expression, formula, factor, or value based on experimental results rather than theoretical analysis" (Oxford English Dictionary 2015, *empiricism, n. definition 2*). Thus, an empirical model is a description of a system, situation or process generated from data that result from observation, investigation or an experiment. Empirical models can be derived from quantitative, qualitative or mixed method analyses.

Data model. A data model is an abstract view (Frank 1992) of the data to be stored in a database that supports a specific task (Spyns et al. 2002; Dillon et al. 2008). A data model identifies the set of objects (concepts) to be stored, their structure and integrity (Frank 1992; Spyns et al. 2002). Data models are generic and independent from specific hardware implementations (Frank 1992). Thus, a data model is a conception or description of the structure of the data stored in a particular database that is independent from hardware and includes integrity rules.

Geo-ontology. An ontology is an explicit, shared conceptualization of a domain (Studer et al. 1998) that is generated via systematic study of what is required to represent that particular reality (Agarwal 2005). In philosophy the goal is to describe 'what something *is*'; in information science the goal is to define a specification of a conceptualization. Kavouras and Kokla (2008) articulate that the geographic domain is somewhere in between these two perspectives. To them geographic ontologies "elucidate explicit knowledge of the geographic domain they describe by capturing the semantics of the concepts involved" (Kavouras and Kokla 2008, 15). Finally, an important distinction between ontology and knowledge bases are that ontologies do not endorse one particular use of the knowledge stored while knowledge bases commonly do (Hoekstra 2009). Thus, in this thesis, a *geo-ontology* is an explicit conception of a shared reality that describes what a geographic system, situation, or process *is*, derived from semantic analysis of a particular domain, that can be translated into a specification for a particular information system.

Figure 4 places existing models of accessibility of the environment along the axes of model type and target population. Bold entries are those that focus on indoor environments, underlined entries focus on features of both indoor and outdoor environments, others focus on outdoor environments. Next, each set of models are discussed in turn from empirical models, data models, to geo-ontologies.

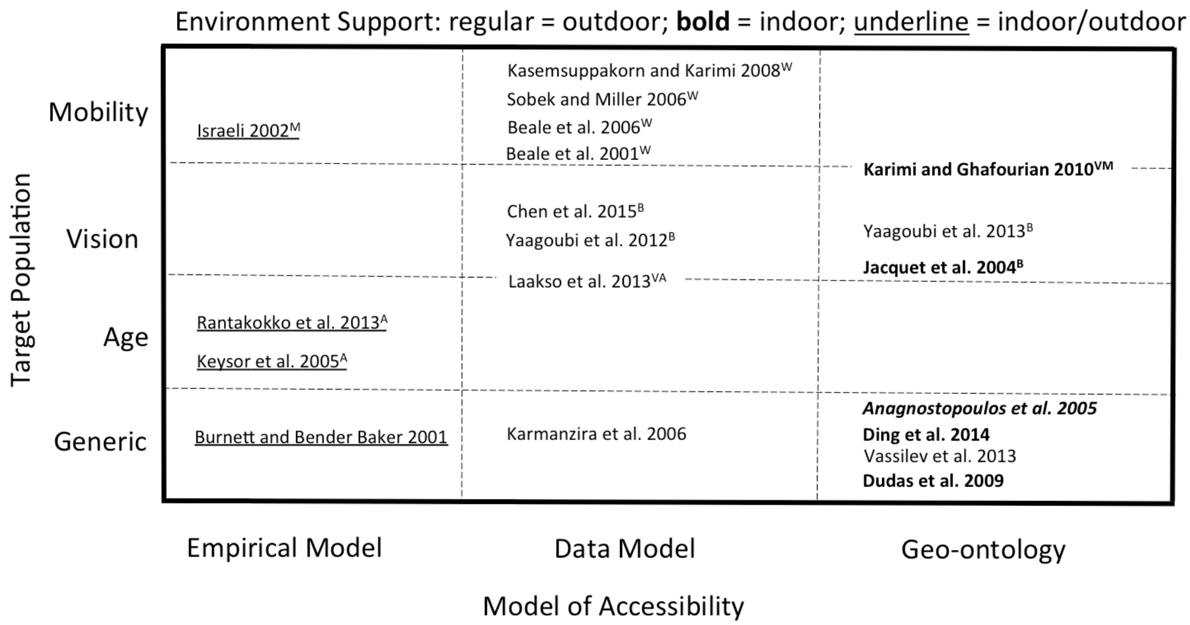


Figure 4 Existing models of accessibility of the environment

2.5.1 Empirical Models

Empirical models of accessibility of the environment have been contributed by tourism researchers (e.g., Burnett and Bender Baker 2001; Israeli 2002) and researchers studying barriers and participation (e.g., Keysor et al. 2005; Rantakokko et al. 2013). Many studies reported important empirical results related to accessibility in the environment from qualitative (Reid 2004; Yau et al. 2004; Richards 2010; Andrade and Bins Ely 2012; Rosenberg et al. 2012) and quantitative analyses (Cavinato and Cuckovich 1992; Gray et al. 2003; Thapar et al. 2004; Bromley et al. 2007; Packer et al. 2008) but did not generate or test a model.

Burnett and Bender Baker (2001) conduct a factor analysis to test the relationship between severity of disability and destination decision criteria. Four destination decision factors were used: environmental, accessible, benefits, and activities. Their analysis showed that as the severity of disability increased the value of environmental, accessibility and activities criteria increased. Israeli (2002) investigated the importance of accessibility factors. By analyzing standards and interviewing experts, seven environmental factors relevant to people using crutches to wheelchairs were identified. Israeli (2002) also tested the correlation between the identified factors and frequency of visits. Although the correlation results were quite weak, Israeli (2002) concluded that the importance placed on certain factors changed (increased or decreased) as the number of visits increased. Israeli (2002) suggests that travelers with disabilities identify the significance of accessibility factors through experience.

Keysor et al. (2005) designed an instrument to evaluate the home and community environment (HACE). After validating the instrument, they tested its ability to differentiate between the distribution of environmental factors and the type of living situation. The test showed that those living in single or multi-family homes had significantly more obstacles in their homes than those living in complex dwellings. Rantakokko et al. (2013) conducted a longitudinal study to measure the impact of environmental barriers on mortality in older adults. Two Cox regression models were tested for outdoor, entrance and indoor areas of the housing environment. Ultimately, the number of barriers in indoor, outdoor, and entrance areas could not predict mortality of older adults in the study. However, a single factor, a lack of handrails in stairways at the entrance to the home, was most associated with mortality in both models. Interestingly, Rantakokko et al. (2013) found that a high number of indoor barriers gave a protective effect to the mortality measure. They are unable to explain this finding but suggest the identification of a threshold between when a barrier becomes a facilitator as a useful future work.

Regarding environmental support, all empirical models reviewed here contribute evidence related to accessibility factors in both indoor and outdoor environments. Regarding the target population, Israeli (2002) focused on people with mobility impairments, Keysor et al. (2005) and Rantakokko et al. (2012) studied populations of older adults, and Burnett and Bender Baker (2001) did not specify beyond the category of people with disabilities in their work.

2.5.2 Data Models

Data models, related to accessibility of the environment, have been contributed by many researchers (e.g., Beale et al. 2001 and 2006; Karimanzira et al. 2006; Sobek and Miller 2006; Kasemsuppakorn and Karimi 2008; Kammoun et al. 2010; Laakso et al. 2013; Chen et al. 2015). Some data models are presented through a tabular view (Beale et al. 2001 and 2006; Karimanzira et al. 2006), others utilize the Universal Modeling Language (UML) (Sobek and Miller 2006; Kasemsuppakorn and Karimi 2008; Laakso et al. 2013) and the most recent study designed their object-oriented data model using CityGML (Chen et al. 2015). Many studies are requirements analyses and recommendations on sets of data that should be collected (Loomis et al. 1994; Strothotte et al. 1996; Petrie et al. 1997; Pittarello and De Faveri 2006; Pressl and Wieser 2006; Ding et al. 2007; Swobodzinski and Raubal 2008; Völkel and Weber 2008; Yairi and Igi 2006; Menkens et al. 2011; Laakso et al. 2011; Prandi et al. 2014) without a data model developed.

Beale et al. (2001 and 2006) design a GIS to model access for wheelchair users in urban areas. After collecting requirements from users, they utilize GIS software and implement the database as a set of event tables. In Beale et al. (2006) the objects in the event tables are further elucidated. Karimanzira et al. (2006) discuss several types of information they aimed to collect about people with disabilities and the environment and present a set of sample data and values in two tables.

Sobek and Miller (2006) develop a web-based routing system for three categories of users: peripatetic (unaided ambulation), aided ambulation with a cane, crutches or walker, and wheelchair users. To support their system, they present a conceptual model of the database using UML that includes individual characteristics and environmental objects. The model includes a set of objects and their attributes and relations and utilizes a graph to model environmental objects such as the sidewalk. Kasemsuppakorn and Karimi (2008) analyze data requirements and design a spatial database for wheelchair navigation. They present a relational model of the database using UML that includes the set of entities, their attributes, integrity constraints (i.e., keys), and the relationships between each entity. Laakso et al. (2013) introduce an information model for describing the pedestrian environment including aspects that are relevant to people with disabilities. The information model is presented in UML and includes only objects in the environment. An important addition to the model is the classification of pedestrian accessibility into two classes, pedestrian passage and pedestrian obstacle (Laakso et al. 2013). This is the first instance of a data model that accounts for both barriers and facilitators in the environment. The model describes attributes and data types for some of the classes; however it does not indicate how the data types are related.

Chen et al. (2015) design an object-oriented data model based on CityGML for people who are blind. The basic data model presented relies heavily on the existing structure of CityGML's paths and simple and complex objects. In the model, obstacles and entrances are simple objects and sidewalks and roads are paths. Semantics are added to the model using an XML schema with transportation, appearance and time-related information. Topological relations are added to the model using an attribute that designates if an object is inside other objects. A limitation of this paper is the treatment of the definition of obstacle. First, they consider a wide range of objects as obstacles even those that are not typically associated with obstacles, such as a flowerbed. Second, they treat all obstacles equally. For example, a large rock and a lamppost are both generalized as obstacles even though they occur in different locations and have different interactions with a person who is blind. All of the models presented utilize graphs to model paths and POIs.

All the data models focused on the outdoor environment. Regarding the target population, Beale et al. (2001 and 2006) and Kasemsuppakorn and Karimi (2008) designed data models to support navigation by wheelchair users, Sobek and Miller (2006) focused on people who used aids for ambulation and people who use wheelchairs, Chen et al. (2015) focus on people with no vision, Laakso et al. (2013) attended to older adults and people with low to no vision, and finally, Karimanzira et al. (2006) did not designate a specific target group.

2.5.3 Geo-ontologies

Researchers designing wayfinding and navigations services have contributed the majority of geo-ontologies of accessibility of the environment (e.g., Jacquet et al. 2004; Anagnostopoulos et al. 2005; Dudas et al. 2009; Karimi and Ghafourian 2010; Yaagoubi et al. 2012a and 2012b; Vassilev et al. 2013; Ding et al. 2014).

Jacquet et al. (2004) focused on supporting locomotion of travelers who are blind using a context-aware locomotion assistance device that can provide semantic information about its surrounding environment. The project included a formal model that describes architectural environments, algorithms to determine what to present to users and a method to position the user in 3D space. The model offered by Jacquet et al. (2004) included a unique combination of geometric and symbolic space. Semantic information is linked to, yet independent from structural information. A key limitation in the model is a lack of information about the environment regarding accessibility. For example, the service enables a person who is blind to hold their mobile device in front of a door and learn that this is the door to their bosses' office but it cannot inform them about various obstacles near the door.

Anagnostopoulos et al. (2005) describe an integrated navigation system for indoor environments, OntoNav, which is based on 'hybrid' (geometric and semantic) modeling of the environment. They claim the system is user centric by incorporating three measures in the routing selection: physical capabilities, perceptual capabilities and routing preferences. The authors developed an Indoor Navigation Ontology (INO), as one component of their navigation service, to support semantic descriptions of navigation paths and enable reasoning for route selection. Route selection is performed after route computation using a generic criterion (e.g., shortest distance) and uses three measures from the user, mentioned above, to select the appropriate path. This work is novel by offering the first example of a navigation service utilizing ontology to provide accessible routes; however, the authors do not offer any rationale for the ontological criteria and rules that their system exploits. Furthermore, their work is not grounded in any existing theory or models for indoor space.

Dudas et al. (2009) introduced ONALIN, an ontology and algorithm, for modeling route criteria specific to those with special needs and computing feasible and comfortable routes. Feasible routes are routes that can be travelled given user constraints and comfortable routes are a subset that is preferred by the user. ONALIN extended the INO (Anagnostopoulos et al. 2005) with requirements in the ADA Accessibility Guidelines and uses these requirements to prune the hallway network of potential obstacles. ONALIN offers an original take on ontology and accessibility by representing a subset of the ADA criteria in ontological form. While this work is novel, the environmental scope of the work is limited to indoor routes, and the semantics of ADA entities, their relations and a justification for which sections of the ADA Accessibility Guidelines are relevant is missing. Karimi and Ghafourian (2010) expanded ONALIN by describing three domains for indoor navigation: transition, POI and mobility. Their expansion supports two new algorithms, ONALIN-PR, to calculate preferred routes, and ONALIN-FN, to prune hallway networks into 'feasible networks', that is a network with inaccessible elements removed. Karimi and Ghafourian's (2010) extension of ONALIN is a strong improvement on the original version by including domains for POI and transition space, yet the limitations of Dudas et al. (2009) remain. A further limitation is a lack of evidence for the categorization of ADA criteria created for 'mobility impaired' and 'visually impaired' groups.

Yaagoubi et al. (2012b) model how people with low to no vision represent space cognitively. Focusing specifically on the mental representation of urban areas, the model is derived theoretically using Lynch's (1960, cited in Yaagoubi et al. 2012b) model of urban areas and Johnson's (1987, cited in Yaagoubi et al. 2012b) image schemata. Image schemata are highly flexible cognitive patterns that exist between abstract propositional structures and mental images (Yaagoubi et al. 2012b). Example image schemata are container, path, part-whole, near-far. Yaagoubi et al. (2012b) provide adaptations of the following schemata in their base model, i.e., container, boundary, surface, object, path, and link, and extend this model with what they call 'force schemata': part-whole, enablement, compulsion, attraction and repulsion, and blockage and restraint removal. The main schemata manifest as concepts and the force schemata are the relations between concepts. Lastly, they draw on their earlier work and incorporate zones of enforcement, which correspond to areas of abstraction, for example, city, neighborhood and street. Yaagoubi et al. (2012b) provide a solid base for representing the mental representations of space used by blind pedestrians; however, they lack detail regarding what kinds of obstacles exist, and they do not include indoor space or transitional space in their model.

Vassilev et al. (2013) present a framework called OntoCarer that utilizes software agents to aid people who need assistance and their caregivers. The framework includes an offline deductive planner and a continuous online planning tool. The core ontology used in OntoCarer is the WHO's ICF classification which is used to model both people who need assistance and those who assist them. Vassilev et al. (2013) mention navigation and transport as two types of assistance provided by OntoCarer and discuss the benefits of mobile devices for location-based services. Unfortunately, they do not discuss any details about how OntoCarer works in these cases.

Ding et al. (2014) propose an ontology-based data integration approach for linked open accessibility data. They survey four sets of open accessibility data available in the U.K. To evaluate and ultimately link these datasets, Ding et al. (2014) propose two different ontology-driven approaches, a hybrid approach designing individual ontologies for each dataset and a single ontology approach. They argue that the hybrid approach is inadequate because generating ontologies for each dataset is difficult and not scalable for future integration due to the need to update the ontology as the data schema changes. The single ontology approach relies on a set of entity mapping rules to map similar entities present in different datasets. They find discrepancies between values for both traditional attributes such as address and accessibility related attributes such as wheelchair access in the datasets analyzed. Based on their entity mapping rules, they designed the Place Access Ontology to describe concepts and relationships for different places. Upon examining their ontology, their entities are undefined with only a few exceptions and properties (or relations) are not defined for any entities. Lastly, they do not include any details regarding the provenance of the entities included in the ontology. Ding et al. (2014) claim that their work helps address accessibility information barriers; however, it is not clear how this can be accomplished.

In summary, empirical models of accessibility of the environment focus on explaining the relationship between barriers in the environment and people with disabilities. These models cover multiple parts of the built environment; however, none of those identified offer evidence to support people with low to no vision. Data models of accessibility of the environment are designed to support wayfinding and navigation services and generally model sidewalks and POIs and obstacles. The models reviewed here did not cover indoor environments but do provide information germane to multiple groups of people with disabilities. Existing geo-ontologies do not support people who use wheelchairs and tend to focus on indoor environments. Furthermore, current ontologies do not provide evidence of the source of their entities (i.e., provenance). The problem with this is that the development of ontology requires attention to the creation of a shared model of the world, therefore, the lack of evidence supporting the ontological and logical choices made by many of the researchers does not ground the process within existing shared knowledge. Another key problem with existing geo-ontologies of accessibility of the environment is a lack of discussion about methodological guidelines used for developing their ontologies. Lastly, only one ontology (Karimi and Ghafourian 2010) focuses on the details of accessible space, the remaining ontologies mainly describe geographic space.

2.6 SUMMARY

This chapter reviews current practice and research related to wayfinding and accessibility in the built environment. The chapter motivates the need for accessibility information and examines the current limitations of wayfinding services and available information about accessibility of the built environment. Information about the accessibility of the built environment is required because the built environment is unpredictable in terms of its accessibility and this affects the participation and independence of people with disabilities. The problem with current wayfinding services is a lack of criteria related to accessibility. These services also lack adequate data to support pedestrian, especially indoor, wayfinding. Finally, public sources of accessibility information: (1) do not delineate who the accessibility information is designed for; (2) do not cover all parts of the built environment; (3) do not provide provenance for their accessibility criteria and; (4) lack sufficient data coverage.

The second goal of this chapter was to assess areas of research on accessibility of the built environment. The studies showed that a diversity of researchers are studying accessibility in the environment from varying perspectives and that studies in different areas have found that physical barriers play an important, although not sole, role in accessibility of the environment. Unfortunately, none of these individual research areas have produced a clear picture of accessibility for multiple groups of people with disabilities across all parts of the built environment. Furthermore, only barriers and participation studies are contributing to an understanding of both barriers and facilitators to accessibility. Several works have tried to formalize knowledge about accessibility in the form of ontology; however these attempts do not provide evidence for their ontological choices (i.e., concept selection or origin), do not use established ontology engineering methodologies or discuss methodology at all in relation to their ontology design, and with one exception, the ontologies do not actually describe accessible space.

3.0 ONTOLOGY DESIGN/ENGINEERING

This chapter discusses the method used for ontology design in this dissertation. Relevant theoretical perspectives include: affordances, and semantic theory. Relevant methodologies include qualitative content analysis (QCA) and ontology engineering.

Ontology engineering methodologies are designed to deal with the provision of guidelines and advice for developers of ontologies (Sure et al. 2009). Pioneers in ontology engineering methodologies have given ontology engineers: (1) useful principles such as clarity, coherence, extensibility, minimal encoding bias and minimal ontological commitment (Gruber in 1993); (2) tools such as the middle-out practice (Uschold and King 1995), the competency question (Grüninger and Fox 1995), and the ontology requirements specification document (ORSD) (Fernández et al. 1997; Fernández López et al. 1999); and (3) advice for common errors to defining classes and class hierarchy such as the use of plural vs. singular entities, eliminating cycles, and sibling equivalence (Noy and McGuinness 2000). Leveraging practices in software design, Fernández López et al. (1997) asserted that ontology development should revolve around a lifecycle model or evolving prototype. Today, many designers of ontology engineering methodologies maintain that ontologies have lifecycles with distinct stages or phases. Figure 5 shows the ontological lifecycle utilized in this dissertation compared to three common ontology engineering methodologies.

Adopting typical phases of the ontology engineering lifecycle, this work includes five phases: knowledge acquisition, specification, conceptualization, verification, and documentation. Figure 5 depicts the lifecycle of the research. Several datasets support the knowledge acquisition phase. The knowledge acquisition, specification, conceptualization and verification phases are iterative in nature while the documentation phase exploits several key software tools to document the research from beginning to end, overlapping the entire lifecycle of the research.

Table 7 Lifecycle phases. *Ongoing through entire lifecycle.

This research (4 phases)	Methontology (Fernandez et al. 1997)	On-To-Knowledge (Sure et al. 2009)	NeOn (Suarez-Figueroa et al. 2012)
	1. Planification	1. Feasibility Study	*Project and Configuration Management
Specification	2. Specification	2. Kickoff	1. Initiation
Conceptualization	3. Conceptualization		2. Design
	4. Formalization	3. Refinement	
	5. Integration		3. Reuse / 4. Reengineering
	6. Implementation		5. Implementation
	7. Maintenance	5. Application and Evolution	6. Maintenance
*Knowledge Acquisition	*Knowledge Acquisition	2. Kickoff	*Knowledge Acquisition
*Documentation	*Documentation	*Documentation	*Documentation
*Verification	*Evaluation	4. Evaluation	*Evaluation and Assessment

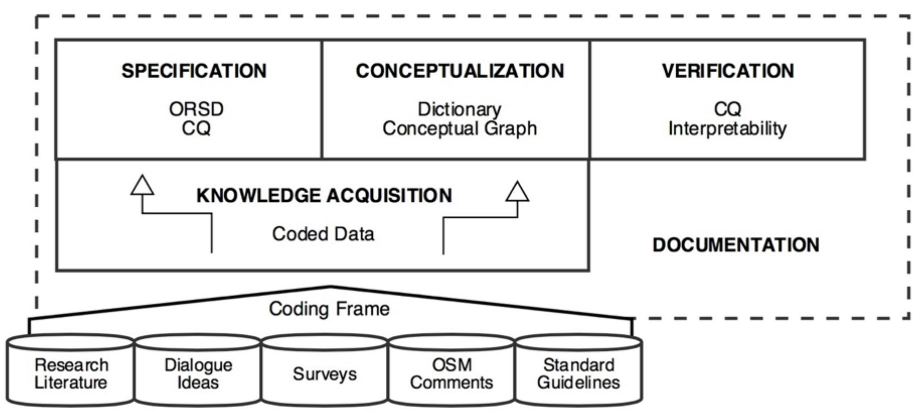


Figure 5 Lifecycle of the research

The knowledge acquisition phase analyses a set of extant texts to answer *RQ1: What are the important aspects of accessibility, in the context of wayfinding, for people who travel in wheelchairs and people with low to no vision?* and *RQ2: Is there a gap between the barriers and facilitators to mobility described by different information providers (i.e., researchers, people in participatory research or online, and standards bodies)?*

The specification and conceptualization phases utilize the knowledge collected during knowledge acquisition to generate an ontology of accessibility in the context of wayfinding to address *RQ3: How can available information about accessibility, specifically barriers and facilitators to mobility, be organized to support the wayfinding information needs and preferences of people who travel in wheelchairs and people with low to no vision?* The remainder of this chapter explains each phase in detail.

3.1 KNOWLEDGE ACQUISITION PHASE

To better understand the concept of mobility and how it relates to different physical environments, it is imperative to have a thorough understanding of what accessibility means to people with disabilities and other stakeholders of accessible wayfinding. The knowledge acquisition process in this work consists of acquiring knowledge about (i) wayfinding information needs, (ii) barriers and facilitators to mobility, and (iii) actions performed in the environment.

3.1.1 Choice of knowledge sources

We have selected the use of extant text data, as opposed to interviewing, surveying or participant observation, for several reasons. The chief aim is to understand barriers and facilitators within the environment for both people who use wheelchairs and people with low to no vision. Performing interviews or participant observations in sufficient quantity for both target groups is difficult in practice. Two representative observation studies contracted only four (Thapar et al. 2004) and eight (Andrade and Bins Ely 2012) participants and within these only one person from each of their targeted groups. Kulyukin et al. (2008) highlight the persistent problem with sample sizes in studies of navigation by people who are blind due to the uneven distribution of people with low to no vision across the U.S. Second, our aim is to cover multiple physical environments (e.g., indoor and outdoor). To adequately address this issue using interviews or participant observations would require longer interviews and lead to more guided walks than may be feasible for participants. The third reason is the existence of a large amount of text data about accessibility on the web. Government agencies (e.g., U.S. DOT) and collaborative mapping entities (e.g., OSM) are collecting a growing number of extant text data that are not being used to investigate accessibility and wayfinding. Finally, a large body of literature about accessibility of the environment exists. For these reasons, extant text will be leveraged in this study.

3.1.2 Choice of analysis method

While the formal and informal analysis of texts is a common source of knowledge used during knowledge acquisition for ontologies (Fernández et al. 1997), the use of qualitative methodologies in ontology and knowledge representation work is a recent practice (Khazraee and Khoo 2011). For example, grounded theory has been used in the knowledge acquisition phases of ontologies of aviation safety information (Forrest 2006), palliative care (Kuziemsky 2006), clinical pathways (Hurley 2007), and natural disaster management systems (Chou 2008).

The method of qualitative analysis selected for this research is Qualitative Content Analysis (QCA). QCA is a methodology for systematic text analysis (Schreier 2012). One distinct advantage QCA holds over other methods of qualitative analysis is its focus on specific aspects of a set of materials instead of the more traditional holistic view of other qualitative methods (Schreier 2012). QCA is selected over the more traditional quantitative content analysis for two reasons. First, some interpretation of the textual materials selected for this research is required. Second, the goal of QCA is to systematically describe meaning in a set of materials (data), which is the goal of the Knowledge Acquisition phase, while the goal of quantitative content analysis is often to test a hypothesis using a set of materials (Schreier 2012). QCA is conducted over two phases. The pilot phase includes the selection and segmentation of data, construction of a coding frame, a trial coding of data, and evaluation/revision of the coding frame. The main phase includes coding of all the data, an evaluation of the coding, and analysis and interpretation of the results. A full description of this process is described in Chapter 4.0 and the results of the process are presented in Appendix A (page 207) and Appendix B (page 249)

3.2 SPECIFICATION PHASE

The requirements gathering process for ontology design is commonly conducted using the ontology requirements specification document or ORSD. Ontological needs are "the necessity of having the knowledge represented in the form of an ontology" (Suárez-Figueroa and Gómez-

Pérez 2012, 97). The ORSD includes the purpose and scope, uses and users, requirements of the ontology (captured via competency questions) and a pre-glossary of terms that describe these requirements. Functional requirements are content specific requirements and to identify them, ontology engineers use interviews and the writing of the requirements in natural language in the form of the so-called competency questions, as the main technique (Suárez-Figueroa and Gómez-Pérez 2012). The process can start top-down, bottom-up or middle-out.

3.2.1 Gathering Requirements

Due to the data-driven nature of this research, the initial requirements are generated in a bottom-up process, using QCA, from the five datasets employed for knowledge acquisition. To collect the requirements, a coding frame was developed to categorize the datasets. A coding frame consists of dimensions, categories and subcategories; each dimension and its children are explained in the Code Book (Appendix A, page 207) and the development of the coding frame is presented in Chapter 4.0 . There are two types of dimensions used in this research, Context Dimensions and Dimensions of Interest. The dimensions of interest are segments of text related to ‘Wayfinding Information Needs’, ‘Barriers and ‘Facilitators’ to mobility and ‘Actions’ in the built environment; in other words, the focus of the requirements. The context dimensions were needed to situate each wayfinding information need or barrier in relation to a place in the world, the traveler being described, etc. Each type of dimension is defined below.

The **Context Dimensions** are ‘Location’, ‘Traveler’, ‘Source’, and ‘Physical Environment’. These dimensions give supporting information about a segment, such as the location in the world, the type of traveller and environmental setting that a segment describes.

The Source dimension provides information about the person who composed the text. For each segment, a selection for each context dimension is required, if the information is known.

The **Dimensions of Interest** are ‘Wayfinding Information Need’, ‘Barriers’, ‘Facilitators’ and ‘Actions’. These dimensions are relevant to a segment, if the text includes an explicit request for information to support wayfinding or describes a barrier, facilitator or action related to an activity, object or space in the built environment. These dimensions are optional and a selection is not required for each segment.

Figure 6 shows a sample segment: *“The exterior ramps were small, but the automatic doors were nice”*. Table 8 shows how this segment is coded using the coding frame. The following paragraphs illustrate how the context dimensions and dimensions of interest were coded.

id-- 2146928140 Venue-- The Coast Inn, , British Columbia, Northern America Accessible-- limited Comment-- The exterior ramps were small, but the automatic doors are nice, and the interior shops have lips at the entrances.

Figure 6 Two segments from collaborative comments shared in OpenStreetMap

The ‘North America-Canada’ category was selected for the Location dimension because British Columbia is listed as the location of the place being described by the comment. The ‘Wheelchair-general’ category was selected for the Traveler dimension because this comment was shared under the tag: *wheelchair:description* which is used in OSM to indicate a comment describing accessibility for a wheelchair. The ‘Public comment’ category was selected for the Source dimension because no information is known about the source other than the person shared the comment on a public website, OSM. ‘Transition’ was selected for the physical environment dimension because the text describes a ramp and automatic door at the entrance (i.e., the transition from outdoor to indoor space) to the Coast Inn.

For the dimensions of interest, the first segment indicates that the ramps near the entrance were small (evidence of a barrier to the ‘ramps’) and that the automatic door openers were helpful (evidence of a facilitator to the ‘entrance’ doorway). The second segment notes the presence of a lip at the entrances (evidence of a potential barrier to the ‘entrance’). Neither segment indicates a request for information or describes an action on the ramp or at the entrance. Thus, for the dimensions of interest, a selection is not required because there may be no evidence, yet for context dimensions the information should be known. The rest of this section will discuss the dimensions of interest.

Table 8 Coded segments

Segments	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action
"The exterior ramps were small, but the automatic doors are nice"	North America-Canada	Wheelchair-general	Public comment	transition	@	ramp	entrance	@
“the interior shops have lips at the entrances”	North America-Canada	Wheelchair-general	Public comment	transition	@	entrance	@	@

3.2.1.1 Wayfinding Information Needs One outcome of the knowledge acquisition phase is a set of wayfinding information needs. A wayfinding information need is a potential query for information sent to a wayfinding tool. Each query was generated by examining the request for information in a data source (coded as “Wayfinding Information Need”) and transforming the statement into a query. The queries collected are representative of the kinds of information ontology engineers gather during the ontology requirements interview process. A total of 227 segments of text were coded as having a “Wayfinding Information Need” and 127 queries were generated from these segments. The four most popular query categories were Pedestrian Path, Pedestrian Crossing, Transit Stop, and general information about a Route. The full set of wayfinding information needs generated are presented in Appendix C (page 627).

Pressl et al. (2010, 282) surveyed people with disabilities in Austria regarding “preferred information needed before traveling to an unknown city” and found that one piece of information preferred by both people with low to no vision and people who travel in wheelchairs is ‘barrier-free toilets’ and ‘wheelchair accessible toilets’, respectively. Matthews et al. (2003, 39) used surveys and focus groups to design an urban GIS for people who travel in wheelchairs in the U.K. and include the following quote regarding ‘toilets’: “What I would like to see mapped is disabled toilets.” Finally, Yau et al. (2004, 954) conducted interviews and focus groups to explore the tourism experiences of people with disabilities in Hong Kong and include the following statement in the summary of their ‘Search for Information’ stage of travel: “They need to identify information on accessibility to scenic spots, toilets, hotel accommodation, and transportation, as well as availability of assistance and presence of travel partners.” During data analysis, these three statements are formulated into the following query or wayfinding information need: “Are there accessible bathrooms available?” A more specific query could be “Is the bathroom at restaurant *x* accessible?”

One thing that becomes clear through this example is the difference between foundational knowledge about accessibility and the accessibility of a place. Current models and systems cannot answer these questions unless that specific area or restaurant has been mapped and evaluated for accessibility. Unfortunately, current criteria defining accessibility differs widely from tool to tool. Because of this, many of the wayfinding information needs expressed by people with disabilities cannot currently be answered. To answer these queries an understanding of what is accessible or inaccessible about a bathroom is required in addition to knowing the specific conditions at restaurant *x*. Knowing this, the ontology designed in this work focuses on conceptualizing foundational knowledge about the accessibility of specific environmental objects and actions performed in the physical environment. Once this knowledge is captured, local implementations of the ontology can be generated to represent the local conditions in for example Pittsburgh or another city and answer "what accessible bathrooms are available in Pittsburgh?" and "Is the bathroom at the Union Grill on Craig Street accessible?"

3.2.1.2 Barriers, Facilitators and Actions To enable the creation of an ontology focused on foundational accessibility knowledge, the same datasets analyzed for wayfinding information needs are also analyzed for indicators of 'Barriers' and 'Facilitators' related to specific environmental objects, and 'Actions' performed in the environment. The following steps were used to construct the set of foundational knowledge for the ontology: (1) get environmental objects, (2) get actions for each environmental object, (3) associate barriers and facilitators with actions.

Get environmental objects The environmental objects used were drawn from sub-categories associated with the 'Wayfinding Information Needs' dimension. Below is the listing of subcategories; bold entries include an environmental object:

Wayfinding Information Need

- -about level of ambient noise
- -about availability of assistance services
- -about a **building**

- -about lighting
- -about **parking**
- -about **pathways**
- -about **pedestrian crossing**
- -about **public objects**
- -about **public transit**
- -about **routes**
- -about accommodations for service animals
- -about **street layout**
- -about tourism
- -about wayfinding
- -about weather

Other environmental objects were collected from the barriers and facilitators subcategories ‘to space’ and ‘to objects’. See Appendix A (page 207) for the full description of each subcategory.

Get actions for each environmental object The actions for each object were collected using the text segments that were coded with an ‘Action’ category. The action language was extracted from the text and revised to remove conceptually overlapping actions. For example, the object ‘interior doorway’ included the actions ‘enter doorway’ and ‘pass through doorway’; the action ‘pass through doorway’ is more representative of the action that a person would perform at the doorway and was selected over the action ‘enter doorway’.

Associate barriers and facilitators with actions The last step is to identify barriers and facilitators to environmental objects and associate them to the actions performed at that object. Each segment of text coded as a 'Barrier' or 'Facilitator' was relevant to an environmental object and action. The following two text segments relate barriers to an 'entrance':

ADA.4-6: [doors, doorways, and gates] 404.2.1 Revolving Doors, Gates, and Turnstiles. Revolving doors, revolving gates, and turnstiles shall not be part of an accessible route.

Packer08-9: That the street entrance was not too complicated or had too many stairs (I mean stairs are ok, but you know, not a huge flight of stairs), not revolving glass doors that are always very difficult to negotiate as a vision impairment person.

Both segments of text are relevant to the target group "Low to No Vision", and the first segment is from the ADA standards in the United States, and the second is from an article that interviewed people living in Australia. One of the barriers described by both segments is the presence of a revolving door at an entrance. The first states that a revolving door may not be part of an accessible route indicating that it would impact the accessibility of the route if present. The second relays the fact that, for the person interviewed, revolving glass doors are very difficult to negotiate. In the dataset, these segments are recorded as a barrier at an entrance for people with low to no vision, the barrier is "revolving door" and it is recorded for the United States and Australia. This process was repeated for all segments of text coded with "Facilitators".

The last step is to associate this barrier to an action performed at the entrance. The barrier discussed above is that a revolving door is a barrier to an entrance for people with low to no vision. A potential action found in the data for an entrance is to 'pass through a doorway'. Thus, the requirement would read "revolving doors are a barrier to pass through doorway for people with low to no vision".

3.2.2 Generating the Specification

The extracted wayfinding information needs are then used to guide the construction of a set of competency questions by focusing the conceptualization on environmental objects in which information is currently needed for wayfinding. To accomplish this, two types of competency questions will be generated for each activity, object and space (called 'item' below).

1. What enables [action] [preposition] [object] for [group of people with disabilities]?
2. What hinders [action] [preposition] [object] for [group of people with disabilities]?

For each object and each group, the two questions are composed for all actions using the knowledge collected during the requirements gathering step (Appendix D, page 639). For example, if an entrance has the action 'pass through doorway' associated with it, then the following two questions are designed and answered for the wheelchair group: Question 1: "What enables [pass through doorway] [an] [entrance] for [people who travel in wheelchairs]?" Answer 1: presence of ramp; automatic door. Question 2: "What hinders [pass through doorway] [an] [entrance] for [people who travel in wheelchairs]?" Answer 2: presence of steps. A total of 260 competency questions were generated, 127 questions related to barriers and 133 related to facilitators to accessibility. Finally, a preglossary was generated from terms in the questions and answers. The full ORSD is presented in Appendix E (page 662). An abbreviated version is shown below in Table 9.

The competency questions were grouped into 16 categories shown in Figure 7, corresponding to the 16 environmental objects determined during requirements gathering. The number of questions for each type of mobility relation, hinder and enable, are shown for each of the target groups, people with low to no vision (LNV) and people who travel in wheelchairs (WCU). No data for the hinder relation was found for the category Destination. No data was found for people with low to no vision and Parking. No enable relations were found for people who travel in wheelchairs and the categories Signage and Route. All other categories have hinder and enable relations for both groups.

3.2.3 Evaluating the Specification

Several important properties can ensure a good specification. Suárez-Figueroa and Gómez-Pérez (2012) refer to many criteria for evaluating a set of functional requirements. The functional requirements (i.e., competency questions) were evaluated using measures of conciseness, completeness, unambiguity, and traceability.

Table 9 OSRD for accessibility in the context of wayfinding

<table>
<tr><td></td><td colspan="2">Ontology Requirements Specification Document</td></tr>
<tr><td></td><td colspan="2">Purpose</td></tr>
<tr><td></td><td colspan="2">to conceptualize accessibility in the context of wayfinding so that collaborative mappers, navigation service providers, and people interested in learning about accessibility in the environment can understand how people with disabilities interact with the environment in order to support (1) the design of wayfinding services and (2) interoperable data sharing of accessibility oriented data.</td></tr>
<tr><td></td><td colspan="2">Scope</td></tr>
<tr><td></td><td colspan="2">a detailed description of barriers and facilitators in indoor, outdoor and transitional environments (buildings, pedestrian paths, entrances, and transit vehicles), and their interaction with people who travel in wheelchairs and people who have low to no vision.</td></tr>
<tr><td></td><td colspan="2">Implementation language</td></tr>
<tr><td></td><td colspan="2">the ontology will be implemented in a future work.</td></tr>
<tr><td></td><td colspan="2">Intended end users</td></tr>
<tr><td></td><td colspan="2">User 1. developers of collaborative databases of accessibility information,
User 2. developers of services for assisting people with disabilities with wayfinding requests
User 3. collaborative mappers who map the accessibility of the built environment</td></tr>
<tr><td></td><td colspan="2">Intended uses</td></tr>
<tr><td></td><td colspan="2">Use 1. To update navigation and collaborative databases with accessibility information by developing a metadata standard based on the ontology
Use 2. To help stakeholders build an understanding of accessibility of the built environment by traversing the ontology</td></tr>
<tr><td></td><td colspan="2">Ontology requirements</td></tr>
<tr><td></td><td>(a)</td><td>Non-Functional requirements</td></tr>
<tr><td></td><td></td><td>If the ontology is to be utilized by developers or collaborative mappers who speak a language other than English, the ontology will need to be translated into the native language of the developer or mapper.</td></tr>
<tr><td></td><td></td><td>Functional requirements: Groups of competency questions</td></tr>
</table>

(b)

The full set of competency questions are listed in Appendix E (page 662). A total of 260 questions were developed (127 related to barriers and 133 related to facilitators).

Seventeen groups of competency questions were collected
(See Figure 7for more details)

Bathroom	7	Pedestrian Path	1
Building	0	Ramp	0
Elevator	6	Route	9
Entrance	4	Service	3
Destination		Signage	
Interior Doorway		Stairway	2
Parking	3	Transit Stop	8
Pedestrian Crossing	2	Transit Vehicle	7

Pre-glossary of terms (See Appendix E, page 662*)*

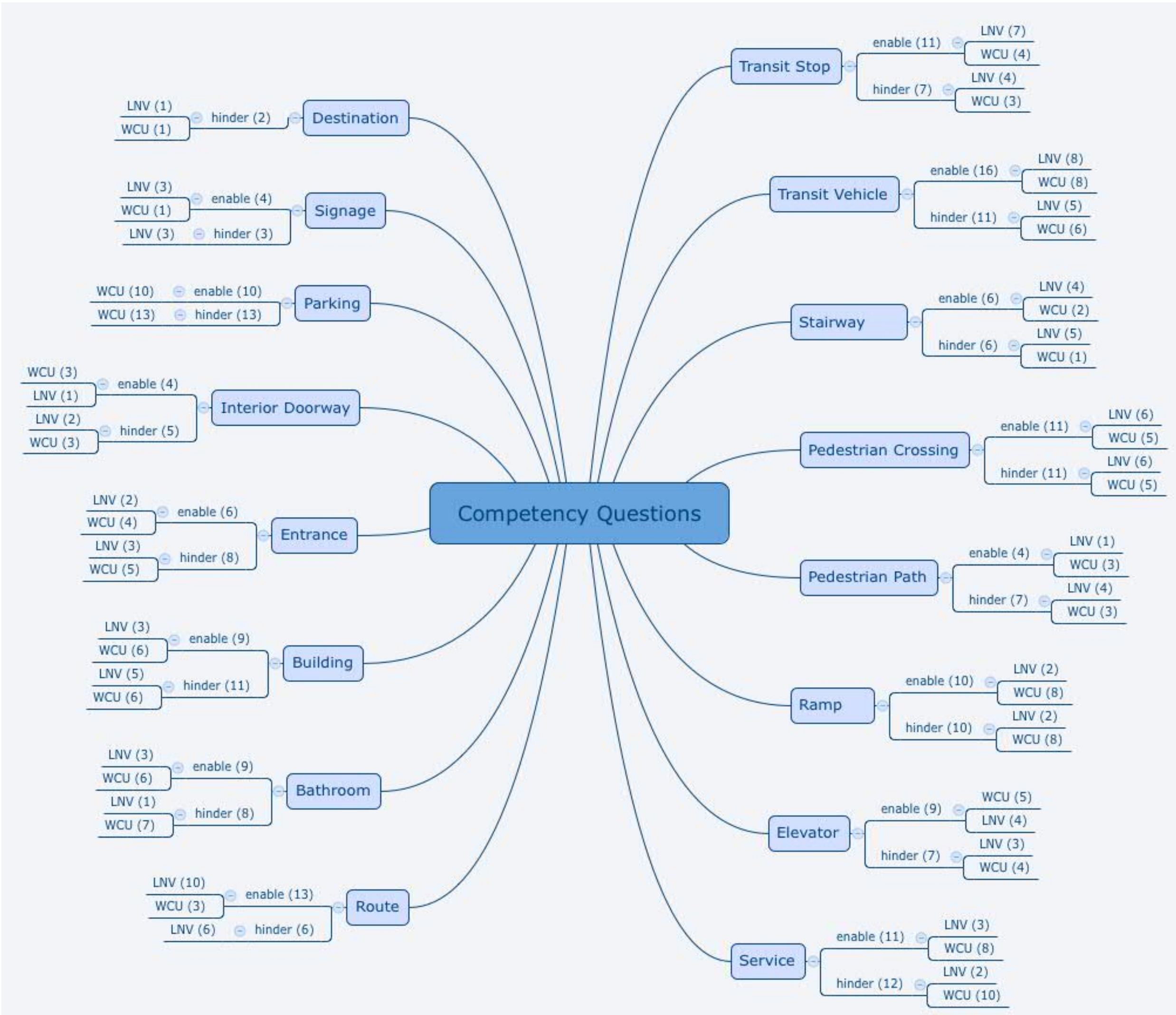


Figure 7 Groups of competency questions

3.2.3.1 Conciseness Conciseness is achieved if there are no duplicated or irrelevant requirements (Suárez-Figueroa et al. 2008). Conciseness was measured by the number of duplicated requirements. The competency questions have no duplicated requirements because each question captures barriers or facilitators to a specific action associated with an environmental object. No objects are duplicated, therefore, the number of duplicated requirements is zero. This is sufficient for a concise specification.

3.2.3.2 Completeness Completeness is achieved if no requirement is omitted (Suárez-Figueroa et al. 2008). Completeness was measured in two ways. First, the percentage of terms in the wayfinding information needs that are present in the pre-glossary was computed. Column one of Table 10 includes terms collected from the wayfinding information needs (Appendix C, page 627). There is a total of 83 terms and 59 of these (71%) are represented in the competency questions. Second, the competency questions were derived directly from the barriers and facilitators collected from the data (Appendix D, page 639) and 100% of the terms are present in the competency questions. These two measures are sufficient for a complete specification.

3.2.3.3 Unambiguity Unambiguity is achieved by each requirement having a single interpretation (Suárez-Figueroa et al. 2008). The actions used in the competency questions are designed as actions that a traveler wants to accomplish such as ‘sit at a table’, ‘move through space’, or ‘open door’. Actions that occur during travel such as ‘trip’, or ‘bang knees’ are considered outcomes of a barrier and if they were included in the competency questions then they would impact the meaning of barrier and facilitator during conceptualization. For example, a facilitator to the action ‘trip’ is an uneven surface. In reality, this is a barrier to ‘moving along a path’ but by using the action ‘trip’ a hindering environmental condition would be interpreted as a facilitator. To avoid this contradiction, all actions are desired actions that a traveler wants or needs to perform during travel. This enables the specification to be unambiguous in terms of the definition of hinder and enable conditions.

Table 10 Mapping between WIN and CQ terms

Terms found in WIN queries (count)	WIN category (#)	CQ categories
crossings (10), **curb cut** (3), **pedestrian crossing** (3), **tactile paving** (2), **pedestrian signal**, **signal**, **signal button**, signal controlled, traffic island, **traffic light**	pedestrian crossing (16)	pedestrian crossing
route (22)	route general (12)	route
sidewalk (12), **path** (3), bridges, **curb**, overpasses, **pedestrian path**, pedestrian subways, **sidewalk condition**, tunnels	pedestrian path (22)	pedestrian path
area (10), sites (2), accommodations, attractions, hotels, leisure facilities, museums, scenic	tourism (6)	Service, building
bus stop (7), **transit stop** (6), **station** (2), **platform**, **stop**	transit stop (14)	transit stop
Bus (6), **public transportation** (2), transit route (2), **buses**, **metro**, **public transit**, timetables, **transportation**	public transit (9)	transit stop, transit vehicle
along (14), **pedestrian traffic**	route enroute (2)	route
streets (7), **block**, environment, **intersections**, lanes of traffic, **open spaces**	street layout (11)	pedestrian path, pedestrian crossing
building (7), **layout** (4), **wide open spaces**	building layout (6)	building
destination (5), POI (2), **shop** (2), restaurants	route destination (3)	destination, service
entrance (4), **door** (2), **ramp** (2), **station entrance** (2) 23	entrance (5)	entrance, interior-doorway, ramp
obstacles (6), **construction** (2), **surface irregularities**	route obstacle (2)	route
directions (6), turn-by-turn (3)	route directions (4)	route
landmarks (4), **audible landmarks**, **sonic landmarks**, **visible landmarks**	route landmark (5)	route
slope (2), **grade**, **steep slope**	route gradient (1)	route, pedestrian path
parking spaces (3), loading zones	parking (4)	parking
stairs (2), **steps** (2)	none	stairway
handrail (2)	none	stairway, ramp
dog	service animal (1)	route
street lights	lighting (1)	pedestrian path
elevator	elevator (1)	elevator
bathrooms	bathroom (1)	bathroom
assistance	assistance (1)	service
street signs	none	signage

3.2.3.4 Traceability Traceability is the ability to track the origin of a requirement (Suárez-Figueroa et al. 2008). For traceability, each instance of a hinder or enable condition is linked to the segment of text confirming the relationship. This information is presented in Appendix D (page 639) and includes both the segment ID in which the evidence can be found and the location in the world to which it is relevant. Thus, each requirement is sufficiently traceable.

3.3 CONCEPTUALIZATION PHASE

Semantics is a topic of interdisciplinary research (Kavouras and Kokla 2008). In the geographic domain, some researchers adhere to the realist view (Kavouras and Kokla 2008) believing geographic concepts are based on reality and independent of human perception. While others (Mark 1993) take a more 'conservative' conceptualist approach assuming that category definitions will vary across cultures, disciplines and languages. Researchers of geography have employed theories under both views; Janowicz (2012) uses Wierzbicka's semantic primitives (realist view) in the design of an ontology engineering methodology, and Rüetschi and Timpf (2005) rely on Johnson's image schemata (conceptualist view) in the design of an ontology of public transport.

An alternative view of geographic categories, and the view adopted in this research, relies on the notion of a 'commonsense reality' or the "environment which we all share in our everyday perceiving and acting" (Smith and Mark 2001). Smith and Mark (2001, 485) utilize primary theory (Horton 1982) and affordance theory (Gibson 1979) to support their 'commonsense reality', a kind of realism, which is based on the assumption that 'commonsense reality' – i.e., all of the basic beliefs that humans need to interact in everyday situations – is a good conceptualization of the world – i.e., "transparent to some corresponding independent domain of reality". Further, due to humans' common biological and psychological mechanisms, primary theory is shared by all cultures (Kavouras and Kokla 2008).

The conceptualization phase aims to use the wayfinding information needs and the information collected about barriers and facilitators to conceptualize accessibility in the context of wayfinding. The conceptualization phase "identifies and gathers all the useful and potentially usable domain knowledge and its meanings" and describes concepts and actions within the domain under study (Fernández et al. 1997, 37). The results of the knowledge acquisition (Appendix D, page 639) and specification phases (specifically the pre-glossary) are used as input to this phase. In this dissertation, concepts and their properties are constructed based on the beliefs and acts of people (researchers, experts, people with disabilities and others interested in accessibility) regarding the everyday task of wayfinding.

3.3.1 Concepts and Definitions

Meaning is central to semantics and is the key issue surrounding geographic concepts. The meaning triangle, proposed by Richards 1923, cited in Kavouras and Kokla (2008), is used to explain the relationships between an object (or referent), a concept (or reference) and a word/expression (or symbol). The gist of the triangle is that in order to represent an object with words you must first identify the related concept. In other words, words (symbols) do not refer to objects (referents) directly; they are only connected indirectly through concepts (references). In this research, primary emphasis will be placed on identifying concepts and subsequently assigning a term to represent the concept.

A further distinction in semantics is the 'mode of meaning'. Under the realist view, these are extension or intension. Extensional semantics are based on identifying the class of things that make up a concept, in other words, extensional definitions of concepts are a collection of individuals belonging to the concept. Intensional semantics are based on identifying a set of essential properties common to individual things belonging to a concept, in other words, intensional definitions refer to a concept's properties. With a few exceptions (e.g., all the countries in Africa), most concepts could have an unlimited set of individuals. Thus, the intensional approach to identifying and defining concepts is more commonly used (Kavouras and Kokla 2008) and is the approach to definitions that will be used in this research.

Concepts are the building blocks of ontologies and other linguistic systems. The probabilistic theory of concepts holds that concepts have a probabilistic structure within which categories exhibit family resemblances and have vague boundaries and that instances belong to a category if they have an adequate number of 'typical' properties. Rosch empirically proved that there is a 'basic level' of categories that are more salient (the vertical dimension) in 1978 (Kavouras and Kokla 2008). For the horizontal dimension, categories should be distinct and this may be accomplished via the use of prototypes. Prototypes can be represented via properties as attribute-pairs. In this research, Rosch's principles are utilized to define concepts used in the ontology.

The pre-glossary constructed in the specification phase is used to comb through the results of the knowledge acquisition phase for information that can aid in conceptual analysis. Data attached to the coding frame provide justification and provenance for the determination of definitions for the pre-glossary terms and help in identifying new related terms and instances. Once a term is found in the documentation, provenance for its definition including its properties and relations can be attached to it. This provenance will help legitimize the definitions as shared conceptualizations.

There are three types of concepts included in the ontology: environmental objects, actions performed in the environment and travelers (i.e., the target groups) who move through the environment and perform actions in the environment. These objects are situated in indoor, outdoor, transition spaces, and transit vehicle environments. The actions performed in the environment were derived using the segments coded with 'Actions'. These actions were organized into a hierarchy with five top level actions: 'Go to a Destination', 'Cross Street', 'Use Public Transit', 'Access a Building', and 'Access a Service'. These top level actions represent the five main activities that people want/need to perform during navigation, and would request information about during wayfinding. Each of these top level actions have subordinate actions that are either required or available to achieve the main action. The final set of concepts are the two groups of travelers, people with low to no vision and people who travel in wheelchairs. People with low to no vision can be either people who are blind or people with some vision. People who travel in wheelchairs can be people who travel in a manual wheelchair or people who travel in a power wheelchair.

3.3.2 Properties and Relations

Properties are the characteristics of things. Properties serve many purposes such as identifying similar things, identifying new instances of things, and explaining the meaning of terms (Kavouras and Kokla et al. 2008). There is some debate surrounding properties in relation to the problem of universals. Some argue that properties are universals (two sidewalks can have the same texture) – distinct from individuals – while others argue that properties are particulars (that the texture of each sidewalk is a numerically distinct individual) – or equivalent to individuals. In this work, properties are considered universals. There are also conflicting typologies of properties. Kavouras and Kokla (2008) discuss typologies of relevance to the geographic domain including: particularizing (sortal), mass, characterizing, semantic, syntactic, essential/rigid, natural kind, artificial properties; qualities and roles; and determinables and determinates. Kavouras and Kokla (2008) emphasize the importance of properties for defining geographic concepts and assert that 'essential properties' are most relevant to the geospatial domain but could be used along with other types of properties. Properties of identified concepts including relationships between concepts will be identified based on essential properties, affordances, semantic relations like inclusion (Storey 1993) and topological relations like adjacency (Kavouras and Kokla 2008).

The essential properties in this research are those pertaining to accessibility. Using the knowledge in Appendix D (page 639), a set of properties, or attributes, are identified for each environmental object. Using the example above of the 'revolving door', the following attribute is given to the concept 'Doorway': door type (automatic, manual, revolving).

Relations contribute to the meaning of concepts and are often considered to be a kind of property (Kavouras and Kokla 2008). Storey (1993) identified seven types of semantic relations: inclusion, possession, attachment, attribution, antonyms, synonyms, and cases. The two most commonly employed relations in both data models and ontologies are those termed 'inclusion' by Storey (1993) and include the subcategories: 'class' or subtype/supertype, 'meronymic' or part-whole, and 'topological' or one object surrounding another. Winston et al. (1987) further clarified mereological (part-whole) relations into 5 categories. Others (Gerstl and Pribbenow 1995, cited in Kavouras and Kokla 2008) distinguish mereological relations based their dependence on the compositional structure of the whole. Here relations are either inherent within the compositional structure (mass, collection, or complex relations) or independent from the compositional structure (segments or portions relations). Regarding spatial relations, the merging of mereology and topology, so called mereotopology, has contributed to relating wholes, parts and boundaries (Kavouras and Kokla 2008). It is a formal alternative to set theory for identifying objects at the mesoscopic level, or the level of everyday human experience (Kavouras and Kokla 2008). In this research, multiple types of relations will be used including ‘class’, ‘meronymic’, ‘topological’ and a special type of relations based on affordance.

Kuhn (2001) mentions that humans distinguish things based on the actions that they afford. Smith and Mark (2001) present their ‘commonsense reality’ as situated squarely in the ‘world of affordances’ according to Gibson (1979). In his book, Gibson (1979) articulates an ecological approach to perception and coins the term ‘affordance’. Affordance is defined as what the environment offers (i.e., provides or furnishes) the animal and implies a complementarity or mutuality between the environment and the animal (Gibson 1979). Thus, affordance captures the interaction between the animal and the environment; neither can exist without the other. This is particularly useful for analyzing the mobility of people with disabilities because it accounts for both the person and environment and conceptualizes a relation between the two.

The phenomenon under study is that of barriers and facilitators to mobility, which imply a relationship (or affordance) between a person and a component of an environment. The interaction between person and environment is essential to defining accessibility because each person has unique characteristics that impact their mobility in the environment. Much work on ontology includes basic hierarchical relationships and little work has been done to identify a robust set of relationships in the domain of accessibility. Existing relations are either unspecified or based solely on inclusion relations (subsumption and mereology). None of the existing geo-ontologies of accessibility utilize topological relations or other types of relations in their work. It is believed that a more detailed set of relationships between people with disabilities and the environment can be captured via affordance and spatial relations.

The relations in the ontology include relationships between environmental objects (object-object), actions (action-action), people and actions (people-action), and environmental objects and actions (object-action). The first group of relationships, object-object, includes three types of relations: -*has-component*, a part-whole relation; -*intersects*, a spatial relation implying overlap between the two entities; and -*connects-to*, a spatial relation implying that two entities touch each other but do not overlap. An example of the -*has-component* relation is 'building <has-component> hallway'. This relation indicates that a hallway is part of a building and cannot exist as an entity independent of a building. An example of the -*intersects* relation is 'route <intersects> hallway'. This relation indicates that an indoor route physically overlaps the hallway space. An example of the -*connects-to* relation is 'street <connects-to> sidewalk'. This relation indicates that the street and sidewalk have a common boundary but are not part of one another and do not overlap.

Relationships between actions are hierarchical or sequential. The hierarchical relation -*involves* is used to indicate a superordinate relationship. For example, 'catch vehicle <involves> wait at stop'. This relationship specifies that catching a public transit vehicle involves waiting at the transit stop. The sequential action -*precedes* is used to indicate the order in which actions in the same level of the hierarchy should be executed. For example, 'catch vehicle <precedes> ride vehicle' specifies that in order to ride a transit vehicle, a person must first catch the vehicle.

People-action relationships connect a group of travelers to a desired action. The -*performs* relation indicates that the person will complete the action. For example, 'person who travels in a wheelchair <performs> catch vehicle'. Given that people can perform many actions, 166 people-action relations were generated. The last set of relationships are a unique set of relationships designed for this dissertation, the mobility relations -*enables* and -*hinders*. These relations include a group of people, an action and an environmental object. The environmental object *-enables* or *-hinders* an action *-performed* by a traveler to complete their travel tasks. There are two kinds of conditions for these relations. First, the presence of an environmental object can enable or hinder an action, and second, an environmental condition (e.g., attribute) can enable or hinder an action. Here are two examples. For the first case, the relation 'presence of elevator (yes) <enables> change floor' specifies that simply having an elevator enables the action. For the second case, the relation 'elevator lighting level (#bright) <enables> enter elevator' specifies that adequate lighting enables a person to enter an elevator.

3.4 VERIFICATION PHASE

The goal of this evaluation task is to evaluate the 'quality of modelling' (Sabou and Fernandez 2012). As noted earlier, a competency question is a query that the ontology must be able to answer (Grüninger and Fox 1995). Today, twenty years after its introduction, the competency question is still the most common approach for evaluating ontologies (Karanasios et al. 2013). The purpose of this evaluation is to verify that the ontology has met the set of ontology requirements. The steps in the evaluation are modeled after the evaluation conducted in Karanasios et al. (2013). First, the set of terms in the pre-glossary of the ORSD, i.e., the terms that describe the competency questions and their answers used to design the ontology, will be taken as input. Next, each pre-glossary term will be found within the ontology and vice versa. There are three possible matches between the pre-glossary term and an equivalent term in the ontology: exact, modified tense, and synonymous. For an exact match, the term in the pre-glossary and the ontology must be identical. For a modified tense match, the terms must be the same word but conjugated to a different tense. For a synonymous match, the terms must be synonyms in WordNet or the Oxford English Dictionary. The results of the comparison are presented in Table 11.

Table 11 Competency question verification

Term sets	Exact	Modified tense	Synonymous	Unmatched	Total
CQ Question terms	115 (86%)	3 (2%)	--	16 (12%)	134
CQ Answer terms	223 (53%)	15 (4%)	29 (7%)	151 (36%)	418
All CQ terms	338 (61%)	18 (3%)	29 (5%)	167 (31%)	552
Ontology terms	298 (82%)	12 (3%)	4 (1%)	49 (14%)	363

The current version of the ontology includes over 85% of the question terms and over 50% of the answer terms. There are several reasons for the lack of full coverage. First, some of the terms in the answers to the competency questions were for very specific items like ‘awnings’, ‘balustrades’ or ‘debris’ that did not make it into the ontology. Second, some of the language was modified to improve the ontology such as changing ‘operable (part)’ to ‘control type’ and combining the actions ‘ascend’ and ‘descend’ a ramp to ‘use’ ramp. Lastly, the environmental object parking was not conceptualized. During the Specification Phase, there were no competency questions related to parking for people with low to no vision because parking is an activity that they do not often do. Because of this, the concepts and relations related to parking will be added in a later round of conceptualization.

Sure et al. (2009, 142) note that the main decision for finalizing the evaluation phase of the process is “whether the evaluated ontology fulfills all evaluation criteria relevant for the envisaged application of the ontology”. Thus, if the ontology can cover an adequate amount of the competency questions then the design of the ontology will end. The overall coverage of the competency question and answer terms is 69% (Table 11). An analysis of the terms within the ontology was also conducted. Over 85% of the terms used in the ontology can be found in the pre-glossary. This indicates that the ontology terms are also well represented in the ontology requirements. One explanation for the 15% of the terms uncovered is that several new terms related to relations were introduced during the conceptualization phase such as ‘intersects’ and ‘component’ that were not present in the pre-glossary. Other new terms relate to the attributes of environmental objects, for example the terms ‘size’, ‘speed’, ‘integer’ and ‘minutes’ were not present in the pre-glossary but the text described a scenario in which the size or speed of something was an important characteristic of determining the mobility relation.

3.5 DOCUMENTATION PHASE

Documentation is collected during each phase using various software tools. The following paragraphs provide pointers to where documentation of each step in the process can be found within the dissertation document.

Knowledge Acquisition. The coding frame (Appendix A page 207), the analysis of selected data sources (Appendix B (page 249), the context of each data source (Table 12), and the genesis of each concept and its properties have been documented (Appendix D, page 639) using Microsoft Excel and Word.

Specification. The queries generated from the raw wayfinding information needs (Appendix C, page 627), a mapping between wayfinding information needs and other knowledge categories (Table 10), and the full ORSD (including the competency questions) (Appendix E, page 662) have been documented using Microsoft Excel, Word and XMind mind mapping software.

Conceptualization. In the conceptualization phase, decisions regarding which concepts discovered during knowledge acquisition are relevant to the requirements and use of the ontology are made. QCA uses a coding frame to organize the analysis. Individual data points (text snippits) are attached to codes in the coding frame. These snippits are used during conceptualization and represent provenance for the ontological decisions. During conceptualization, these decisions are documented. The notion of provenance is important for attaching evidence that supports the categories, properties, and dimensions identified for the constructed concepts.

Verification. The verification of the ontology (Section 3.4) has been documented within the dissertation text.

3.6 SUMMARY

This chapter discussed the methodology for designing an ontology of accessibility in the context of wayfinding which addresses RQ3. The research includes four phases, knowledge acquisition, specification, conceptualization, and documentation. The knowledge acquisition phase is discussed in detail in Chapter 4.0 . The resulting ontology is presented in Chapter 7.0 .

4.0 QUALITATIVE CONTENT ANALYSIS

This chapter describes the methodology for knowledge acquisition in the dissertation. Qualitative content analysis (QCA) is used to acquire knowledge for the ontology design and to answer RQ1 and RQ2. First, the data sources are described. Second, the methodology, specifically the pilot phase and main phase are explained. QCA is a methodology for systematic text analysis (Figure 8). The terms 'data' and 'materials' will be used synonymously in this chapter.

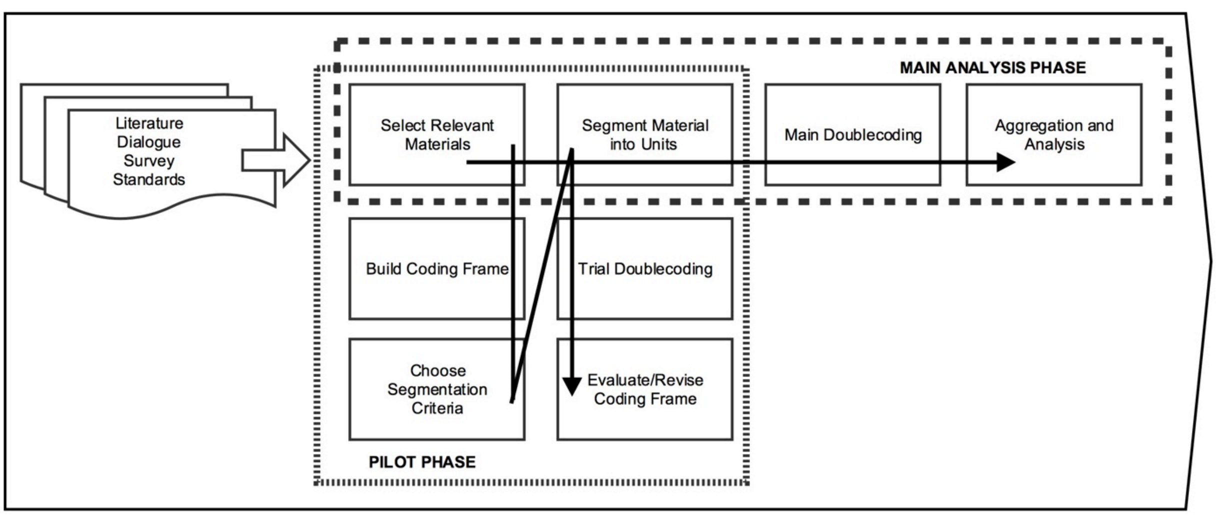


Figure 8 Methodology for knowledge acquisition

4.1 THE DATA

The data described below provide free text written from multiple perspectives on accessibility by researchers, experts, people with disabilities, and other persons interested in accessibility. Extant texts are a common source of data yet they are challenging in a few ways. The context of each data source is provided in Table 12.

First, extant data come in a variety of forms, and in most cases, the analyst had no influence on the data's creation (Charmaz 2006). A second, related problem is that the texts are often produced for very different purposes. Texts are constructed for specific purposes and are positioned within social, economic, historical, cultural and situational contexts (Charmaz 2006). Lastly, a text, as a form of discourse, "follows certain conventions and assumes embedded meanings" (Charmaz 2006). This requires a clear identification of the context of each data source and constant attention to the presence of embedded meanings within the text.

Before a data source was selected for analysis, the context of the data source was evaluated using questions suggested by Charmaz (2006). The questions and answers are presented in Table 12. Having a sense of the context of each data source will aid in the synthesis process because it helps identify biases and hidden meanings within the data. Each of the five data sources have different groups who generate the information. In some cases, such as the survey, the group is known while in others, such as OSM, it is difficult to find this information. The last column in the table highlights the benefit of each data source to the dissertation.

4.1.1 Literature

A large body of literature about accessibility of the environment exists. Many studies were covered in Chapter 2.0 but there are others. These studies represent a rich source of extant data on accessibility in different environments. Some studies aim to design wayfinding and navigation or tourist information systems for people with disabilities, others aim to understand barriers and facilitators to people with disabilities' participation in society. Each type of study contains useful information for understanding mobility or wayfinding and they are conducted from a multitude of perspectives. Unfortunately, there is little overlap between these different research studies. The use of findings from barriers and participation studies in wayfinding and navigation studies is rare (one known example is: Kasemsuppakorn and Karimi 2008). This is problematic because studies on barriers and participation and tourism systems include a rich set of information about accessibility in the environment that is not being adequately leveraged by wayfinding and navigation scholars. For this reason, literature on barriers and participation and tourism information systems are analysed in addition to wayfinding and navigation studies in this dissertation.

4.1.2 Dialogue

The National Online Dialogue on Transportation and Assistive Devices and Technologies was an online dialogue created by the Accessible Transportation Technologies Research Initiative (ATTRI) in 2014. ATTRI is a 5-year USDOT joint research and development initiative co-led by Federal Highway Administration (FHWA) and Federal Transit Administration (FTA). The motivation for the dialogue was to "[seek] input on mobility and transportation technology preferences and needs from transportation riders who have disabilities". The Dialogue's focus on technology preferences and needs make it a useful source of data on wayfinding information needs. The site was set up as an online event, using IdeaScale, in which people submit ideas, comment and vote on these ideas over a specified period. The results and full text of the Dialogue were published in an August 2014 report by ATTRI (Greer et al. 2014). Ideas were collected under five categories: Vision, Mobility, Hearing, Intellectual and Crosscutting.

4.1.3 Surveys

A group of researchers from Carnegie Mellon University and the University of Pittsburgh conducted the Technology Survey and Challenges Survey, as part of the NavPal project, in the summer of 2014. The Technology Survey focused on the use of technology by people with disabilities and their ideas for how such technology can be improved, making it a valuable source of data regarding wayfinding information needs. The second survey, the Challenges Survey, focused on how people with disabilities travel and the challenges they encounter in various environments and situations (e.g., emergency evacuation). This survey offers insight into common challenges in both indoor and outdoor environments. Respondents to both surveys categorized themselves as having visual, auditory, and ambulatory disabilities. IRB approval was obtained from the University of Pittsburgh (study #: PRO16110281) to use this data as an Existing Dataset.

4.1.4 OpenStreetMap

Wheelmap is a project of OpenStreetMap that allows people to tag locations with a wheelchair accessible designation of ‘yes’, ‘limited’, or ‘no’ and designate if the toilet is accessible or not. Wheelmap is an initiative of Sozialhelden e.V. a non-profit organization in Germany. With the introduction of the latest OSM editor, iD, the wheelchair tag was added to the main mapping page. In order to use iD, a user must log in and they can also add comments. For more experienced OSM users they can add a text description using the ‘wheelchair:description’ tag to add more specific information about the accessibility of a location. The comments describe points of interest around the world. This is useful to gain a more global view of accessibility in other English speaking nations.

4.1.5 Standards

Standard guidelines provide a legal mechanism for enforcing accessibility in the built environment. Accessibility legislation has been passed and standard guidelines have been designed in numerous countries over the last 50 years. A brief overview of standard guidelines is presented in Section 2.3.1. Standard guidelines are written in legal form adhering to the conventions of the country of origin. Standard guidelines focus on the construction and alteration of facilities (buildings or sets of buildings) and/or the design and implementation of transportation services. These documents are useful because they provide the ideal view on accessibility along with detailed technical requirements (i.e., measurements) for accessing services and facilities.

Table 12 Context of potential data sources

Context Question	Literature	Dialogue	Survey	OpenStreetMap	Standards
1. What are the parameters of the information?	Wayfinding, tourism, participation and barrier studies	Desired technology for transportation	Desired technology and mobility challenges	Description of accessibility of a specific place (e.g., business)	Scoping and technical requirements for accessible environments
2. On what and whose facts does this information rest?	Study participants and researcher's ideas	Any person who submits ideas and comments	People with disabilities who submit responses	Any person who tags a location	Appointed governmental body that includes people with disabilities
3. What does the information mean to various participants or actors in the scene?	New discoveries and tools; new publications	Justification for new services; expression of needs	Expression of technology needs and challenges	Better pre-trip planning; advocating accessibility	Newly constructed places are accessible; Enforceable guideline
4. What does the information leave out?	Due to space limitations, many details are omitted	Demographic information about the submitter	The ability to follow-up with further questions	Demographic information about the tagger	Designation of who each requirement benefits
5. Who has access to the facts, records, or sources of the information?	People with full text access to literature	Anyone on the web	Specific researchers	Anyone who can access OSM	Anyone on the web
6. Who is the intended audience for the information?	Researchers, the public, funding agencies	DOT, regional transportation planners, the public	Researchers	The public	Public and commercial entities, construction companies
7. Who benefits from shaping and/or interpreting this information in a particular way?	Researchers, sometimes people with disabilities	Transit agencies, transit riders	Researchers	The public, owners of accessible locations	The public, designers or service providers-if exempted
8. How, if at all, does the information affect actions?	May influence researcher's or other's ideas on accessibility	May set priorities for transportation planners, may lead to implementation of real transit technology	May influence researcher's ideas on accessibility	May allow someone to visit an uncertain location, support research about accessible places	Forces new construction and rehabs to be accessible unless an exemption applies
Benefits for this dissertation	Wayfinding requirements, Access to the environment	Technology needs and public transit	Technology needs, challenges in indoor, outdoor environments	Global view of actual conditions of accessibility	Ideal case for accessibility, detailed measures

4.2 PILOT PHASE

The QCA methodology includes two phases. The first phase is the pilot phase which includes selecting materials, segmenting selected materials into units of coding, constructing a coding frame, coding a small set of materials, and evaluating and revising the coding frame. These will be discussed below.

4.2.1 Selecting Materials

Selection involves two steps: selecting the first set of materials to use and coding the data collected for the study as relevant or not relevant for analysis. This research utilizes multiple sources of data that are not similar in structure or composition. In this case, Schreier (2012) recommends using a simple coding frame (relevant, not relevant) to systematically identify the relevant parts of each dataset. Table 13 shows the total data collected and the relevant data selected from each data source. On average, 40% of the total data collected was considered relevant. The definitions used for relevant vs. not relevant materials are the following:

- Relevant materials:
    - indicate a wayfinding information need
    - indicate or describe how an object is a barrier or facilitator to accessibility
- Non-relevant materials:
    - include none of the criteria above

The analysis of the Literature dataset required an additional pre-filtering step to identify "useful" articles. The unit of analysis for relevant materials found in Literature is one *article*. Articles were collected using keyword searches in the following databases: Medline, CINHAL, IEEE Explore, Compendex, INSPEC, ACM Digital Library, Business Source Complete and Google Scholar. Keywords used included: accessibility; people with disabilities; wayfinding; navigation; requirements; information need; barrier; and facilitator. After reviewing the initial set of articles, more articles were collected via citation chaining. *Useful* articles included studies that (1) designed a wayfinding, navigation or tourism service/system, (2) assessed the built environment using an accessibility checklist, or (3) conducted surveys, interviews or focus groups, related to wayfinding process or barriers and facilitators in the environment, with people with disabilities. After the pre-filtering process, 189 articles were considered useful: 78 wayfinding and navigation studies, 91 barrier and participation studies, and 20 tourism studies. Only the 'Results' and 'Discussion' sections of each article were evaluated because these sections commonly present new findings and models. Using the relevance criteria above to appraise the 189 useful articles, 83 articles were selected: 25 wayfinding and navigation studies, 45 barrier and participation studies, and 13 tourism studies.

Table 13 Data selection

Data Source	Total Units Collected	Relevant Units Selected
Literature	189 articles	83 articles
Dialogue	60 ideas/ 129 comments	23 ideas/ 16 comments
Survey	39 open-ended questions	22 open-ended questions
OpenStreetMap	758 comments	346 comments
Standard	132 chapters	61 chapters
Total Units	1295	547

The unit of analysis for relevant materials found in Dialogue is one *idea or comment*. The ideas and comments were collected from the report by Greer et al. (2014). Dialogue received a total of 60 ideas and 129 comments. Of the five categories, two – Intellectual and Hearing – did not produce any relevant content. Seventeen ideas and 50 comments were shared in the mobility category, 10 ideas and 14 comments in the vision category, and 25 ideas and 45 comments in the cross-cutting category. After analysis, 23 ideas and 16 comments (23-16) were considered relevant: (10-10) Mobility, (5-0) Vision, and (8-6) Cross-cutting. One concern with collaboratively submitted content is the number of diverse users participating in the discussion. The number of unique individuals contributing to Dialogue was analysed. In the vision category, 60% of the ideas and 57% of the comments were contributed by unique individuals. In the mobility category, 82% of the ideas and 64% of the comments were submitted by unique individuals. In the cross-cutting category, 80% of the ideas and 40% of the comments were submitted by unique individuals. In all cases, except the cross-cutting comments, over half of the contributors were unique individuals.

The unit of analysis for relevant materials found in Surveys is one *question*: in the cases of open-ended questions including multiple sub-questions, these are counted as unique questions. Technology Survey included seven open-ended questions, three of which had multiple sub-questions, making the total number of open-ended questions 16. Challenges Survey included six of open-ended questions, three of which included sub-questions, making the total number of open ended questions 23. Of the 39 open-ended questions, 22 were considered relevant after appraisal.

The unit of analysis for relevant materials found in OpenStreetMap is one *comment*. The Planet.osm file (i.e., the full current dataset) for OpenStreetMap was downloaded on July 2015. The Planet.osm file grows daily and is ~40GB of data. It can be downloaded in a compressed XML format and the OSM community has developed tools to query and extract specific data from the large file. The osmosis tool was used in this work to query and extract data that included the following key:value pairs: 'wheelchair:description', and ‘wheelchair:description.en’. These key:value pairs are used to tag free text comments related to wheelchair accessibility in the OSM database. These data were then analysed against a set of countries where English is the main native language. This yielded 908 comments. A final step of processing included removing comments that were duplicates, not written in English, listed as a closed establishment, and unclear such as ‘accessible’ or ‘good’ with no further explanation. A total of 758 comments were evaluated for relevance. After the analysis, 346 comments were considered relevant. They are from the following countries: Australia-35 comments, Canada-171 comments, the United Kingdom-92 comments, and the United States-48 comments.

The unit of analysis for relevant materials found in Standards is one *chapter or part*. Standard guidelines from four English speaking countries, the United States, Australia, the United Kingdom, and Canada were collected. A total of 132 chapters were evaluated and 61 were considered relevant. The following sentence lists the total number of chapters or parts of a standard guideline and the number of relevant chapters after the hyphen. US ADA Accessibility Guidelines (10-6 chapters), US Public Rights of Way Guidelines (4-1 chapters), UK Code of Practice on Services (15-2 chapters), Ontarian Design of Public Spaces Standard (12-4 chapters), Ontarian Public Transport Standard (50-19 parts), Australian Access to Premises-Buildings (6-1 parts), and Australian Standards for Accessible Public Transport (35-28 parts). Many of the chapters in these documents are preliminaries, definitions or scoping sections so the chapters selected are dominantly from the technical sections of each guideline.

4.2.2 Segmenting Selected Materials

Segmentation in QCA is the process of dividing relevant, selected material into units. There are several units of importance: units of analysis (i.e., an article, a question, a chapter), units of coding (i.e., a segment) and units of context (Schreier 2012). A unit of analysis is a unit that should be described in the final analysis. The unit of analysis for each data source was presented in Section 4.2.1. A unit of context is any amount of the surrounding material or external material that is required to understand the meaning of a unit of coding (Schreier 2012). For example, the study area of an article gives its location context, or the identity of the entity speaking in the text determines the source context.

Units of coding are sections of text that fit within only one subcategory of each dimension of the coding frame (Schreier 2012). In other words, the unit of coding may be coded for all of the frame's dimensions but it can only be coded within one subcategory of each dimension. Units of coding can be selected using formal or thematic criteria. The formal criterion is based on units of writing, such as words, sentences, paragraphs, or sections. The thematic criterion is based on a change in topic. During the pilot phase of the research, both formal and thematic segmentation was explored.

For this research, the paragraph unit is too large and often includes multiple wayfinding information needs, barriers or facilitators. Other formal criteria such as a sentence or word are too small as some of the relevant material spans more than one sentence. This is true for all data sources. For these reasons, a thematic criterion will be used for all data sources analysed in the dissertation. Using the thematic criterion, the data can be segmented into units of coding (i.e., segments). Table 14 shows a sample idea from Dialogue (i.e., a unit of analysis) and several units of coding (separated by []) derived by using the thematic criterion. Segmentation using the thematic criterion requires a judgement by the researcher regarding what constitutes one idea or one topic. This is tied to the dimensions and sub-categories in the coding frame. For example, the first thematic segment in Table 14 is about the length of time it takes to cross the street and the time the signal allows for crossing the street. This indicates that too short a time to cross the street is a potential barrier to people who travel in wheelchairs. The second segment is also about the length of the light but indicates that a longer light would be beneficial for crossing and argues that attaching the lenth of the light to the status of the pedestrian signal button could be a further aid to crossing. This segment is about a facilitator to crossing the street and the relationship between the button and the signal.

Table 14 Sample units in QCA

The entire idea in the cell to the right is the **'unit of analysis'**. The content within **[**brackets**]** constitute one **'unit of coding'**. These units of coding are segmented using the thematic criterion.	Cross Walks for those with limited mobility **(1) [**When a cross walk button is pushed it changes the length of time the light stays green. Ever saw a person who is using a wheelchair or on crutches try to cross 6 lanes of traffic? Some lights are so short even able-bodied people will have to run the last 1 to 1 1/2 lanes to get to the sidewalk safely.**]** Lights are set for cars, not people**. (2) [**Suggest is that the light would stay green longer, only if the button is pushed.**]**

4.2.3 Building a Coding Frame

One of the advantages of QCA listed by Schreier (2012) is the reduction of data. The mechanism responsible for reducing data in QCA is the coding frame. It is a hierarchical set of concepts (codes) that represent both the specific aspects of interest and the content of data. The segmented units of coding are assigned codes from the coding frame during analysis. There are two main parts of the coding frame, the dimensions and the subcategories. Dimensions are the main categories of interest in the research; subcategories relate to each selected dimension and can be viewed as values or instances of that dimension.

Like other QCA studies, the coding frame used here was designed using both concept-driven and data-driven strategies (Schreier 2012). The concept-driven approach utilizes a priori concepts found in the research questions under study, basic information required for wayfinding, and common sense components of the built environment. For example, conceptually-driven dimensions are ‘wayfinding information need’, ‘barriers’ and ‘facilitators’. Sample, conceptually-driven subcategories are ‘person with low vision’, ‘person in wheelchair’, ‘information about a building’ or ‘barrier to a building’. The remainder of the coding frame was created using the data-driven strategy of subsumption. Subsumption is done by reviewing relevant content and subsuming it under an existing subcategory or creating a new subcategory to represent the content (Schreier 2012). Because this research has multiple data sources, the data-driven process began by choosing the relevant data from one data source and designing the frame for that source, followed by a second source, and so on until all sources have been examined and are covered by the coding frame.

Once the draft codes (dimensions and sub-categories) are generated, they must be defined. A definition for a code has four parts: a name, a description of what it means, examples from the data, and (sometimes) decision rules (Schreier 2012). Each code should have a definition so that when the coding begins, the researcher can review what each code means, see examples selected from the data that exemplify that code, and if necessary, use a decision rule to choose between conceptually similar codes.

The draft coding frame (the derived and defined dimensions and subcategories) and a small set of pilot data was given to a second coder. The second coder and myself used the coding frame to assign codes to the segments of pilot data. Next, during in-person meetings, the performance and limitations of the draft coding frame were discussed. The coding frame was revised based on the conversation and a new iteration with the revised frame and a new set of pilot data began. This was repeated until more than 10% of each data source was trial coded which resulted in 10 iterations.

The first version of the coding frame included three dimensions: ‘wayfinding need’, ‘traveler’ and ‘environmental mobility’. During coding, it was apparent that options for general cases were missing. For example, under ‘wayfinding need’, a subcategory was created for ‘information about landmarks’, however, there was no sub-subcategory that indicated ‘general landmarks’. This was needed because sometimes the text merely requests information about landmarks without specifying what kind of landmark. Secondly, any coding of the environment was implicit. For example, subcategories like ‘barrier to a bathroom’ or ‘barrier to an elevator’ are clearly indoor environments and ‘barrier to pedestrian crossing’ or ‘barrier to pedestrian path’ are clearly outdoor environments. The cases of ‘barrier to transit stop’ or ‘barrier to parking’ are not as clear. For example, the transit stop could be an outdoor bus shelter or an indoor train platform or the parking area could be an outdoor lot or an indoor garage. To address these issues, the frame was revised to include a general category under each subcategory and a new dimension to capture the ‘Environment’ was created. Lastly, the subcategories ‘barriers’ and ‘facilitators’ were created under the ‘Environmental Mobility’ dimension.

The second iteration of trial coding was conducted with the modified frame. During this coding session, two pieces of contextual information were missing from the frame. To support RQ2 and RQ3, information about the location within the world that each segment describes and the identity of the entity speaking in the text are required. Thus, two new dimensions were added to the frame ‘Location’ and ‘Source of Evidence’. Two more iterations of coding were completed until the next modification of the frame. Schreier (2012) discusses the idea of mutual exclusiveness and warns against mixing dimensions within the coding frame. Upon inspection of frame, during the fourth iteration, we determined the dimension ‘Environmental Mobility’ was not mutually exclusive because it contained subcategories for ‘barriers’ and ‘facilitators’ which are two main interests of the dissertation. Thus, the dimension was broken into two dimensions ‘Barrier’ and ‘Facilitator’.

During the fifth iteration, the subcategories under the new ‘Barrier’ and ‘Facilitators’ were recategorized into ‘specific spaces’, ‘general spaces’, ‘objects’, and ‘transit’. Also, to support RQ3, a new dimension ‘Action’ was added to capture actions associated with spaces, objects, and activities. This was the last structural change made to the frame during the trial coding. At this point, the coding frame had eight dimensions ‘Location’, ‘Traveler’, ‘Source of Evidence’, ‘Environment’, ‘Wayfinding Need’, ‘Barrier’, ‘Facilitator’, and ‘Action’. To reach the trial coding minimum of 10% of each source, four more iterations of coding were conducted. After the trial coding concluded several final modifications were made to the coding frame. New subcategories were added to ‘Location’ and ‘Traveler’ and unnecessary subcategories were removed from the ‘Wayfinding Need’ ‘Barrier’ ‘Facilitator’ and ‘Action’ dimensions. The full version of the coding frame is presented in Appendix A (page 207).

4.2.4 Trial Coding and Evaluation of Coding Frame

The purpose of trial coding is to apply the draft coding frame and identify any difficult codes or missing dimensions. This is a very important step in QCA because once the coding frame is evaluated and revised and the main coding begins, the coding frame cannot be changed. If a proper trial coding is not conducted, then important information may be missing from the main analysis of the data.

In this research, the goal is to summarize and describe the data not test a hypothesis. In this case, the data used during the trial coding can be recoded during the main analysis. Schreier (2012) emphasizes that the selection of materials for trial coding is the most important decision during the Pilot Phase of the analysis. She recommends selecting data that represents all the variability in the materials and suggests that 10-20% of the material be included in the trial coding. This dissertation includes five very different data sources. To address the variability of the materials, at least 10% of each data source was included in the trial coding (Table 15).

Table 15 Trial materials

Data Source	Total Relevant Units	Relevant Trial Units	Percent of Total
Dialogue	23 ideas	8 ideas	0.35
Survey	22 questions	4 responses	0.18
Literature	83 studies	12 studies	0.14
Standards	61 chapters	6 chapters	0.10
OpenStreetMap	346 comments	133 comments	0.38

4.2.4.1 Reliability The reliability of the coding frame during the trial coding will be evaluated by interrater reliability between two coders. For the main coding, described in the next section, a different method of reliability, the stability of one coder over time was used. As mentioned in Section 4.2.3, the coding frame was constructed over 10 iterations of trial coding. During each iteration, a small set of data (~40 segments) was coded and the coding frame was modified if needed. Once the trial coding was complete, the coding frame had eight dimensions and 139 subcategories.

Reliability is a measure commonly used in quantitative content analysis (Schreier 2012). It is a measure of agreement between two independent coders or one coder over time. For the trial coding, the percent agreement ((number agreed/total number)*100) was measured between myself and the second coder for each segment for each iteration. Table 16 shows the detail for each iteration.

Several considerations are important for determining acceptable levels of reliability. First, the purpose of the trial coding was to develop the coding frame and discuss its development with the second coder. For example, even though one iteration may result in a lower reliability score, the process allows for disagreements to be discussed and the coding frame to be improved for the next iteration. Second, this research includes a variety of data and different data was introduced in each iteration. This means the new cases were introduced during each iteration which may result in a lower reliability score. At the end of the trial period, the overall agreement for each data source was the following: Literature 67%, Dialogue 71%, Survey 49%, OpenStreetMap 77% and Standards 72%.

Table 16 Trial coding details

Iteration	Data Coded	Units of Analysis	Segments	Agreement
1	Dialogue Survey	1 4	13 34	0.77 0.49
2	Literature	1	31	0.63
3	Standard	2	34	0.66
4	OpenStreetMap	30	30	0.71
5	Literature	2	25	0.70
6	OpenStreetMap	38	50	0.77
7	Dialogue	7	20	0.64
8	OpenStreetMap	65	53	0.84
9	Standard	4	20	0.78
10	Literature	9	71	0.68
Overall		163	381	0.70

4.2.4.2 Validity Face validity is the measure of validity recommended for evaluating data-driven coding frames (Schreier 2012). Since the goal of this process is knowledge acquisition, an exact description of the material in relation to the research questions was sought. While the dimensions were mainly chosen using concepts in the research questions, the subcategories were derived using the data driven method, thus face validity is most appropriate.

Face validity has three parts. One part is the use of residual categories. A residual category is generally called "Miscellaneous" and is a dimension added to a coding frame to deal with a segment that cannot be coded by any of the existing dimensions in the coding frame.

During the entire pilot phase, less than five segments (1% of the pilot segments) were coded into the Miscellaneous dimension. After each case, a new subcategory was created to capture the missing content.

Another part is the frequency of segments applied to subcategories within a dimension is a useful measure of face validity. The coding frame changed substantially during the first five iterations. After the seventh iteration, the coding frame remained stable using the final eight dimensions. An analysis of the frequency of codes applied to the pilot data was conducted using the last four iterations (#7-10) because the frame was not changed. The frequency of coding for each subcategory over the last four iterations was counted and the standard deviation of the codes for each dimension was calculated. If the frequency of a code falls outside of one standard deviation it may indicate low face validity because the category may not be sufficiently differentiated. On the other hand, if the category is differentiated, it may be an empirical finding. Table 17 lists the codes falling outside of one standard deviation for each dimension and provides an explanation of why this is the case and any changes made as a result.

The final measure (part) of face validity is the level of abstraction of the subcategories. Many of the subcategories in the 'Information', 'Barrier', 'Facilitator', and 'Action' dimensions could be considered abstract. For example, these categories could be broken into further subcategories such as 'barrier-pedestrianpath-width' or 'barrier-pedestrianpath-texture'. This would allow for a more specific coding of *what* barrier along a pedestrian path is being described (i.e., too narrow or too rough). Given the purpose of this part of the work is knowledge acquisition and the size of the existing coding frame, a decision was made to keep these categories intact and to distinguish the detailed wayfinding information needs, barriers, facilitators, and actions described in the text during the Conceptualization Phase of the research.

Table 17 Trial coding details

Dimension	Codes falling outside 1 SD	Explanation
Location	North America	Most of the data are from North America. In the final coding frame, this was broken into United States and Canada.
Traveler	Wheelchair-general	Most of the data do not distinguish manual vs. power wheelchair use, thus a more general category is needed. Also, more research focuses on wheelchair users and the OSM data, a large portion of the dataset, is exclusively focused on wheelchair users.
Source	Person with a disability who is a '*member*' of the relevant group	This category was undifferentiated and in the final frame, new categories were added to capture the direct voices of 'members' vs. the findings of interviews, surveys, and observations.
Environment	Outdoor	The literature selected for the pilot phase may have included more articles focused on outdoor space.
Information	Pedestrian path Tourism	A decision was made to keep these categories intact and distinguish the detailed wayfinding information needs during conceptualization. If the same pattern is observed during the main analysis, this may be an empirical finding.
Barrier	Entrance Pedestrian path	A decision was made to keep these categories intact and distinguish the detailed barriers during conceptualization. If the same pattern is observed during the main analysis, this may be an empirical finding.
Facilitator	General mobility Entrance Pedestrian path	A decision was made to keep these categories intact and distinguish the detailed facilitators during conceptualization. If the same pattern is observed during the main analysis, this may be an empirical finding.
Action	Entrance Transit stop	This category was created to aid in constructing relationships during conceptualization. A decision was made to keep these categories intact and distinguish the detailed actions during conceptualization.

In summary, the use of residual categories was small and each instance resulted in a new category to capture the content. The frequency of each subcategory was evaluated and a decision was made to either modify the coding frame or keep the categories intact. Lastly, the categories that appear abstract in the coding frame were designed with knowledge acquisition in mind and to minimize the complexity of the coding process. Due to these factors, the face validity of the coding frame is acceptable.

4.3 MAIN PHASE

The main phase includes applying the coding frame to all the selected data, evaluating the coding, and analysing and interpreting the results. These steps will be discussed below.

4.3.1 Coding selected data

The main coding is conducted on all selected data. The coding frame should not be changed unless major errors are found. No major errors were found during coding. Table 18 includes several examples of relevant segments of text and their corresponding codes. For the entire coded dataset, see Appendix B (page 249). The extracted text and its segment code (e.g., "Dialogue-31") are listed in column 1. The remaining six columns represent the dimensions of the coding frame; two of the Dimensions are not shown to conserve space. The content of each cell is a sub-category of the dimension that is relevant to the extracted text. If the cell includes a "@" symbol, then it does not have any content relevant to that dimension.

4.3.2 Evaluation of coding

The practice of doublecoding continued during the main analysis but a measure of stability or the comparison between one coder over time was captured instead of the measure of interrater reliability collected during the trial coding. Schreier (2012) recommends at least a two week break between coding sessions. The first coding of the entire dataset (n=1605 segments) occurred in September and October 2016; the second coding, which included 12% of the data (n=197 segments) was conducted in January and February 2017. Just as the trial coding, the variability in the data was considered when choosing which data to doublecode. Table 19 lists the materials that were doublecoded. Table 20 shows a set of acceptable reliability scores for each data source across all dimensions in the coding frame. These values were estimated based on the level of interpretation required for each dimension, the specific context of each data source, and the evaluation of the trial coding. Table 21 includes the computed measures of stability between the two time points.

Table 18 Examples of coded data

Segments	Location	Traveler	Environment	Information	Barrier	Facilitator
Dialogue-31 "Map of all transit routes within the metropolitan area with detailed schedules for each route"	North America-US	low vision	outdoor	Transit-general	@	@
Lit-Matthews-18 "[Toilets:] What I would like to see mapped is disabled toilets."	Europe-UK	wheelchair-general	indoor	building-bathroom	@	@
OSM-366 "Narrow footway and low step at wide doors"	Europe-UK	wheelchair-general	transition	@	pedestrian path	entrance
Challenges Survey 30 "If I don't know the place, I have to figure out the layout of the halls and room numbering system. Signage is often not accessible. If there are huge open spaces, it can be worse than outdoors"	North America-US	blind	indoor	building-layout	indoor space	@
ADA.3-10 "[clear floor and ground space] 305.3 Size. The clear floor or ground space shall be 30 inches (760 mm) minimum by 48 inches (1220 mm) minimum."	North America-US	target groups	indoor	@	@	indoor space
Lit-Banda-Chalwe-4 "The absence of curb cutouts, for example, pose pertinent permanent barrier to wheelchair users, indicating the need to include this item in access to/ approaching the building"	AFRICA	wheelchair-general	outdoor	@	pedestrian path	building

Table 19 Materials doublecoded during main coding

Dataset	Total Segments	Double coded Segments
Literature	617	74 (12%)
OpenStreetMap	443	53 (12%)
Standard	358	43 (12%)
Survey	134	21 (16%)
Dialogue	53	6 (11%)
TOTAL	1605	197

Table 20 Acceptable agreement levels by data source and dimension

Acceptable %	Location	Traveler	Source	Environment	WIN	Barrier	Facilitator	Action	Overall
Literature	100%	75%	75%	75%	75%	50%	50%	75%	72%
Dialogue	100%	75%	75%	75%	75%	50%	50%	75%	72%
Survey	100%	100%	100%	75%	75%	50%	50%	75%	78%
OpenStreetMap	100%	75%	100%	75%	100%	50%	50%	75%	75%
Standard	100%	75%	100%	50%	100%	50%	50%	75%	75%

Table 21 Stability scores for main coding

Stability	Location	Traveler	Source	Environment	WIN	Barrier	Facilitator	Action	Overall
Literature	1.00	0.96	0.85	0.88	0.95	0.84	0.85	0.85	0.90
Dialogue	1.00	1.00	1.00	1.00	0.83	1.00	0.83	0.83	0.94
Survey	1.00	1.00	1.00	1.00	**0.76**	0.86	0.90	0.90	0.93
OpenStreetMap	1.00	0.98	1.00	0.87	1.00	0.83	**0.79**	0.94	0.93
Standard	1.00	**0.79**	1.00	**0.81**	1.00	1.00	0.81	0.91	0.92
Total	1.00	0.95	0.97	0.91	0.91	0.91	**0.84**	0.89	0.92

4.3.3 Analysing and interpreting the results

After the double coding, a final code was selected for each unit of coding. The resulting dataset was sorted and filtered to extract the set of segments that included explicit requests for information, i.e., wayfinding information needs (n=227), descriptions of barriers (n=719) and descriptions of facilitators (n=895) to accessibility. Table 22 shows the frequency of wayfinding information needs, barrier and facilitators obtained from each data source.

Studies found in the literature represent the richest source of extant data on accessibility in the environment. The literature provided a large amount (64%) of the wayfinding information needs identified, 86% of which came from the wayfinding and navigation studies. The literature provided almost half (46%) of the barriers and nearly one-quarter (24%) of the facilitators identified. The barriers and participation studies were a rich source of barriers (54%) and facilitators (57%) while the tourism studies provided a balanced amount of wayfinding information needs (14%), barriers (18%) and facilitators (27%). The OpenStreetMap comments provided the second most segments to the dataset. This dataset did not include any wayfinding information needs. Since OpenStreetMap is focused on mapping and describing specific places, it makes sense that users would share their experiences at a location not requests for information about the locations. Thus, the information collected includes a large set of barriers (41%) and facilitators (29%) to accessibility.

Table 22 Coding results

Dataset (% of total data)	Segments	WIN	Barriers	Facilitators
Literature (39%)	617	146 (64%)	331 (46%)	216 (24%)
OpenStreetMap (28%)	443	0	292 (41%)	261 (29%)
Standard (22%)	358	0	38 (5%)	345 (39%)
Survey (8%)	134	59 (26%)	38 (5%)	52 (6%)
Dialogue (3%)	53	22 (10%)	20 (3%)	21 (2%)
TOTAL	1605	227	719	895

Six standard guidelines (Table 1) were coded representing 22% of the total number of segments coded. The nature of standard guidelines is to provide a detailed description of the requirements for accessibility when constructing buildings, and designing transportation and other public services. The largest portion of facilitators to accessibility (39%) were collected from the standard guidelines. This makes sense because the focus of the standards is on facilitators to accessibility in buildings or when using public transportation. Even so, a few barriers (5%) were also found in the standards. Unfortunately, the standard guidelines did not provide any wayfinding information needs. A total of 22 open-ended survey questions (10 for the Technology Survey, and 12 for the Challenges Survey) were coded. Relative to the number of segments in the total dataset (8%), the surveys provided a large number (26%) of the wayfinding information needs identified. Although, they provided only a few barriers (5%) and facilitators (6%), the surveys allow for better understanding of the context of the barriers and facilitators than the OpenStreetMap data or some of the Dialogue ideas. Dialogue provided a relatively small amount of wayfinding information needs (10%), barriers (3%) and facilitators (2%). While Dialogue represents the smallest number of segments (3%) collected, the wayfinding information needs are very important considering that two of the data sources did not provide any wayfinding information needs.

4.4 SUMMARY

This chapter presented the methodology used to acquire knowledge for the ontology design. The results of the coding will be used to answer RQ1 (Chapter 5.0) and RQ2 (Chapter 6.0) and as input to the Specification and Conceptualization Phases of the research. Qualitative content analysis proved to be an effective method for acquiring knowledge. There were 1605 total segments coded from the five datasets. After coding, 227 wayfinding information needs were collected, 719 barriers and 895 facilitators to accessibility were collected. The reliability and validity values were acceptable. The full coding frame is provided in Appendix A (page 207) and Appendix B (page 249) includes the full set of coded data.

5.0 IMPORTANT CATEGORIES OF ACCESSIBILITY

This chapter addresses RQ1: *What are the important categories of accessibility, in the context of wayfinding, for people who travel in wheelchairs and people with low to no vision?* Dimensions of interest relate to types of information needed and barriers and facilitators to accessibility in the environment. As mentioned in Chapter 4.0 , Qualitative Content Analysis was used to code categories of wayfinding information needs, barriers and facilitators from each data source. In other words, explicitly requested information, descriptions of barriers that hinder mobility and facilitators that enable mobility were identified from extant text data, described in Chapter 4.0 . This chapter discusses overall trends in the data and trends specific to the target groups, and presents a set of important categories of wayfinding information needs, barriers and facilitators to accessibility.

5.1 CONTEXTUAL CONSIDERATIONS

Several kinds of contextual information were coded for each text segment. This section presents trends and limitations in the dataset related to the contextual factors such as the traveler who is requesting accessible information or experiencing barriers, where in the world the data is relevant, and the area of the physical environment that the data describes.

5.1.1 Traveler Context

The traveler context is the group of people with disabilities that need a piece of information or experience a barrier or facilitator to accessibility. The two main travelers of interest in this dissertation are people with low to no vision and people who travel in wheelchairs. Due to certain practices in universal design and research design, this context is not always clear. For example, standard guidelines are designed using a universal design approach. This means that clear designation of which group benefits from a technical guideline is not paramount and thus these designations are infrequent. In the dataset, only 18% of the text from the standard guidelines provided a clear traveler context. In research practice, it is common to design a study to address multiple target groups and discuss them as a unit such as ‘people with disabilities’ or ‘people with mobility and visual impairments’. While common, this practice is less prevalent in the datasest, only 13% of the segments were missing the traveler context.

A large portion (45%) of the data collected from the Cross-cutting idea category in Dialogue is missing the traveler context. In some cases, idea submitters shared information about themselves such as the fact that they work as an access professional or that they were a person who travelled in a wheelchair but in many cases this was not available. To account for this missing context, the Traveler dimension category ‘Target Groups’ was used to record the lack of traveler context. The category Target Groups means that the segment of text describes a wayfinding information need, barrier or facilitator that applies to one of the target groups but it is unclear which group. Figure 9 displays the frequency of wayfinding information needs, barriers and facilitators for each traveler context category.

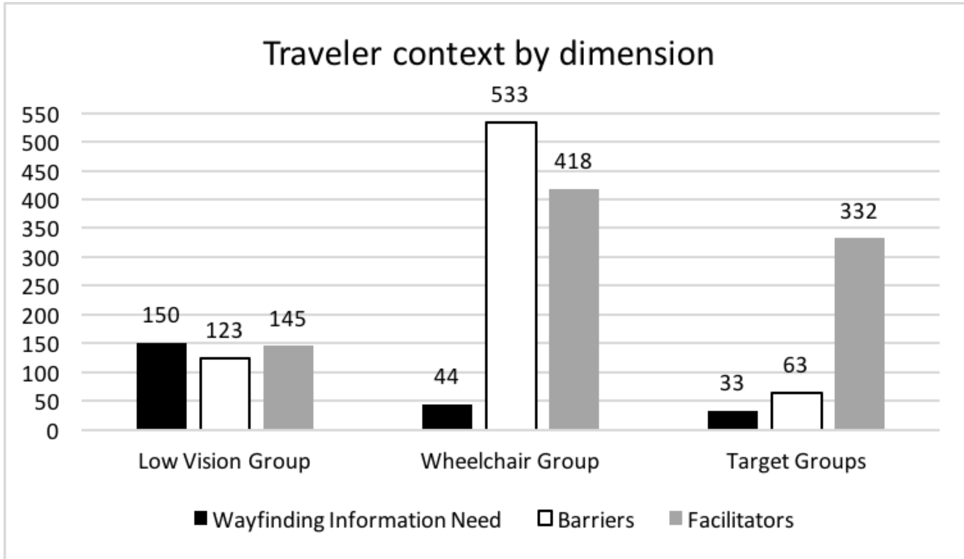


Figure 9 Traveler context of captured Dimensions of interest

The largest set of wayfinding information needs were collected for the low to no vision group. The bulk of these segments were collected from the Surveys which received more responses from people with low to no vision. The amount of wayfinding information needs collected for the wheelchair group is three times less than those collected for the low to no vision group; however, the wheelchair group includes more barriers and facilitators than any other group. This is because the data collected from OpenStreetMap represents a large portion of the total data and focused exclusively on people who travel in wheelchairs. The large number of facilitators (37%) in the target group category are due to the influence of the standard guidelines. The influence of missing context on the wayfinding information needs and barriers dimensions was less significant.

5.1.2 Location Context

Another useful contextual category is the location in the world a piece of data describes. This is recorded at the continental level and is called the location context. Figure 10 shows the location context for each dimension of accessibility. Most segments are relevant to North America and Europe. The dominance of North American perspectives relates to the data sources used in the dissertation and the decision to restrict the data to English language text. Two of the data sources, Dialogue and Surveys, focused solely on the United States and four of the standard guidelines documents were from North America. Conversely, the data related to Africa, Asia, and South America came solely from the Literature dataset.

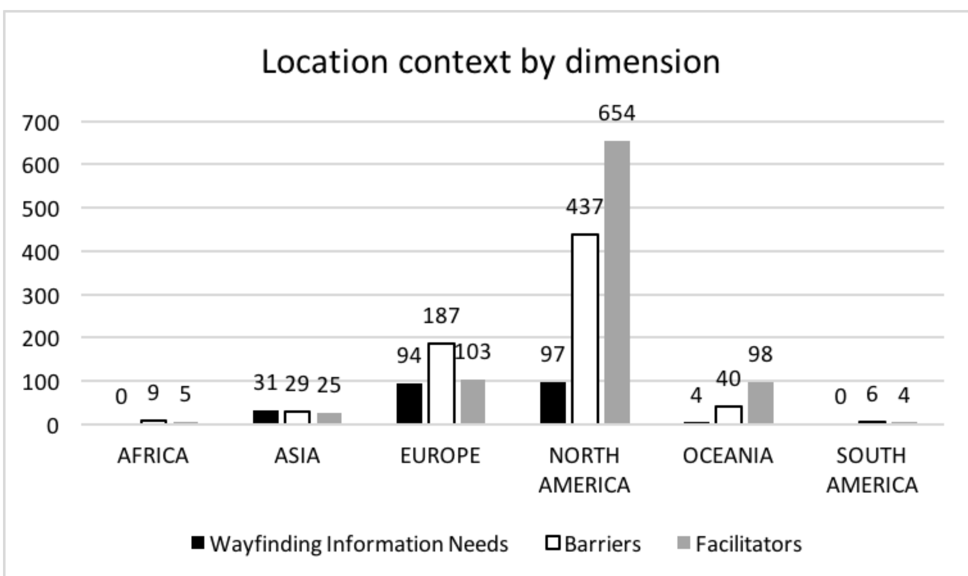
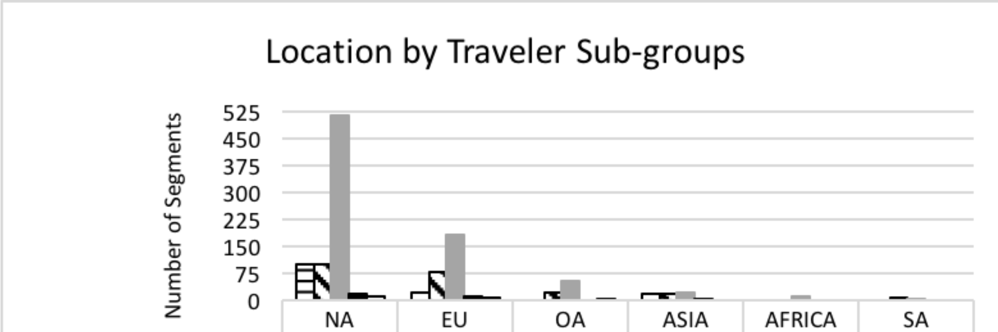


Figure 10 Location context of captured Dimensions of interest

A balanced number of wayfinding information needs were found for North America and Europe; however, the number of barriers and facilitators coded for North America were much higher than any other continent. Similarly, the number of facilitators in North America and Oceania were much higher than the other dimensions due to the focus of standards guidelines on facilitators to accessibility in the built environment. Europe does not show this pattern because of a change in the accessibility legislation and standard guideline development under the Equality Act which is scenario-based as opposed to more typical technical guidelines. Lastly, the second largest dataset was the OpenStreetMap data and this included more data from North America than any other location. OpenStreetMap also provided data from Europe and Oceania.

The sub-groups within the Traveler context are people who are blind and people with low to no vision in the Low-to-No-Vision Group and people who travel in manual wheelchairs (‘wheelchair-manual’), power wheelchairs (‘wheelchair-power’) or people who travel in an unspecified type of wheelchair (‘wheelchair-general’) in Wheelchair Group. Figure 11 combines the location and traveler contexts to show the distribution of data by travelers across each location. The trend towards data in North America remains, yet here we can see the dominance of the wheelchair-general category across multiple locations.



	NA	EU	OA	ASIA	AFRICA	SA
blind	101	20		19		
low vision	98	77	21	18		6
wheelchair-general	514	181	55	23	12	1
wheelchair-manual	17	11		3		
wheelchair-power	9	8	1			

Figure 11 Location context by target group

5.1.3 Environmental Context

The final piece of relevant context is the environmental context. This is the physical environment that each segment of data describes. The immediate observation from Figure 12 is the large number of wayfinding information needs for the outdoor environment. In fact, 82% of the wayfinding information needs identified are related to this environment. A more balanced set of barriers and facilitators were collected for indoor, outdoor and transition environments. Each of these environments contains over a quarter of the barriers collected, and the indoor and outdoor environments each contain more than a third of the facilitators collected. The indoor-outdoor category is needed because standard guidelines often include technical requirements that are applicable to both indoor and outdoor settings, e.g., ramps or pathways.

For the Traveler sub-groups, the outdoor environment is fairly balanced across the blind, low vision and wheelchair-general categories (Figure 13). In both the transition and indoor environment categories, data in the wheelchair-general category represents over 75% of the total data for that category. The large number of wheelchair-general data in the transition category is influenced by the OpenStreetMap dataset which includes entrances as an important part of the accessibility of a place.

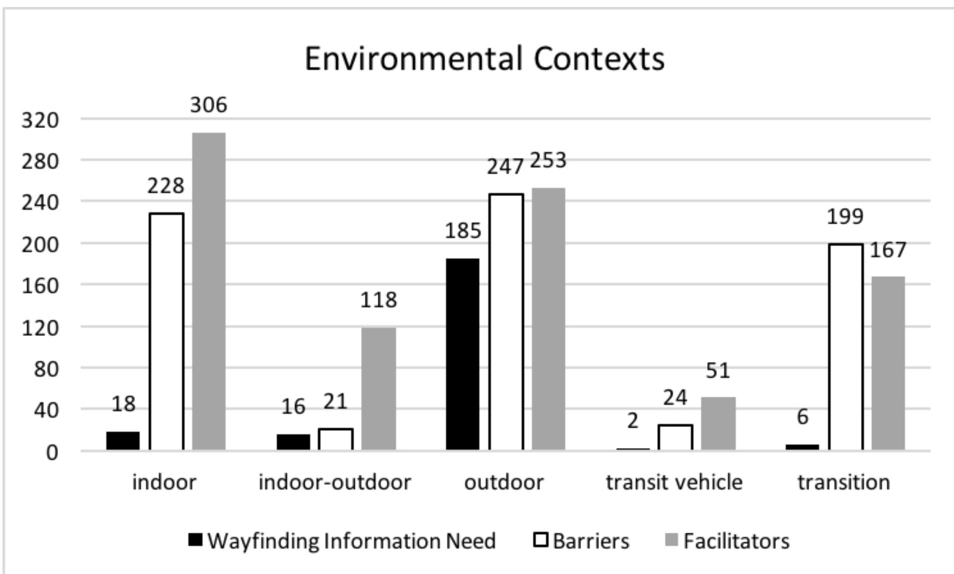
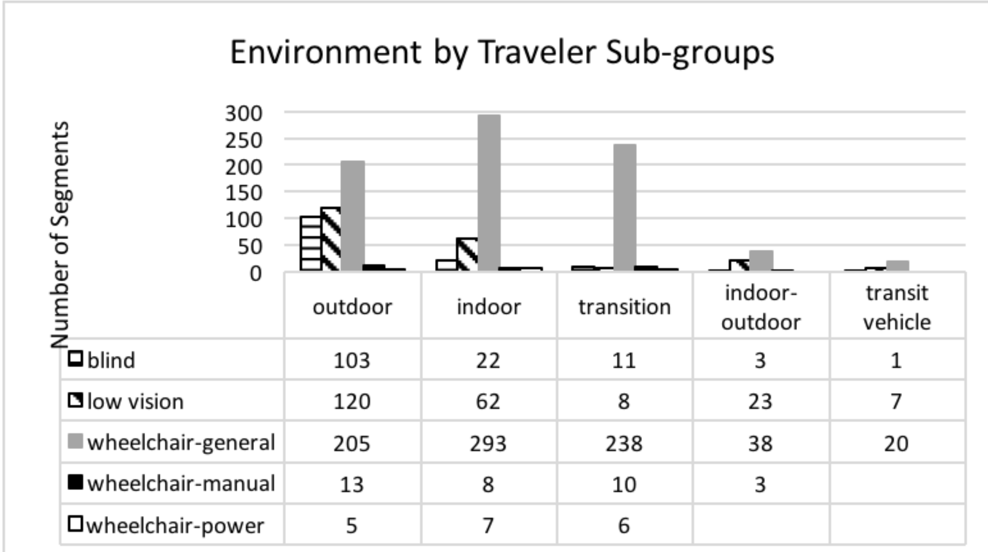


Figure 12 Environmental context for aspects of accessibility



	outdoor	indoor	transition	indoor-outdoor	transit vehicle
blind	103	22	11	3	1
low vision	120	62	8	23	7
wheelchair-general	205	293	238	38	20
wheelchair-manual	13	8	10	3	
wheelchair-power	5	7	6		

Figure 13 Environmental context by traveler group

5.2 DIMENSIONS OF INTEREST

This section presents the overall trends for each dimension of accessibility: wayfinding information needs, barriers and facilitators.

5.2.1 Wayfinding Information Needs

Wayfinding information needs collected include topics such as pedestrian path, public transit, information about routes and buildings. From the categories listed in Figure 14, the dominance of outdoor environments is clearer. The pedestrian path consists of the pathways constructed for pedestrians such as sidewalks or pedestrian bridges. For example, segment #12, from Chen et al.

(2015), indicates that information about obstacles along the sidewalk and the slope of the sidewalk are important types of information: “*the person with visual impairments should also be informed of obstacles on the sidewalks, and some special features and surface irregularities (e.g., a small sharp slope).*”

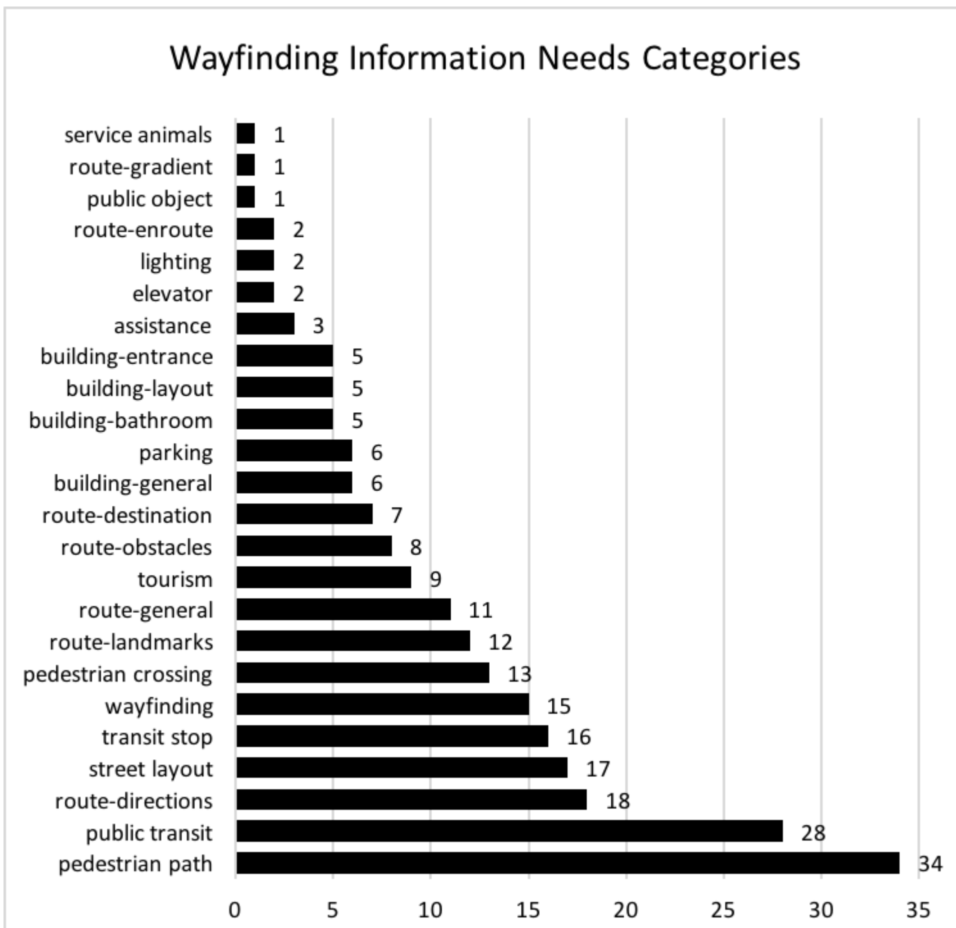


Figure 14 Wayfinding Information Needs

Public transit includes activities related to locating transit stops, and waiting for and boarding public transportation vehicles. Information about public transit can be as general as "*learning what transportation is available*" (Challenges Survey Segment #4) or as specific as "*Planning a safe route between the origin address and the nearest transit-stop or station; … Planning and following the best and safest route between the transit-stop or station and the final destination*" (Dialogue Segment #29). Information related to routes includes directions and landmarks along a route, and information about the destination or gradient along the route. One Survey respondent said, "*I'd use number of doors and braille signage if available*" (Challenges Survey Segment #44). This indicates that access to data about the number of doors along a route or the locations of braille signage ahead of time, could aid the wayfinding process.

Information about a building moves from the entrance of the building to the interior spaces like elevators and bathrooms. One survey respondent indicates that if building information was available in advance, they could use it to plan a route: "*It's hard to plan the indoor part of a route, since building information isn't usually available in advance*" (Challenges Survey Segment #32). In Menkens et al. (2010), "*ramps,* [and] *elevators*" (Menkens Segment #9) were found to be useful pieces of data for people who travel in wheelchairs. These examples illustrate the kinds of information needed about specific activities related to wayfinding and objects in the environment. Categories of wayfinding information needs identified for different travelers is shown in Figure 15.

The top four results overall (Figure 14), pedestrian path public transit, route directions, and street layout, do not align exactly with the top four results of any traveler subcategories. Given that the most wayfinding information needs were collected for the low-to-no-vision group, the top categories for people who are blind and people with low to no vision dominate the top four results overall. The only category in the top four for the wheelchair group is the pedestrian path. Other categories in the top four for this group are ‘tourism’, ‘parking’, and ‘building’. These reflect the fact that information related to planning a long distance trip, finding a parking space, and accessing a building may be the most important types of information this group seeks. Additionally, the results show that many wheelchair users use cars for transportation while people with low to no vision are more likely to be riders of public transit. The power wheelchair group did not have any wayfinding information needs and manual wheelchair users only had one in the category ‘assistance’. It is not shown in the graphic to conserve space in the legend.

Regarding the wayfinding information needs for the low-to-no-vision group, the top four categories of information indicated by people who are blind and people with low vision are not identical. Information related to step-by-step directions along a route and getting a sense of the street layout are common across the two sub-groups. Information about routes and wayfinding in general are needed by people who are blind, while using public transit and characteristics of the pedestrian path appear more relevant for people with low vision. Looking at the two overall groups, the wayfinding information needs expressed by people with low to no vision focus more on getting oriented in space while those collected for the wheelchair group are more focused on getting access to a location.

5.2.2 Barriers

Barriers to accessibility are hindrances to movement through a certain space or to completing a certain activity. Important categories of barriers collected include barriers at the entrances, along the pedestrian path, to accessing or using a service, and to indoor spaces like bathrooms (Figure 16). Two categories included more segments describing barriers than facilitators: interior doorway and outdoor space. One interpretation is the two main categories of barriers are entrances (which are similar to interior doorways) and pedestrian path (which is an outdoor space).

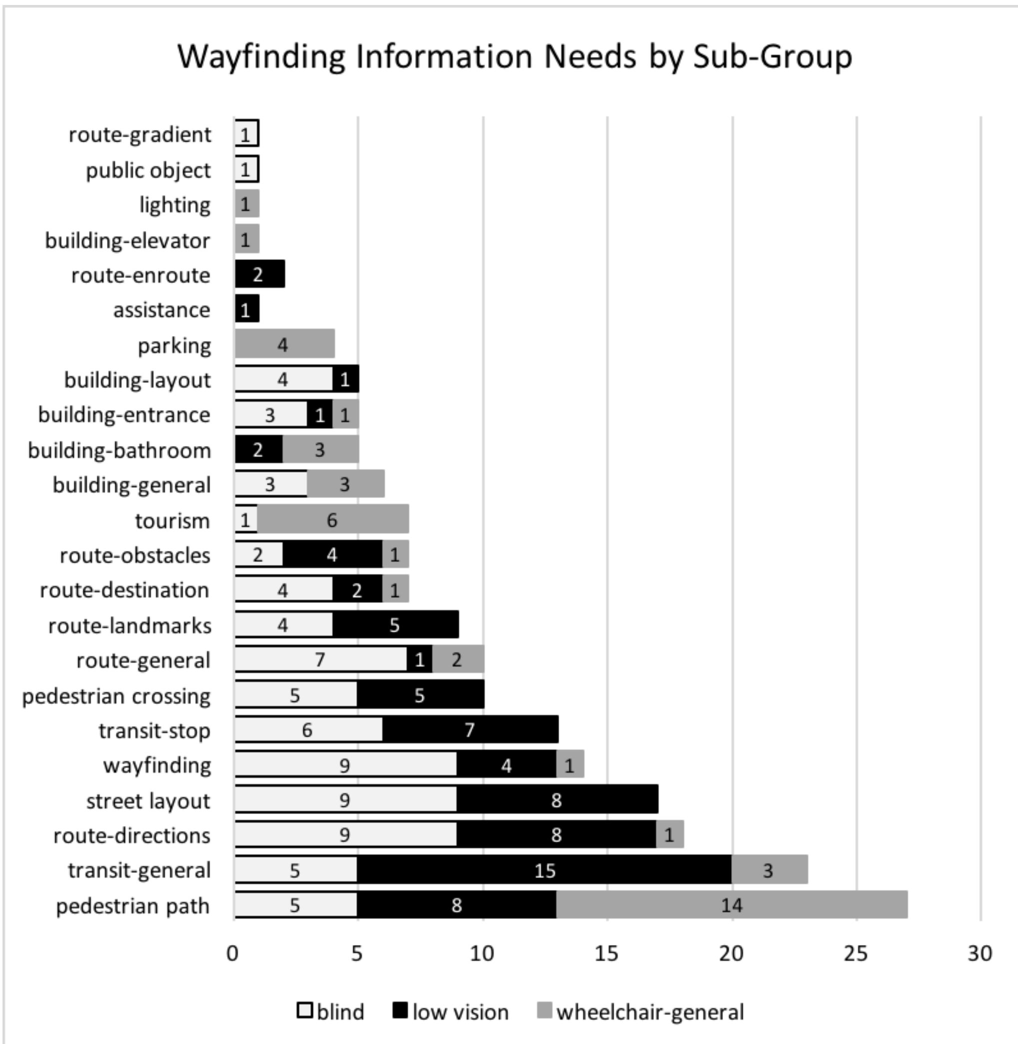


Figure 15 Wayfinding information needs by traveler sub-group

Stairs were a common barrier to entrances for both groups of travelers (

Table 23 and Table 24). "*Two sets of stairs to enter the building*" (OSM Segment #228). "*That the street entrance was not too complicated or had too many stairs (I mean stairs are ok, but you know, not a huge flight of stairs), not revolving glass doors that are always very difficult to negotiate as a vision impairment person*" (Packer08 Segment #9).

Segments in the dataset were twice as likely to describe barriers along the pedestrian path than facilitators. The maintenance of sidewalks and potential obstructions along the sidewalk are example barriers that affect both groups of travelers. For example, "*Uneven terrain and badly maintained sidewalks are difficult to travel over*" (Challenges Survey Segment #106). In the standard guidelines for accessibility in Ontario, potential barriers along the sidewalk are listed, *"[exterior paths of travel] Minimum clear width: The minimum 1,500 mm clear width must be free from any obstructions. Any obstructions such as advertising boards, planters and newspaper boxes must be placed outside of the pedestrian route to meet the minimum 1,500 mm clear width requirement*" (AODA Public Spaces Segment #36).

Barriers to a service include an inability to gain access to a building where the service is performed, move through the space once inside or access a public restroom. For example, "*Inside shops, many other problems are evident, for example, heavy doors, cluttered aisles, inaccessible shelves and narrow checkouts*" (Bromley Segment #11), or "*Accessible car park. But no accessible toilet facilities*" (OSM Segment #21).

Barriers in indoor spaces also affect both groups of travelers. One segment relevant for the wheelchair group focused on the ability to maneuver, "*the interior spacs were small*" (OSM Segment #48). For the low to no vision group, the design suggestion, "*They pointed out that* *protruding objects with sharp edges such as cabinet handles should be avoided*" (Kutintara Segment #1), implies that protruding objects that are undetectable may pose a danger to travelers via their sharp edges.

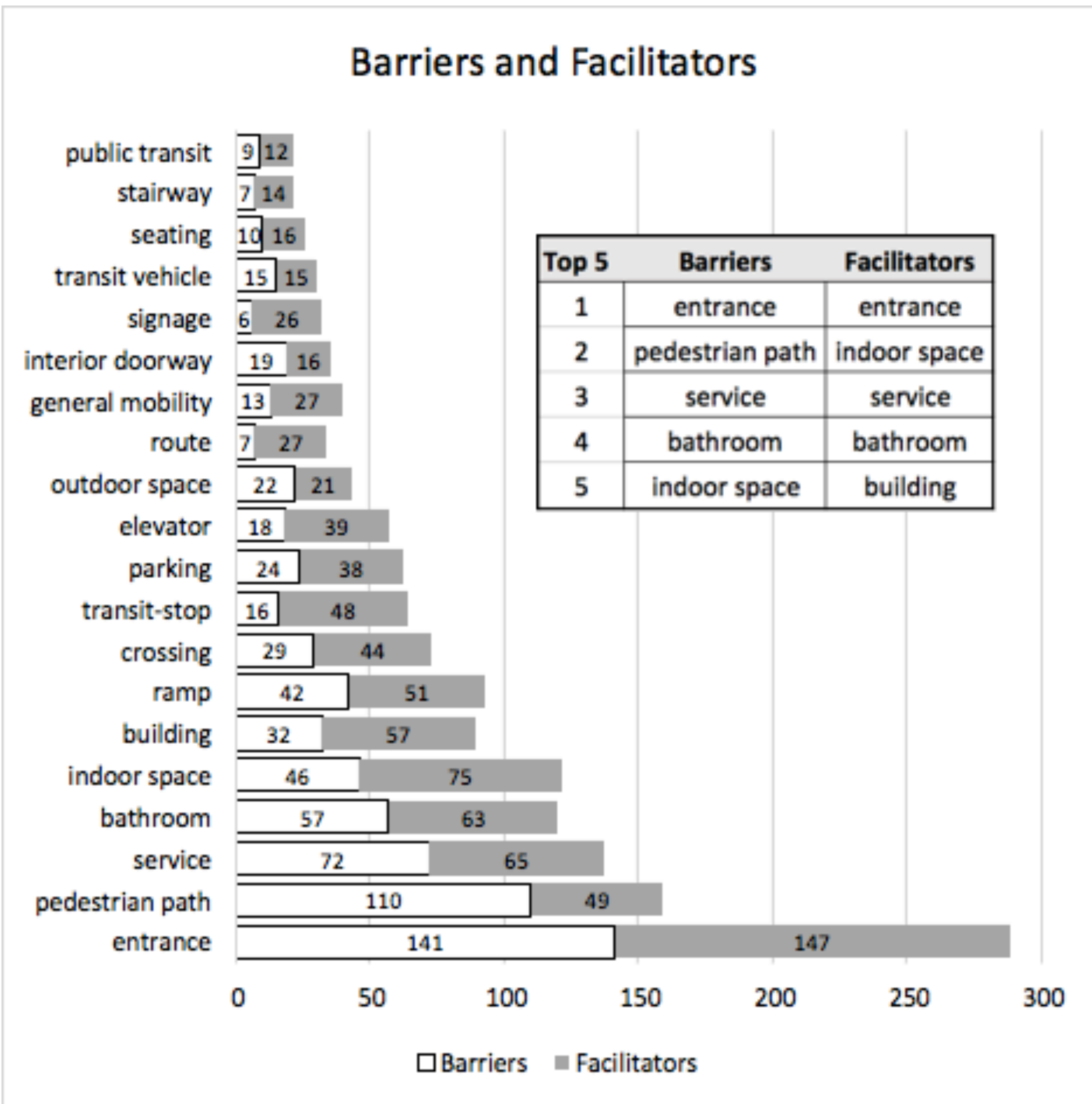


Figure 16 Barriers and Facilitators

Table 23 Barriers for low to no vision group subcategories

	blind		low vision (general)	
	Barrier	Facilitator	Barrier	Facilitator
pedestrian path	8	3	21	3
indoor space	3	7	4	14
outdoor space	10	9	3	5
crossing	3	2	7	5
route	5	4	2	6
transit stop	3	2	4	7
entrance	2	8	2	3
general mobility	1	2	3	9
signage			4	11
elevator			4	9
building	1	1	4	2
public transit	1		3	4
stairway			2	5
service			4	2
wayfinding	2	2	2	
bathroom		1	1	3
destination	3			
hallway			2	1
handrail				2
nighttime mobility			1	1
ramp			1	1
room			1	1
transit vehicle	1		1	
interior doorway				1
parking		1		
public object				1

For the wheelchair group, accessing bathroom facilities is a common barrier stemming from narrow doorways and poorly designed spaces. For example, "*Very small bathroom doorway not wide enough to enter*" (OSM Segment #230) and "*some restrooms do not come equipped with grab bars, the doorways are not wide enough, or the tub, toilet, and sink are too widely separated, so that she is constantly traveling across the room. Mike has found bathroom doors that swing the wrong way and toilets that are too high (making transfer difficult)*" (McClain98 Segment #15).

Table 24 Barriers and Facilitators by Sub-group

	wheelchair-general		wheelchair-manual		wheelchair-power	
	Barrier	Facilitator	Barrier	Facilitator	Barrier	Facilitator
entrance	125	94	3	4	3	2
service	65	62	1			
bathroom	55	36				1
building	23	50	1	2		1
pedestrian path	57	11	5	1	1	
indoor space	29	32	2	2	4	1
ramp	31	15	3	1	3	
parking	21	16	1			
interior doorway	16	10	1			1
crossing	13	9	1		1	
seating	9	13				
transit vehicle	10	10				
elevator	3	4				
transit stop	6	11				
general mobility	5	9				
outdoor space	4	3	1	2		1
hallway	3	2	1		1	
route	2	3				
public transit	1	2			2	
Nighttime mobility	2	2				
room	2	2				
public object		2	1			
handrail	1	1				
stairway		2				
signage	1					

5.2.3 Facilitators

Facilitators to accessibility enable movement through space or the completion of an activity. Important categories of facilitators collected include facilitators to entrances, indoor spaces, services, bathrooms, and buildings (Figure 16).

Entrances are also an important category for facilitators. Thapar (2004) reported and many OpenStreetMap contributors discussed automatic door openers and access via ramps. For example, "*The facilitators most often reported by the WC were automatic doors, lack of stairs at building entrances*" (Thapar Segment #8) and "*easy access via a ramp*" (OSM Segment #7).

The data included more instances of facilitators to indoor space than barriers to indoor space. Reid (2004) reported "*one person stated that having all the living space confined to one floor would be great*" (Reid Segment #7). While Nascimento et al. (2012) summarized that "*Some features that are considered highly important to ensure autonomy to the visually impaired, as Braille signs on doors indicating the apartment number and tactile floors that lead guests with visual impairments to the room, were not found in any of the hotels in the sample. This relevance was related by the people with visual impairment in interviews*" (Nascimento Segment #1).

Facilitators to a service were also an important category. One OSM contributor notes that "*Displays containing jewelry were a good height for visibility. Lots of floor space to maneuver a wheelchair*" (OSM Segment #105). Thus, the ability to maneuver within the store and to view the jewelry in the cases facilitated access for this traveler. One person with low to no vision expressed that having adequate light to view a menu at a restaurant enabled them to eat out at a restaurant, "*every night we went into the restaurant they provided one table with a light and* *candle light, they were extremely good and they expected nothing in return*" (Richards Segment #7).

Bathrooms are a necessity. Facilitators to bathroom use collected in the data include those listed by an OSM contributor, "*Washroom located within restaurant and is accessible with grab bar included. Sink/soap dispenser may be a big high, but room provided for wheelchair to slide underneath*" (OSM Segment #174). Standard guidelines like the ADA also provided technical requirements for facilitating access to "*[lavatories and sinks] 606.3 Height. Lavatories and sinks shall be installed with the front of the higher of the rim or counter surface 34 inches (865 mm) maximum above the finish floor or ground*" (ADA Ch.6 Segment #16).

The last group of facilitators that were frequently coded are facilitators to buildings. One OSM contributor listed two facilitators to a building, an automatic door and elevator, "*Automatic doors and elevator to access each floor*" (OSM Segment #237). In a study of travelers with low to no vision, "*Good lighting levels*" (Darcy Segment #23) were listed as a facilitator to traveling inside a building.

5.3 IMPORTANT ASPECTS OF ACCESSIBLE WAYFINDING

The discussions in Section 5.2 rely on the frequency of coding for each category in the three dimensions of interest, wayfinding information needs, barriers and facilitators. One goal of this chapter is to identify a set of important categories of accessibility for the two target groups. To achieve this, the frequency of coding is triangulated with other measures of the dataset. These important categories translate into fundamental objects in the environment that have varying degrees of accessibility. This means that people in the two target groups will want to access information about the object before travel (i.e., have a wayfinding information need) or describe accessibility of the environment relative to a barrier or a facilitator for accessing or using that object. In the dataset, data is coded into a set of dimensions or categories. Thus, the category stands in as a proxy for the object.

To assess if a category in our dataset is "important", three factors are considered in the triangulation: source, location and frequency. The source of segments included in a category are the datasets that have been collected and discussed above. If a category is described in several of these datasets, it may indicate that the category is an important topic for multiple groups including people describing their experiences, standards bodies and researchers. The locations that segments are relevant to are determined by the "Location" dimension of the coding frame. If a category is relevant to multiple locations, it may indicate that this category is related to accessibility in multiple areas of the world. The frequency of a category is measured by the number of segments that have been coded as having content relevant to that category. If a category has a high frequency of segments, it may indicate that it is a dominant category of discussion related to accessibility.

For each category of a dimension, the number of segments coded, the number of sources contributing segments, and the number of relevant locations are counted. For each measure, quartiles are calculated. If a data point is in the 75th percentile (in other words, the top 25% of the values), it is assigned a value of 1, otherwise it is assigned a value of 0. Once each measure has been counted and assigned a value of 0 or 1, the assigned values are summed for each category. If the total is 3, this means that the category is (1) present in several datasets, (2) discussed for several locations, and (3) is frequently mentioned overall. In this case, the category is considered *important*. This was done for categories in the wayfinding information need, barriers and facilitators dimensions.

An example illustrating the process for the wayfinding information needs relevant to people who travel in wheelchairs will be used. Table 25 shows the count of sources, locations and segments for wayfinding information needs categories relevant to people who travel in wheelchairs. The bottom of the table shows the inter-quartile range for each measure. The counts falling into the top 25% of the values (i.e., greater than or equal to Q3) are highlighted in bold text in the table.

Table 25 Count of important measures and quartiles.

Wayfinding Information Needs subcategories (Wheelchair Group)	Number of Sources	Number of Locations	Number of Segments
assistance	**1**	1	1
building-bathroom	**1**	**2**	**3**
building-elevator	**1**	1	1
building-entrance	**1**	1	1
building-general	**1**	**3**	**3**
lighting	**1**	1	1
parking	**1**	**3**	**4**
pedestrian path	**2**	**3**	**14**
public transit	**2**	**2**	**3**
route-destination	**1**	1	1
route-directions	**1**	1	1
route-general	**2**	**2**	2
route-obstacles	**1**	1	1
tourism	**1**	**2**	**6**
wayfinding	**1**	1	1
Q1	1	1	1
Q2 Median	1	1	1
Q3	1	2	3
Q4	2	3	14

In Table 26, for each measure, the categories falling into the top 25% of values are assigned the score of 1 and the others are given a value of 0. Bold text indicates a value lies in the top 25%. The row highlighted in grey is the beginning value for the top quartile. The values are then summed across each measure. Thus, important categories of wayfinding information needs for people who travel in wheelchairs are bathroom, building, parking, pedestrian paths, public transit and tourism.

Based on the analysis, Table 27 shows the important categories of wayfinding information needs, barriers and facilitators to accessibility for each target group. From the first glance, the two target groups require different kinds of information and experience barriers and facilitators in different ways. Regarding wayfinding information needs, the categories of importance to people with low to no vision, finding out about public transit options, getting route directions, and learning about the street layout, are more focused on getting oriented. For people who travel in wheelchairs, the categories related to buildings, parking options, the pedestrian path, public transit options, and tourism focus more on getting access to places. Information related to public transit was important for both groups.

Table 26 Scores with important categories highlighted.

Wayfinding Information Needs subcategories (Wheelchair Group)	Sources	Locations	Segments	Score
assistance	1	0	0	1
building-bathroom	**1**	**1**	**1**	**3**
building-elevator	1	0	0	1
building-entrance	1	0	0	1
building-general	**1**	**1**	**1**	**3**
lighting	1	0	0	1
parking	**1**	**1**	**1**	**3**
pedestrian path	**1**	**1**	**1**	**3**
public transit	**1**	**1**	**1**	**3**
route-destination	1	0	0	1
route-directions	1	0	0	1
route-general	1	1	0	2
route-obstacles	1	0	0	1
tourism	**1**	**1**	**1**	**3**
wayfinding	1	0	0	1

For people with low to no vision, more barriers were discussed in relation to indoor spaces and along pedestrian paths. These two categories are fairly general and only indicate that this group experiences barriers both indoor and outdoor, and the barriers outdoor are dominantly encountered along pedestrian paths. For people who travel in wheelchairs, more barriers were found in relation to bathrooms, entrances to buildings, indoor space, parking, ramps, and accessing services. These categories include more specific areas than those found for the other group. The pedestrian path was a category that includes barriers important to both groups.

Regarding facilitators, categories relevant for people with low to no vision are general mobility, indoor space, route and signage. Within these categories, the text describes facilitators to these objects and activities. This indicates that facilitators are needed to improve general mobility and to navigate indoor spaces and along routes and to interact with signage. In other words, to get oriented in space. Categories related to people who travel in wheelchairs were bathroom, building entrance, indoor space, parking, ramp, and service. These indicate that this group benefits from facilitators to accessing and using bathrooms, buildings, parking, and services. In other words, to gain access to specific spaces and objects in the environment.

Table 27 Important categories

Group >> Dimension	Low-to-No-Vision Group	Wheelchair Group	Across Groups
Wayfinding Information Needs	Public Transit Route Directions Street Layout Transit Stop	Bathroom Building Parking Pedestrian Path Public Transit Tourism	Public Transit
Barriers	Indoor Space Pedestrian Path	Building Entrance Pedestrian Path Ramp Service	Pedestrian Path
Facilitators	General Mobility Indoor Space Route Signage Pedestrian Crossing Transit Stop	Bathroom Building Entrance Indoor Space Ramp Service	Indoor Space
Within Groups (Barriers and Facilitators)	Indoor Space	Building Entrance Ramp Service	
Within Groups (All)	Routes Transit Stop	Buildings	

An overall theme for people with low to no vision is the route while for people who travel in wheelchairs, buildings are a central theme. Interestingly, public transit is an important piece of information needed by both groups but none of the important barrier or facilitator categories relate directly to public transit. This may indicate that accessing information about public transit is the biggest barrier to using public transportation. In the case of people with low to no vision, the types of information they need and the barriers and facilitators they encounter are not a one-to-one match. Whereas, for people who travel in wheelchairs, their wayfinding information needs correspond well to the barriers and facilitators encountered during travel. For example, information about bathrooms and parking may be required because facilitators are important to accessing these spaces while information about the pedestrian path may be required because the likelihood of encountering barriers along the pedestrian path is higher than other environments.

5.4 SUMMARY

This chapter presented the findings related to the first research question regarding important categories of accessibility for two groups of travelers. The first part of the chapter presented the context of the data collected and highlights the dominance of data relevant to North America, people who travel in wheelchairs and outdoor environments. This is useful for understanding the relevance of the insights offered in this chapter and the dissertation. The second section of the chapter discussed and illustrated, using samples from the dataset, important categories of wayfinding information needs, barriers and facilitators to accessibility. In this section, the focus of the wayfinding information needs of people with low to no vision on getting oriented vs people who travel in wheelchairs on getting access was presented. The last section of the chapter offers a set of important categories of accessibility by triangulating measures of the frequency of a category in the dataset, the number of locations in the world that a category was relevant to and the number of data sources that included segments for a category. The analysis found 12-15 important categories across the three dimensions of interest for each traveler group. Across the two traveler groups, public transit was found to be a common important category of wayfinding information, the pedestrian path was found to be an important barrier category and indoor space an important facilitator category. Perhaps the most important insight gained in this chapter is that people with low to no vision are more concerned with getting oriented in space while people who travel in wheelchairs require information related to physically accessing the environment. This implies that different kinds of wayfinding services may be required for each group of travelers or, at the very least, different kinds of information are important to each group.

6.0 THE VIEWS OF INFORMATION PROVIDERS

This chapter addresses RQ2: *How do different information providers (i.e., researchers, people in participatory research or online, and standards bodies) describe accessibility?* This chapter introduces three views on accessibility, namely those of everyday people moving through space, researchers studying accessibility, and standards bodies creating standard guidelines for accessibility. The gaps identified between each view are highlighted and discussed.

6.1 VIEWS ON ACCESSIBILITY

There are three main views on accessibility today and each of these are represented in the dataset. The term ‘view’ is used to mean “a particular manner or way of considering or regarding a subject; an opinion, idea, or theory formed by reflection or study” (Oxford English Dictionary 2017, *view, n. definition 14a*). The first view is from the perspective of everyday people and people with disabilities who move through space and encounter challenges or aids to mobility within the environment. The second view is the that of researchers in various fields studying accessibility and reporting their findings. The last view under study is from the perspective of standards bodies who create accessibility guidelines in line with national or provincial accessibility legislation. In this chapter, the view of each group on accessibility is estimated by the language they use, their support for this dissertation's traveler groups, and the barriers and facilitators to accessibility they highlight.

6.1.1 Everyday people experiencing accessibility

Everyday people experiencing accessibility could be people with disabilities, their carers, or other currently non-disabled people who make observations about accessibility and share their observations in their own words. In the data, this view is represented by segments of text categorized as 'member', 'person with a disability' or 'comment made online at a public website' within the Source of Evidence dimension. These segments of text include direct quotes taken from their public online comments (74%), research literature (15%) or their responses to one of the surveys (11%).

6.1.2 Researchers studying accessibility

Researchers studying accessibility are people studying in the fields discussed in Section 2.4 in Chapter 2.0 . They include people designing and implementing wayfinding and navigation or tourism services/tools and people studying architectural barriers, everyday participation in society, or tourism practices. In the data, this view is represented by segments of text categorized as 'wayfinding professional', 'access professional', 'tourism professional', 'interview', 'observation' or 'survey' within the Source of Evidence dimension. The category 'survey' here which applies to surveys conducted by and reported by researchers in the Literature dataset is distinct from the 'Survey' dataset which includes the Technology and Challenges Surveys. These segments of text are the summary of the findings of interviews with, observations of or surveys of people with disabilities or the results of other analysis conducted by the researcher. These segments of text do not include direct quotations, they are summarizations or conclusions almost exclusively (99%) taken from the Literature. These are considered researchers words because they are summarizing the findings considering their research questions or aggregating the voices of the people they interacted with during their study.

6.1.3 Standards bodies creating guidelines

Standards bodies creating standard guidelines include appointed boards of individuals who are serving a governmental role in designing policies that promote and enforce accessibility legislation. Standard guidelines were collected from four different countries (Table 1). Standard guidelines related to the built environment include: the Americans with Disabilities Act Accessibility Guidelines (ADA.AG 2010) and Public Rights of Way Guidelines (ADA.PROW 2011), the Accessibility for Ontarians with Disabilities Act Design of Public Spaces Standard (AODA.DPSS 2014) and the Australian Disability Discrimination Act Access to Premises-Buildings (DDA.AP-B 2013). Standard guidelines related to transportation include: the Australian Disability Discrimination Act Accessible Public Transport (DDA.APT 2011), the Accessibility for Ontarians with Disabilities Act Transportation Standard (AODA.TS 2014), and the Americans with Disabilities Act Accessibility Guidelines (ADA.AG 2010). Lastly, the standard guideline related to services is the United Kingdom's Equality Act Code of Practice on Services (EA.CPS 2011). In the dataset, this view is represented by segments of text categorized as 'standard' within the Source of Evidence dimension. These segments of text are collected exclusively (100%) from the Standards dataset.

6.2 LANGUAGE USED TO DISCUSS ACCESSIBILITY

One way to look at these different views on accessibility is to examine the language used in the segments of text coded for barriers and facilitators. Segments of text with any code under the 'Barriers' or 'Facilitators' dimension were collected for each view. The number of segments are shown in Table 28. Word frequencies were calculated for the top 100 words (with four or more characters) expressed by each view. It is no surprise that the term 'accessible' or 'access' appeared in the top four terms for all views.

Several figures below show a graphical display of these words for each view using a word cloud. Logically, the term 'participation' is found in the top 10 terms and the term 'reported' is in the top 20 terms for the Researcher view (Figure 17) 28. The Researcher view includes a few terms related to compliance, e.g., 'required', 'accommodate' and 'adequate', but the People view (Figure 18) does not include these kinds of terms. The top 30% of terms in the Standard view (Figure 19) include terms associated with compliance such as 'minimum', 'must', 'provided', 'maximum', 'comply' and 'least'.

A full fifth of the top 100 terms for each view are terms related to objects or spaces in the environment. For example, 'ramp', 'door', 'route', and 'street' appear in the top 41 terms across all views. The terms ramp and door are very common words appearing in the top five terms in most views. The activity 'travel' also appeared in all views.

Many terms in all views related to measurement. One important difference in language use is the terms used to describe measurements of the built environment. Predictably, terms of measurement used in standard guidelines are quantitative values, for example 'inches', 'percent', 'length', 'depth' and 'diameter', or associated with compliance, e.g., 'within'. On the contrary, measurement terms expressed by both People and Researchers were mainly qualitative values like ‘large’, ‘enough’, ‘high’, or ‘wide’. Terms unique to People included ‘narrow’ and ‘small’ and those unique to Researchers included ‘distance’ and ‘uneven’. Table 28 shows the percentage of segments of text shared by each information provider that include a quantitative measure like ‘36 in’ or ‘190 mm’. Standards bodies use many more quantitative measures (52%) than the other two groups (<10%).

	Researchers	Term frequency
1	**accessible**	**97**
2	**wheelchair**	**83**
3	**ramps**	**83**
4	**doors**	**55**
5	**sidewalk**	**51**
6	participation	49
7	spaces	47
8	pedestrian	44
9	curbs	39
10	entrance	36
11	crossing	36
12	building	36
13	barriers	33
14	people	33
15	reported	32
16	surface	29
17	travel	29
18	streets	28
19	person	27
20	area	27

Figure 17 Terms used by researchers

	People	Term frequency
1	**door**	**183**
2	**accessible**	**166**
3	**wheelchair**	**116**
4	**entrance**	**104**
5	**ramp**	**96**
6	steps	72
7	wide	60
8	bathroom	55
9	automatic	50
10	building	47
11	open	46
12	parking	45
13	space	44
14	floor	41
15	narrow	40
16	room	39
17	toilet	39
18	stop	39
19	pedestrian	38
20	high	37

Figure 18 Terms used by people

	Standards	Term frequency
1	**minimum**	**223**
2	**space**	**221**
3	**inches**	**214**
4	**access**	**197**
5	**ramps**	**186**
6	surface	186
7	pedestrian	154
8	must	152
9	provided	128
10	curb	115
11	doors	107
12	maximum	100
13	floor	96
14	clear	89
15	width	82
16	characters	81
17	ground	75
18	cross	75
19	sides	71
20	transitions	71

Figure 19 Terms used by standards bodies

One explanation is that standards bodies are mandated to define the ideal case for accessibility to ensure equal rights for people with disabilities in many avenues of life and for compliance in the construction and rehabilitation of buildings. People who engage in participant research or share their experiences online describe the real conditions of accessibility that tey encounter within the environment. In between these two views, Researchers engage with people to understand their needs and share their experiences with others and assess environments using accessibility checklists to ascertain the achievement of ideal conditions of accessibility. This indicates a fundamental difference in the goals of each information provider. The standards bodies are tasked to *define* the ideal conditions for accessibility while people and researchers *describe* the real conditions of accessibility.

Table 28 Percent of quantitative values used in text

View	Total segments	Segments with quantitative values (% of total data)
People	645	31 (5%)
Researchers	375	22 (6%)
Standards bodies	358	186 (52%)

A final set of terms found within each view are terms associated with hindering or enabling access to the environment. There are no terms that cross all three views, but there are terms that overlap between two categories. For example, the term ‘clear’ was present in both the Standard and Researcher view and the terms ‘automatic’, ‘difficult’, ‘need’, ‘easy’, ‘able’, ‘always’, and ‘good’ were present in both the People and Researcher views. Terms unique to the Researcher view were ‘barrier’, ‘lack’, ‘poor’, ‘allow’, ‘without’, and ‘absence’. People uniquely used the terms ‘steep’, ‘safe’, ‘busy’, and ‘available’. Lastly, terms unique to the Standard view included ‘reach’, ‘raised’, and ‘contrast’.

The distribution and kinds of terms can give insight into the locus of attention of each view regarding accessibility. The Standard view clearly emphasizes compliance and detailed measurements but does not frequently use terms associated with mobility directly. The People view emphasises objects in the environment and uses common language to describe measurement and hindering and enabling situations. The Researcher view balances between the other two view with some frequent terms related to compliance and others relating to hindering and enabling situations.

6.3 TRAVELERS SUPPORTED BY EACH VIEW

Another useful examination is the traveler groups that each view discusses. As presented in Chapter 5.0 , there are several subgroup categories under the Traveler dimension. Table 29 shows these subgroups and the proportion of segments representing each view. Both the People and Researcher views include more descriptions of barriers than facilitators while the Standard view includes nine times more descriptions of facilitators than barriers. Thus, the distribution of facilitator descriptions is more balanced across the three views.

Table 29 Traveler subgroups and views on accessibility

	Barriers				Facilitators		
Traveler Subgroup	**PEOPLE**	**RESEARCH**	**STANDARD**		**PEOPLE**	**RESEARCH**	**STANDARD**
People who are blind	28 (7%)	16 (6%)	0		32 (9%)	9 (5%)	0
People with low vision	21 (5%)	51 (20%)	7 (18%)		25 (7%)	47 (26%)	32 (9%)
General wheelchair users	345 (81%)	145 (57%)	6 (16%)		289 (78%)	81 (45%)	30 (9%)
Manual wheelchair users	13 (3%)	9 (3%)	0		8 (2%)	3 (2%)	0
Power wheelchair users	12 (3%)	3 (1%)	0		7 (2%)	0	0
Target groups	6 (1%)	32 (13%)	25 (66%)		9 (2%)	40 (22%)	283 (82%)
Total	**425**	**256**	**38**		**370**	**180**	**345**

The first clear indication is the fact that at least 60% of the text associated with the standards could not be categorized into one of the traveler subcategories. This implies that standard guidelines cannot provide adequate context for understanding specific aspects of accessibility for the subgroups. One explanation of this is the influence of universal design practice in the design of standard guidelines which ensures that services and building construction are 'universally' accessible to a large range of individuals. Those segments that do have context are fairly balanced across both main groups. The largest group supported by the standard guidelines are the category target group. This category was added because most of the standard guidelines do not delineate a subgroup. This means that standard guidelines need to be combined with other sources of information to adequately conceptualize accessibility for specific subgroups.

The Researcher view described more barriers and facilitators for people who travel in wheelchairs. Over 25% of the texts included information related to people with low to no vision and a non-insignificant amount of texts could not be coded into one subcategory. One advantage of the researcher as information provider is the fact that they often include people with disabilities as participants in their research. This is important for understanding the priorities of the specific subgroups. Chapter 5.0 showed that there are some categories of barriers and facilitators that are more important or influential to accessibility than others. This knowledge can be leveraged to prioritize data collection for those aspects of the built environment and to design services that meet the current priorities of travelers.

The view of People is critical for understanding the current conditions of accessibility. While we can get a sense of this reality by studying existing research, capturing the experience of accessibility in the words of a person who has experienced it is far more powerful. Looking at the data shared by the people view, the main subgroup for both barrier and facilitator descriptions are general wheelchair users. This may be explained by the influence of the OpenStreetMap dataset which is the second largest dataset and is exclusively about wheelchair users. This dataset only contributes to the People view. After removing the influence of this dataset, people who travel in wheelchairs are still the dominant subcategory for barriers but the low to no vision group become the dominant category for facilitators. Overall, the People view, minus the influence of the OpenStreetMap dataset, has a balanced set of data across the blind, low vision and wheelchair general categories in both barrier and facilitator descriptions.

Segments written from the Standard view focused heavily on compliance and detailed measurements, segments written or spoken from the People view use words that describe hindering or enabling situations and focus more on objects in the environment and lastly, the Researcher view lies between the other views by emphasizing compliance but also hindering and enabling situations.

6.4 BARRIERS AND FACILITATORS IDENTIFIED

A final way to look at the differences between each view is to survey the categories of barriers and facilitators that each view includes. In Chapter 5.0 , a set of important categories for the two Traveler groups were derived. In the barrier dimension, one category – pedestrian path – was important to both groups. Table 30 shows the most five most common barrier and facilitator categories across each view; in the table bold=across groups top5; underline=people+research top5; italics=relation to standard top5; *=20-30%; CAPS=within group across BF. The 'pedestrian path' category is within the top 5 most common categories for all three views. For the Research and Standard views, the 'pedestrian path' category is 20-30% of the total text segments. Within the low-to-no-vision group, there was an additional important category – 'indoor space'. For both the People and Research views, 'indoor space' was in the top 5 common categories. Within the wheelchair group, the categories ‘entrance’, ‘ramp’ and ‘service’ were also important. In Table 30 the ‘entrance’ category is very common among all three views. Additionally, the ‘ramp’ category is common for the Standard and Researcher views while the ‘service’ category is common for the People and Researcher views. Overall, the Research view provides the most complete coverage of both traveler groups.

Table 30 Barrier and facilitator categories

Barriers (n=719)			Facilitators (n=895)		
PEOPLE	RESEARCH	STANDARD	PEOPLE	RESEARCH	STANDARD
ENTRANCE*	**Pedestrian path***	**PEDESTRIAN PATH***	*ENTRANCE**	INDOOR SPACE	RAMP
SERVICE	**entrance**	**ENTRANCE**	SERVICE	general mobility	ELEVATOR
BATHROOM	service	stairway	INDOOR SPACE	building	*ENTRANCE*
pedestrian path	INDOOR SPACE	*RAMP*	building	*pedestrian path*	*PEDESTRIAN PATH*
INDOOR SPACE	*ramp*	ELEVATOR	BATHROOM	parking	crossing

In the facilitator dimension, one category – ‘indoor space’ – was important to both groups. In the case of the three views, only the People and Research views commonly discussed facilitators to ‘indoor space’. One explanation of this is that the standard guidelines use language that is more specific than the other two views, thus facilitators related to indoor space are discussed but it may be discussed about specific objects in indoor space like elevators or stairways. For the low-to-no-vision group, the categories ‘general mobility’, ‘route’, ‘signage’, ‘crossing’ and ‘transit stop’ were also important. ‘General mobility’ is a common category for the Research view and the ‘crossing’ is common in the Standard view. For the wheelchair group, in addition to ‘indoor space’, the categories ‘bathroom’, ‘entrance’, ‘ramp’ and ‘service’ were important. The ‘entrance’ category is common in both the People and Standard views. Other common categories in the People view include ‘service’ and ‘bathroom’. The Standard view also includes the category ‘ramp’. In the case of facilitators, the People view provides the most comprehensive coverage of important categories of accessibility for both traveler groups.

6.5 IMPACT ON CONCEPTUALIZING ACCESSIBILITY IN CONTEXT OF WAYFINDING

The investigation of different views on accessibility has provided several insights relevant for conceptualizing accessibility in the context of wayfinding. First, the use of qualitative versus quantitative language to describe barriers and facilitators represents a gap in how the measurement of accessibility is described by different views. People and Researchers offer descriptions of the true case of accessibility, however, if these descriptions are to be used in a more universal conceptualization applied to multiple destinations and to multiple locations within the world, a more objective measurement of these conditions is necessary. By utilizing the quantitative definitions of the ideal case for accessibility given in standard guidelines to aid in defining the qualitative descriptions provided by the other views, a more universal conceptualization of accessibility can be generated. This may ensure its applicability to individual destinations and to different areas of the world.

The second insight relates to the inability of standard guidelines to adequately define accessibility for specific subgroups of people with disabilities. Information provided by people and researchers are more suitable for conceptualizing which parts of the built environment are a priority for ensuring access. The lack of context for individual subgroups represents a gap within the standard guidelines that can be filled by using the categories of accessibility designated as important by people and researchers to extract relevant content from the standard guidelines and attaching it to priority categories for each group.

A final insight relates to the emphasis that each view places on accessibility in orienting in space versus accessing space. In the analysis of the top barriers and facilitators identified by the different views, we see the influence of the different goals of each main group of travelers that was presented in Chapter 5.0 . People and researchers described categories of barriers and facilitators that center on orienting within the environment for people with low to no vision and accessing spaces for people who travel in wheelchairs while standard guidelines tend to prioritize categories related to accessing spaces. This implies that they have a stronger emphasis on supporting people who travel in wheelchairs. Lastly, the emphasis on orienting barriers and facilitators like indoor space and general mobility by people and researchers make their contributions central to a conceptualization of accessibility that centers on the activity of wayfinding.

6.6 SUMMARY

This chapter presented the findings related to the second research question: Is there a gap between the barriers and facilitators to mobility described by different information providers (i.e., researchers, people in participatory research and online, and standard guidelines)? Three views on accessibility were introduced and discussed using three explorations of the dataset. The views are those of everyday people moving the environment, researchers studying accessibility and standards bodies creating standard guidelines. An exploration of the language used by different views revealed a gap in the terms used to describe measurements of accessibility in which people and researchers used qualitative measurement terms while standard guidelines dominantly defined accessibility using quantitative terms of measurement. A second exploration of travelers represented by each view showed a concentration of segments describing barriers to accessibility for people who use wheelchairs in both the People and Researcher views and facilitators to accessibility in the Researcher view. Facilitators described in the People view showed a concentration on people with low to no vision, once the influence of the OpenStreetMap dataset was removed. The most significant insight gained is that that Standard view lacked traveler context for over 60% of both barriers and facilitators described. In the final exploration of barriers and facilitators discussed by each view, the Research view provided the most comprehensive coverage of important barriers for both traveler groups and the People view was more comprehensive for the facilitators.

Ultimately, for a comprehensive view on conceptualizing accessibility, we need people's real experiences to give priority to important characteristics of the environment and to ensure that a conceptualization of accessibility is comparable across specific locations quantitative measures available through the standard view on accessibility is necessary. Lastly, the perspectives of people and researchers are the only views that can provide insights into what is necessary for conceptualizing accessibility in the context of wayfinding.

7.0 ONTOLOGY OF ACCESSIBILITY IN THE CONTEXT OF WAYFINDING

As defined in Section 2.5, a geo-ontology is an explicit conception of a shared reality that describes what a system, situation, or process *is*, derived from semantic analysis of a geographic domain, that can be translated into a specification for an information system. The ontology designed in this dissertation is concerned with the process of accessible wayfinding and is based on an analysis of accessibility in everyday environmental spaces.

The ontology includes three types of entities and four types of relations. Entities include the ***travelers***, ***objects*** in the built environment, and ***actions*** performed in the environment during wayfinding. Relations include <is-a> (class relation), <has-component> and <involved-in> (both part-whole relations), <intersects> and <connects-to> (spatial relations) and <enables> and <hinders> (mobility relations). A total of 1605 segments of text were coded during the knowledge acquisition phase; 719 segments included descriptions of “Barriers”, 895 segments described “Facilitators” and 287 described “Actions” in the environment (see Chapter 4.0). All the segments included a designation of the traveler discussed in the text (see Chapter 5.0). The remainder of the chapter introduces the entities, their properties and relations captured in the ontology.

7.1 TRAVELERS

There are many different types of traveler. In this study, there are two travelers of interest that correspond to the two target groups under study, *people with low to no vision* and *people who travel in wheelchairs*. These are the two concepts related to travelers in the ontology. The level of vision (e.g., total blindness, low vision) and type of wheelchair (manual, power) are recorded as attributes. A ***person with low to no vision*** can be a *person who is blind* or a *person with low vision* and can utilize assistive technology to perceive the environment like a guide dog or a white cane. A ***person who is blind*** is considered to have no, or very little, vision. A ***person with low vision*** retains some level of vision from a designation of legally blind to the ability to distinguish shapes. A ***person who travels in a wheelchair*** can be a *person who travels in a manual wheelchair* or a *person who travels in a power wheelchair* and spends some of their daily life using a wheelchair. A ***person who travels in a manual wheelchair*** propels the wheelchair manually with their own strength and bodyweight. A person who travels in a power wheelchair uses a control to manipulate the motor of the wheelchair for propulsion. Both people who travel in wheelchairs and people with low to no vision perform the following actions: *go to destination*, *cross the street*, *use public transit*, *access a building*, and *access a service*.

7.2 OBJECTS IN THE ENVIRONMENT

Objects in the built environment are found in structures (indoor) and on landscapes (outdoor). These objects are recognizable to most people because they are in the spaces in which we live our lives. The objects found in indoor and outdoor settings are listed and described below. The environmental objects include the 16 initial objects found during the requirements gathering and embedded in the competency questions. A total of 48 environmental objects were identified and conceptualized. One additional consideration is that the objects conceptualized in the ontology represent typical cases; a-typical cases are not included in the ontology. An example of an atypical environmental object is an elevator that opens to the outside instead of inside. We assume that all elevators open into indoor spaces in the ontology.

7.2.1 Indoor spaces

Indoor spaces are defined by the presence of four walls and a roof. Figure 20 depicts objects in indoor spaces and their relations. The prototypical indoor space is a *building*. A ***building*** is a built structure that has at least one *room* and an *entrance*. *Buildings* include several components: *rooms*, *hallways*, *elevators*, and *stairways*. *Buildings* can be a *destination* and can be for specific purposes such as a *transit station* or a *parking structure*. A ***room*** is a four-walled structure within a *building* that has a *doorway* that can be an indoor *destination*. A *doorway* is a passage between two spaces and is a central feature of any indoor space.

Rooms generally have ***items***, which are objects in a room that can be picked up, and ***aisles***, or walkways created within the open space of a room. ***Hallways*** form a network of passages constructed from the walls of a *building* that connect to one or more *rooms* via *doorways*. Some *hallways* have ***ramps*** which are sloped floors that provide a transition from one level to another within a *building* or allow passage through a *doorway*. *Ramps* are often accompanied by *handrails*. A ***handrail*** is a railing that can be used to maintain balance when using *ramps* or *stairs*. Most *buildings* include ***stairways*** which serve as vertical spaces that include *steps* and *handrails* and provide a transition from one level to another within a *building* usually via a *doorway*. A ***step***, the core component of a *stairway*, is a platform that is risen above the floor with a hard surface. Some *buildings* include other vertical spaces like ***elevators*** or mechanized cars that can travel vertically between levels of a *building*. *Elevators* have a *doorway*, a ***call button*** to request the car and a ***call signal*** to alert a rider when the car arrives.

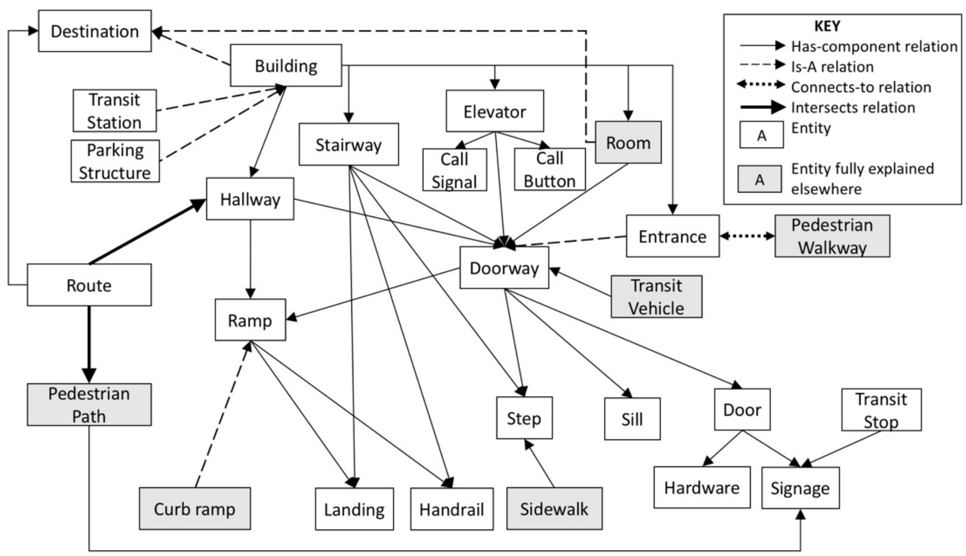


Figure 20 Objects in indoor and transition space

7.2.2 Transition spaces

Transition space involves moving from one entity to another through a *doorway*. A *traveler* can transition within indoor space and from indoor to outdoor (and vice versa). In indoor space, a *traveler* can move from one *room* to another in a *building*, move from the *hallway* into an *elevator* or *stairway*, or board a *transit vehicle* in a *transit station*. In the transition between indoor and outdoor space, a *traveler* can move from a *building* to the *sidewalk*, or deboard a *transit vehicle* onto the *sidewalk*. The central component of a transition space, and of indoor spaces in general, is the *doorway* (Figure 20). A ***doorway*** is a passage between two spaces that includes a ***sill***, or lip along the floor of *doorway*, and can include a *door*, *ramp* and/or one or more *steps*. A ***door*** is a movable sheet in a *doorway* that when closed becomes part of a wall. *Doors* are equipped with *signage* identifying the spaces surrounding the *door* and *hardware* that afford opening, closing, and locking the *door* in place. ***Hardware*** are devices that afford grasping and manipulating an item. A ***sign*** is an item of communication that utilizes visual, audio or tactile features. ***Entrances*** are a special kind of *doorway,* thus inheriting all the components and characteristics of a doorway, that connects indoor and outdoor spaces by connecting a *building* to a *pedestrian walkway*.

7.2.3 Spaces of Public Transit

Transit spaces connect indoor and outdoor space. *Transit stops* and *transit vehicles* are the two main types of transit spaces (Figure 21). ***Transit stops*** are locations where pedestrian *travelers* can connect-to and catch a *transit vehicle* and often serve as conduits to a public transportation system. *Transit stops* can be indoor spaces like *transit stations* or in outdoor space on the *sidewalk*. Outdoor *transit stops* generally intersect with the *sidewalk* and are demarcated by a *sign* while others include a more visible indicator like a shelter in addition to the *sign*. ***Transit stations***, a kind of *transit stop* and *building*, are indoor spaces and thus inherit many of the characteristics of indoor space. As a kind of *transit stop*, *transit stations* inherit connections-to *transit vehicles* and the *sidewalk* while as a special kind of *building* they inherit the components and characteristics of a *building*. ***Transit vehicles*** are moving vehicles, like a bus, that can be defined as a special kind of *room* that moves *travelers* through space. *Transit vehicles* inherit the components *doorway*, *aisle* and *items* from the *room* entity but also include *seating*. *Transit vehicles* connect-to *transit stops* to pick up *travelers*.

7.2.4 Outdoor spaces

Outdoor spaces make up most of the Earth and urban outdoor spaces are a common focus of wayfinding activities. Moving from *buildings* to *transit stops* or parking areas and using *pedestrian paths* to walk from place to place are common activities performed in outdoor space. The ***street***, the most common built space outdoors, is a paved surface that affords vehicular travel, <has> *street parking spaces*, *parking lots*, and *crosswalks* and <connects-to> *pedestrian paths*. **Pedestrian paths** are outdoor pathways for pedestrian traffic, <like> *pedestrian walkways*, *tunnels* and *bridges*, *trails*, and the *sidewalk*. Pedestrian paths often <have> *signs* to orient *travelers* and aid in decision making along the *route* to the *destination*. A ***pedestrian walkway*** <is-a> *pedestrian path* that <connects> the *entrance* of a *building* to the *sidewalk*.

A central component of outdoor built spaces is the *sidewalk*. The ***sidewalk*** is a constructed space <connected-to> a *street* that affords walking/propelling. *Sidewalks* <have a> *curb*, and <can include> *steps*, a *curb* and sometimes a special kind of *ramp*, the *curb ramp*. A *curb* is the edge of a *sidewalk* where the *sidewalk* connects-to the *street*. The transition from the *sidewalk* to the *street* (and vice versa) includes one *step* either onto the *sidewalk* or down to the *street*. To aid this transition, some sidewalks <have a> ***curb ramp*** which is a sloped floor that provides a smooth transition between the *sidewalk* and the *street* within a *pedestrian crossing*. A ***pedestrian crossing*** is an area of the *sidewalk* near the intersection of two or more streets that <has> a *crossing signal*, *crossing button* and a *crosswalk* and <can include> a *curb ramp*. A ***crossing signal*** is a device that alerts a *traveler* using visual, audio, and tactile communication that it is safe to cross a *street*. A ***crosswalk*** is the <part-of> a *street* that affords safe crossing from one *curb* to another.

The final set of environmental objects are those related directly to wayfinding, routes and destinations. A ***route*** **<**has> a *destination*, *landmarks* and *obstacles* and <intersects> with a *pedestrian path* or *hallway* to link a *traveler's* origin to the desired *destination*. A ***destination*** is <part-of> a *route* and is a location that a traveler desires or needs to reach to access a service.

A ***landmark*** is a salient characteristic, <like> an *audio*, *tactile*, *olfactory*, or *visual cue*, of the surrounding environment used by a *traveler* to orient themselves along a *route*. Finally, an ***obstacle*** is any item or condition that that blocks passage along a *route*.

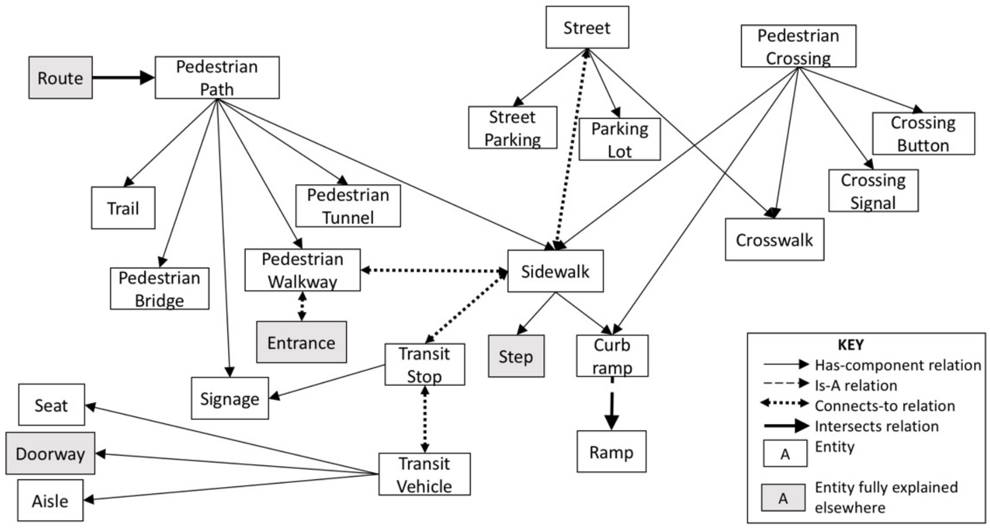


Figure 21 Objects of in transit and outdoor space

7.3 ACTIONS

Travelers move in space to achieve their daily goals or needs and during this movement travelers complete specific actions. Several of the environmental categories represent activities, such as 'general mobility' or 'wayfinding', and spaces, such as 'indoor space' and 'outdoor space'. The actions described for these categories were added to the specific environmental objects they described. For example, many of the actions found for 'indoor space' were relevant to the objects 'building' or 'room'; thus, these actions were assigned to 'building' or 'room' categories and the category 'indoor space' was no longer used.

A total of 272 actions were identified for 25 environmental categories. Next, the extracted actions and environmental categories were reviewed and reduced to 16 environmental objects and 111 actions. After further aggregating five top level actions were identified and their subordinate actions were organized into a hierarchy. Two top actions, *go to destination* and *access service*, were identified as common activities for everyday travel. The activity *go to a destination* (Figure 22) involves the subordinate activities *use public transit* (Figure 23) and *cross the street* (Figure 24). The activity *access service* (Figure 25) requires the *access a building* (Figure 26) and *go to destination* activities. Each top level action will be describe below.

7.3.1 Go to a destination

One common wayfinding goal is to *go to a destination*. Destinations can be known like going to work or the grocery store or unknown like going to a new cinema to watch a movie or visiting a new doctor's office. If a traveler wants to go to a destination, first they must *proceed to the destination* and then they should *locate the entrance* to the destination. Figure 22 shows the action *go to destination* and its subordinate actions. Each box represents an action and the boxes are connected by one of three types of arrows. The thin arrows indicate that the superordinate action <involves> the subordinate action. The thin solid line indicates a required subordinate action and the thin dotted line indicates that the subordinate action is optional but not required. The final arrow is the thick black arrow which indicates that the actions in that level of the hierarchy are sequentially ordered and must occur in that order to fulfil the superordinate action. In the case of *go to destination*, the traveler must first *proceed to the destination* before they can *locate the entrance* to the destination.

To *proceed to a destination*, the traveler must *move along the path* and occasionally *cross the street* and *observe obstacles*. The traveler may optionally *use public transit* to *proceed to the destination* if it is not within walking distance. *Moving along the path* requires the traveler to *move in space,* and *to move in space* the traveler must *walk or propel* through the space and *orient oneself* to the environment. Other actions could be to *turn 180 degrees*, *change level* (i.e., go up a step) or *pass people* within the space. By *listening* to, *touching*, *looking* around the environment and *smelling* the air, the traveler can *orient themselves*. By completing these actions, the traveler can successfully *proceed to the destination*. After they reach the destination, they will need to *locate the entrance*. This action can involve either *hearing announcements*, or *reading tactilely* or *reading visually* to *read the sign* and finally *identify the door*. Once the door is identified then the entrance is located.

7.3.2 Use public transit

An optional way to *proceed toward a destination* is to *use public transit* (Figure 23). *Using public transit* involves catching, riding and deboarding a transit vehicle. To *catch the vehicle*, the traveler must first *find the stop* by *moving along the path* and if moving through a transit station, *pass through a doorway*. Once the stop is found, then the traveler will *wait at the stop*, *orient themselves* to the environment so they can *recognize the vehicle*, *hail the operator* to indicate they wish to *catch the vehicle* and finally *pass through the doorway* to *board the vehicle*. Once the traveler *catches the vehicle*, they will *ride the vehicle* to the destination. One condition for riding a transit vehicle is to *pay a fare* and then the traveler will *move through the space* to *find a seat* on the vehicle or if they travel in a wheelchair they may *secure their wheelchair* in a wheelchair space. Once the traveler reaches the destination they will *deboard the vehicle* by *making a stop request*, *moving through the space* to the exit and *passing through the doorway* to the street or boarding platform. To *make the stop request* the traveler must be able to *reach and grasp the stop request*.

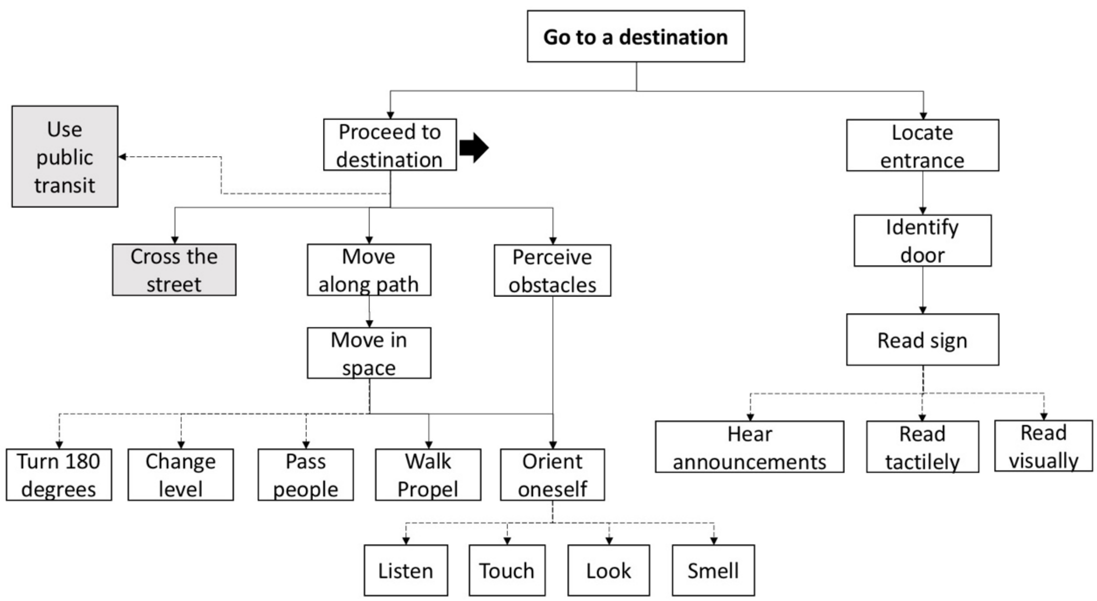


Figure 22 Go to destination activity

7.3.3 Cross the street

If not using public transit, the traveler will likely be moving along the pedestrian path and will need to occasionally *cross the street* at a pedestrian crossing. *Crossing the street* involves first *locating the crossing* by *moving along the path* and *orienting oneself* to the environment. Once the crossing area is found, the traveler *stops at the curb*, *aligns with the direction of travel* and waits to *hear the signal* for crossing. Once the signal sounds, they will *enter the roadway* and try to *stay in the crosswalk*. Once they reach the other side they can *use a ramp* (if present) or step up to *move from the street to the sidewalk* and finally *enter the sidewalk* to complete the crossing.

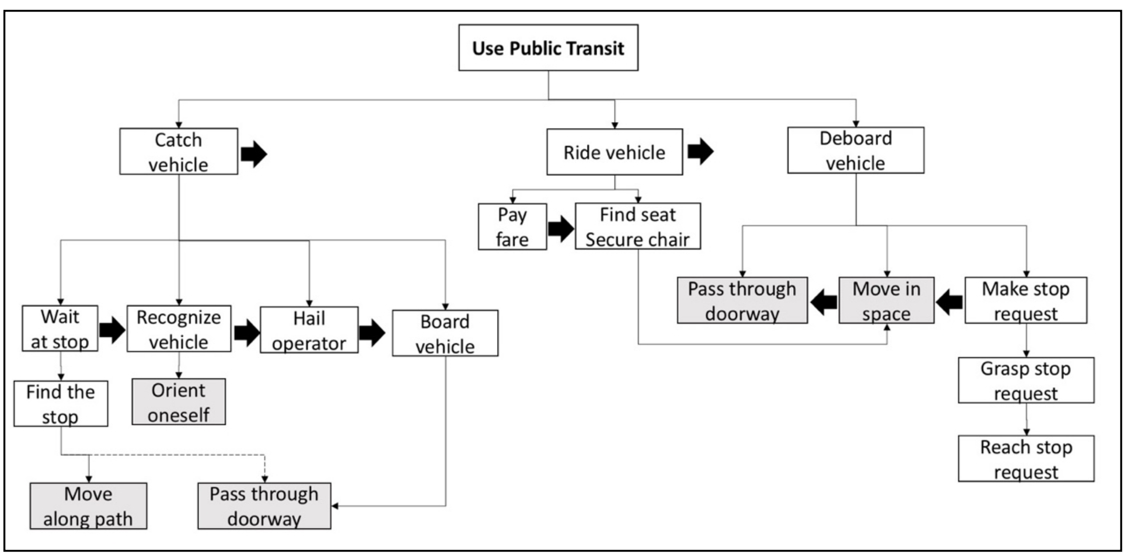


Figure 23 Use Public Transit activity

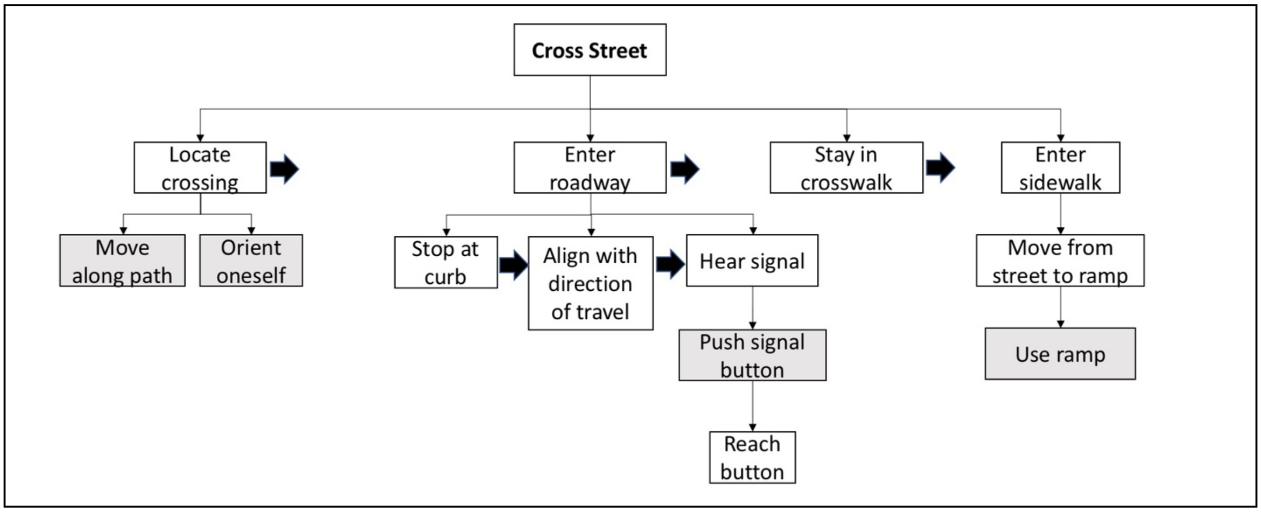


Figure 24 Cross street activity

7.3.4 Access a service

When a traveler *goes to a destination*, they often try to *access a service*. Services include eating at a restaurant, sending a package in the mail, buying items at a store and many other activities. Most services are accessed within a building so the activity *access a building* is often required. There are many possible actions related to *accessing a service*, a few common examples are presented in Figure 25. If the service is in a restaurant, the traveler may *interact with employees* or *sit at a table*. In the case of a department store, the traveler may *see displayed items*, *reach the items*, *try on clothing*, and *navigate the checkout line*. One critical action related to *accessing services* is the ability to *use the bathroom*. The first action associated with *using the bathroom* is to *enter the bathroom* by *passing through the doorway*. Once in the facility, the traveler must *move in the space* and *pass through a stall door* (if present) to the toilet. To *use the toilet*, the traveler must *sit on or transfer to the toilet* and then *flush the toilet*. Once the traveler is finished they will repeat the actions in the reverse order and then *wash their hands* at the sink. One optional action related to *use bathroom* is to *bathe*.

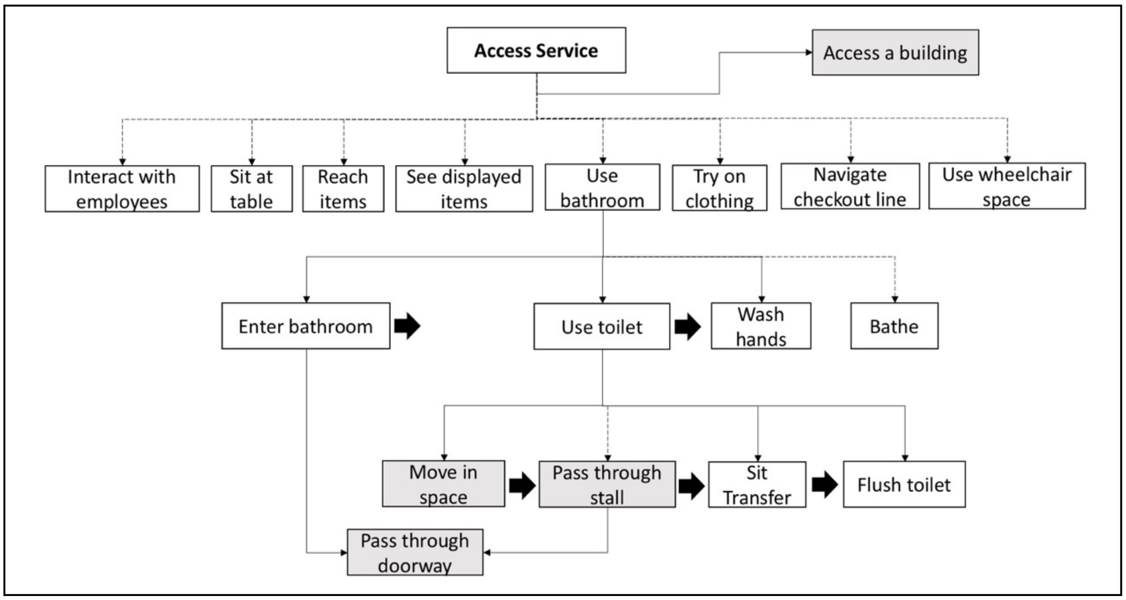


Figure 25 Access Service activity

7.3.5 Access a building

The last activity of interest in the dissertation is to *access a building*. This activity focuses on how to move through the spaces within a building. The first step is to *enter the building* either using a ramp or steps. To *use the ramp*, the traveler must *approach the ramp* and ascend while *staying aligned on the ramp*, *staying within the ramp boundaries,* and alternatively, the traveler can *turn on the ramp* or *grasp the handrails*, if necessary. To *use the steps*, the traveler must *detect the location of the stairs*, *detect the edge of each step* and *maintain their balance* as they ascend or descend, perhaps *grasping the handrail* for stability. Once at the top of the ramp or steps, the traveler will *approach the doorway* and then *open the door* by either *pushing a door button* or *manipulating the hardware*. Sometimes, the traveler may need to *stop on the ramp* to *open the door*.

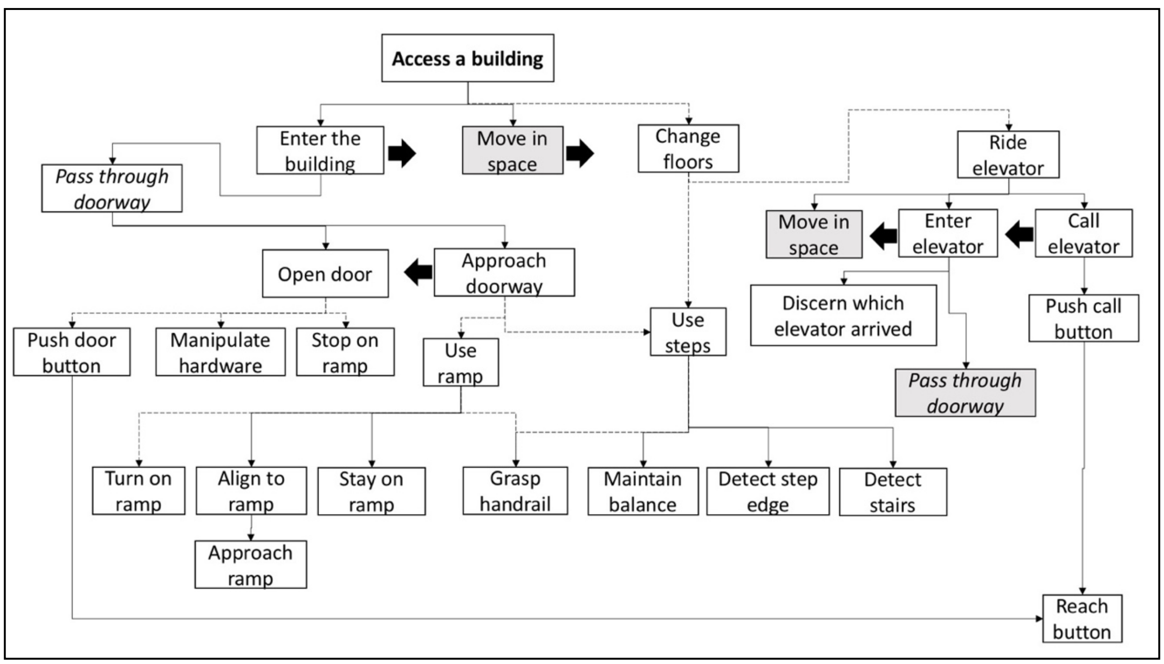


Figure 26 Access a building activity

Once the door is open and the traveler has entered the building, they will *move into the space* and depending on the destination within the building may need to *change floors using steps* or by *riding an elevator*. To *ride the elevator*, the traveler must be able to *reach the call button* to *call the elevator* and *enter the elevator* once it arrives by *discerning which elevator arrived* and *passing through the doorway*. The final action is to *move in space* towards the desired destination within the building.

7.4 RELATIONS

The ontology includes travelers, environmental objects, and actions to describe the built environment and the activities related to wayfinding. The relations between each concept are also important. The following relations are used throughout the ontology: is-a (class relation), has-component and involved-in (both part-whole relations), intersects and connects-to (spatial relations) and enables and hinders (mobility relations). The first set of relations are the 'is-a' relations. These relations are transitive, meaning that the properties of one object transfer to its child objects. For example, a 'sidewalk' is-a 'pedestrian path'. Because is-a is a transitive relation, 'sidewalk' inherits properties of a 'pedestrian path'. The second set of relations are part-whole relations, 'has-component' and 'involved-in'. These relations are used to show that one object is 'part-of' another object or that one action involves another action. For example, a 'pedestrian path' <has-component> 'pedestrian crossing'. Given the previous relation 'sidewalk' is-a 'pedestrian path', the sidewalk can then inherit properties of pedestrian path; therefore, the sidewalk also <has-component> pedestrian crossing. The third relation is the 'intersects' relation. This is a spatial relation that implies that the former overlaps with the latter. The final relation is the mobility relation. This is a special relation developed for this dissertation that includes two possible types: ‘enables’ and ‘hinders’.

Within the ontology there are three types of relationships between concepts: object-object, action-action, traveler-action, and action-object relations. The object-object relations are <is-a>, <intersects> or <connects> relations. Fifty-eight object-object relations were generated. Action-action relations are organized in a hierarchy with required and optional subordinate actions. A total of 103 action-action relations were generated. The action-object relations are the actions that store the barriers and facilitators and are generated based on the presence of an environmental object or a potential attribute value of that object. A total of 199 attributes were identified for the 16 environmental objects and are presented in Appendix F (page 688). A total of 379 mobility relations *(-enables* and *-hinders*) were generated. The mobility relations are important for relaying the accessibility of the environment for a given action. Figure 27 and Figure 28 provide an illustration of the <enables> relation for the two travelers.

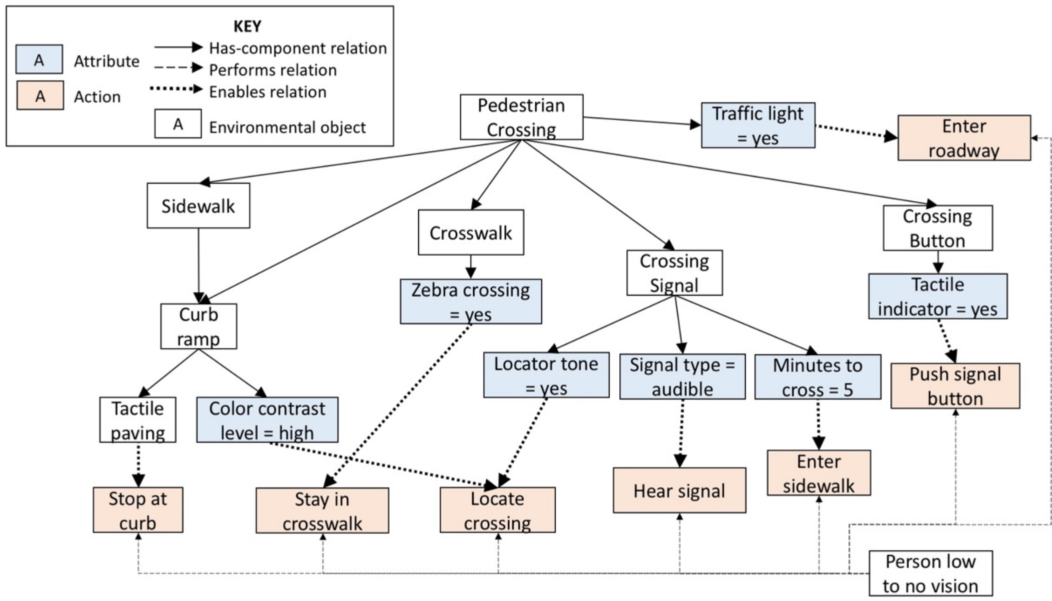


Figure 27 Cross the street – low to no vision

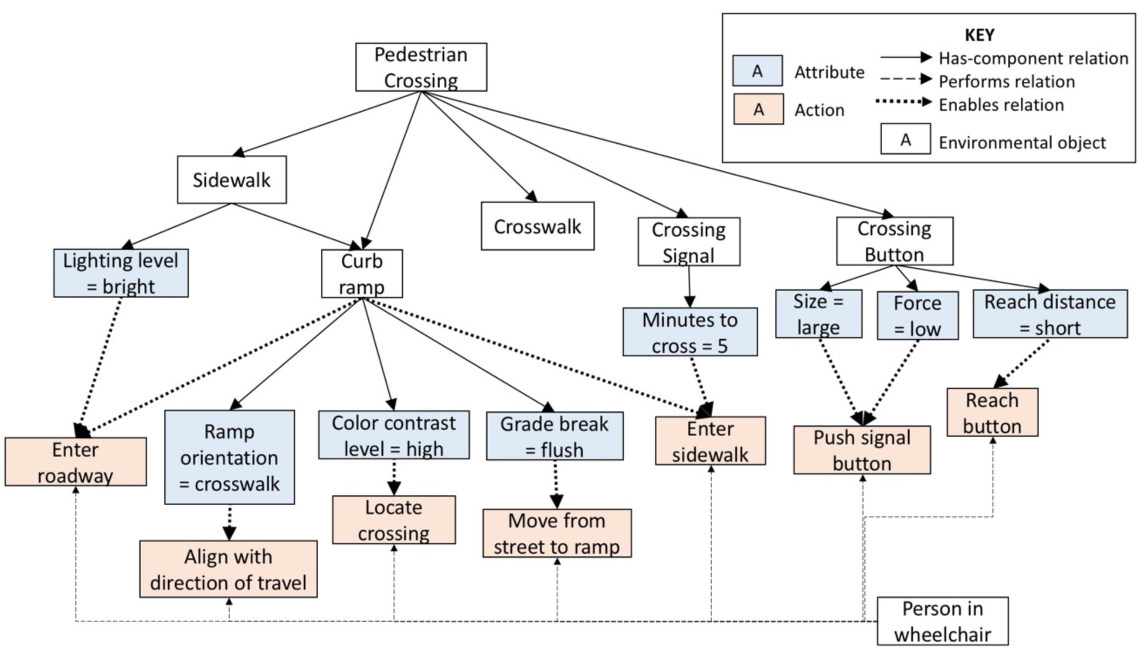


Figure 28 Cross the street – wheelchair user

7.5 DISCUSSION

7.5.1 Language choices

One important consideration for creating an ontology is the selection of terms used to represent concepts. In the current version of the ontology, most of the terms are taken from English spoken in the U.S. because it is most familiar to the author. However, English is spoken in multiple countries with local variations. Table 31 includes several examples of common concepts and the terms used to describe them in the U.S., U.K., Canada and Australia. The first concept, a room with a toilet, is described with different words in the four English speaking areas. In the U.S., the concept of a 'bathroom' is used whether the room is in a home or a public facility, while in the U.K. and Australia, the term 'bathroom' is used exclusively for a room with a bath (bathtub). These differences are important when analysing text data from these different countries. In the ontology, the term bathroom was selected to represent the room with a toilet.

The second row of the table concerns the edge of a sidewalk which is commonly referred to as a 'curb' in the U.S. and Canada, and a 'kerb' in the U.K. and Australia. In this case, the term is essentially the same but with a different spelling. In other words, if you heard someone say the term, it would sound like the same word, but in print you would recognize the difference. The spelling 'curb' is used in the ontology. The last example is the area designated to cross a street. In this case, the term pedestrian crossing is used in all four areas with differing levels of specification. In the U.K., there are many different types of pedestrian crossings with specific names like zebra crossing, pelican crossing, etc. In the U.S. and Canada, the term 'crosswalk' is commonly used to describe this outdoor space. In the ontology, both 'pedestrian crossing' and 'crosswalk' are used. In the ontology, the term 'pedestrian crossing' is used to denote the entire crossing area, including the signals and their operating parts, while the term ‘crosswalk’ specifically refers to the space on the street that is crossed. This decision allows for the more abstract term ‘pedestrian crossing’ to contain the more specific area of the ‘crosswalk’ and is a better way to organize the information conceptually.

Table 31 Sample concepts and terms

Concept	U.S.	U.K.	Canada	Australia
Room with a toilet	Bathroom, restroom	Toilets, loo, lavatory	Washroom	Toilet, loo, dunny
The edge of a sidewalk (pavement)	Curb	Kerb	Curb	Kerb
Designated area to cross a street (road)	Crosswalk, pedestrian crossing	Pedestrian crossing, crossing, zebra crossing, pelican crossing, puffin crossing, toucan crossing	Crosswalk, pedestrian crosswalk, pedestrian crossing	Pedestrian crossing, zebra crossing, pelican crossing

In the future, when the ontology is implemented for specific places like in Pittsburgh, Toronto, London or Perth, the terms used to describe each concept will need to change or at least have relationships with equivalent local terms. One way to deal with these different terminologies is to create a mapping table (like Table 31) that includes a description of each concept represented in the ontology, the terms currently used to describe these concepts, and equivalent terms used in other locations. This table could be generic as the country level (like Table 31) or as specific as a regional, state, or city level of detail. Beyond the use of the English language, a similar table could be created that maps the concepts to equivalent terms in any language with the help of a native speaker. The most important consideration is that the terms selected (regardless of the language) signify the *concept* represented within the ontology, not simply the current term used to describe that concept.

7.5.2 Evaluation of the ontology

The ontology has been verified against the competency questions to ensure that it can answer the requirements used in its design (see **Chapter 3**). The specification of the ontology was evaluated using 4 criteria: completeness, conciseness, unambiguity, and traceability. The completeness of the specification is calculated via its coverage of the wayfinding information needs, barriers and facilitators, and the other three criteria are considered in the design decisions (see **Chapter 3**). The evaluation has verified that 88% of the terms in the questions and 64% of the terms in the answers are represented in the ontology. This represents a good start at covering the domain requirements. Looking at the terms in the ontology, 86% of the terms are found in the requirements (competency questions), and that 82% of the terms in the ontology are drawn directly from the CQ.

The next immediate step for verification is to begin a new round of conceptualization related to parking and seating environments. Many of the missing terms relate to these two environments. A further verification step includes measuring the 'interpretability' of the terms against a known dictionary of synonyms, WordNet. This is discussed further in the conclusion chapter (**Chapter 9**). Beyond verification, the ontology can be validated by the target groups. This is a logical next step after the verification of the modelling of the ontology and could be done via focus groups with potential users of the ontology. This is also discussed in **Chapter 9**.

7.6 SUMMARY

This chapter presented the ontology of accessibility in the context of wayfinding designed in this dissertation. The ontology includes entities describing travelers, objects in the built environment, wayfinding objects, and a set of actions conducted by travelers in the built environment. The ontology conceptualizes indoor environments via the building entity, outdoor environments via the pedestrian path entity, transition environments via the doorway entity and considers the transit vehicle a fourth environment worth definition. Wayfinding is captured via the route and destination entities, and the actions are presented in a hierarchy of common activities conducted within the built environment. The concept of mobility is captured using two special relationships – hinder and enable – that occur between an action and an environmental object or wayfinding object. The ontology contributes to the existing knowledge on barriers and facilitators to accessibility and offers a new perspective on accessibility in the context of wayfinding.

8.0 DISCUSSION

Several aspects of the findings of the dissertation are worth further exploration. For the specific findings of the dissertation see Chapters 5.0 6.0 and 7.0 . This chapter provides additional insights into what these findings may mean for understanding and mapping accessibility in the context of wayfinding. A second goal of the chapter is to discuss the workflow of the methodology in more detail and provide a set of recommendations to future researchers. For specific details regarding the methodology see Chapters 3.0 4.0 .

8.1 INSIGHTS ON THE RESULTS

8.1.1 Wayfinding information needs

During the requirements gathering phase, 127 wayfinding information needs were identified. The top categories of wayfinding information needs were ‘pedestrian path’, ‘public transit’, ‘route directions’, ‘street layout’, and ‘transit stop’ (Chapter 5.0). The two categories of ‘pedestrian path’ and ‘public transit’ were important to both groups indicating that information about outdoor environments and public transit spaces are core areas that wayfinding developers should address in their tools. The low to no vision group shared three times more wayfinding information needs than the wheelchair group and the top categories for that group are the same as the top listing overall. Additional wayfinding information needs for the wheelchair group included 'tourism', 'parking', 'bathrooms' and 'buildings'. These areas focus more on indoor spaces and gaining access to buildings.

8.1.2 Barriers and facilitators to accessibility

The top barriers for both groups related to entrances, pedestrian path, service, bathroom, and indoor space. For the low to no vision group, barriers were encountered along the pedestrian path, in indoor spaces and outdoor spaces, at entrances, at signage and at pedestrian crossings.

The top facilitators were described at entrances, in indoor spaces, accessing services, and in bathrooms and buildings. Many of the important facilitators listed by the low to no vision group were not present in the top listings; these include facilitators to general mobility, along routes, at signage, in pedestrian crossings and at transit stops.

8.1.3 Descriptions of accessibility

An analysis of the language used by different information providers in Chapter 6.0 revealed that people with disabilities, people contributing to collaborative maps and researchers tend to describe accessibility using qualitative terms (e.g., narrow or wide) while standard guidelines are more likely to use quantitative language (e.g., specific measures such as 36 in) to define accessibility. The contributions made to collaborative maps and findings reported in literature assessing barriers using checklists describe the actual conditions of accessibility that are present in the built environment, while standard guidelines describe the ideal case for accessible environments. With this understanding, the choice of language becomes important.

By using qualitative language, we can only get a rough sense of the true conditions of accessibility or in other words, the experience of accessibility in relation to the reporter. For example, one doorway may be wide enough for one person but too narrow for another based on the size of their wheelchair or other conditions in the environment. In this case, an assessment of the actual width of the doorway would be a more objective measure of accessibility and it would allow for analyzing if the width of the door matches the ideal width of a doorway codified in the standard guidelines for that part of the world.

The best case for collecting these detailed measures is within a collaborative map. Section 2.3.3 introduced a set of collaborative maps focused on accessibility and the need to balance the number of criteria to encourage and maintain participation in these tools. There is a danger that too many or too detailed criteria will discourage people from adding data about real places into the database. Another mechanism for collecting data about real places is for wayfinding service providers to allocate resources to updating their existing database with information about accessibility including detailed measures. This could also be challenging because these companies often have many ongoing projects and finite resources. Perhaps the evidence presented in Chapter 5.0 related to the most important categories of accessibility will help these service developers prioritize the collection of data that would make the most impact on accessibility information provision such as information about public transit, and access along pedestrian paths and indoor spaces. A final most promising source of collecting true measures of the environment is mapping parties in which a group of people come together for a few hours and intensely map a specific area. With some training and the measures attached to the ontology (Chapter 7.0) in this dissertation, part of the work during the mapping party could be to collect specific measurements along with more qualitative assessments of accessibility. On the bottom line, any kind of assessment of accessibility is useful, and hopefully as technology progresses, better methods for obtaining objective measures on the ground will be designed.

8.1.4 Defining accessibility

Orientation & Mobility literature and work on cognitive mapping by people with low to no vision have argued for many years about the importance of orienting people with low to no vision with the paths of travel they will need most often in their daily lives and the construction of mental maps of the physical environment. Consequently, it is a well-known fact that people with low to no vision require more support for getting oriented in the environment and benefit from practicing a route with an Orientation & Mobility trainer. Chapter 5.0 offers a new insight regarding the need for orientation in the descriptions of barriers and facilitators to accessibility for people with low to no vision. Several of the most important categories in which people with low to no vision described facilitators to accessibility – general mobility, along a route, and interacting with signage – all relate to orienting in space. This indicates that the environment itself is less of a hazard for people with low to no vision than the absence of orienting information about the environment. In other words, in this case, accessibility is an information and communications issue; which confirms the interdisciplinary nature of the role and potential contribution of information professionals to the study of accessibility in the built environment.

By contrast, none (Table 27) of the important barriers or facilitators or even wayfinding information needs found for people who travel in wheelchairs related to orienting. By far, the most important categories for this group – bathrooms, the entrances of buildings including ramps, and access to services – all focus on gaining access to and using the facilities within buildings. These categories suggest the central role that the environment itself plays in accessibility for people who travel in wheelchairs. Considering this, the provision of information for people who travel in wheelchairs is vital to increasing their decision-making power but may not ameliorate the conditions of accessibility in the same manner as it would for people with low to no vision.

8.2 INSIGHTS ON THE METHODOLOGY

This section will present the workflow of the methodology used in this dissertation, including specific steps, benefits of the process, an indication of who can use the methodology and finally a set of recommendations for researchers who plan to use the methodology in their own work.

8.2.1 Workflow of the methodology

The methodology used in this dissertation includes five phases. Each phase includes at least one step and results in a set of documents. Figure 29 depicts the phases and steps of the methodology with a pair of requirements for using the methodology in the center. For the remainder of this section, the term ‘utilizer’ will be used to denote a researcher or practitioner who plans to use the methodology. The first requirement is that the utilizer is studying an ill-defined domain that is studied in various ways by multiple groups of people. In the case of accessible wayfinding, there are a multitude of disciplines that study accessibility from different perspectives (Chapter 2.0) and the concept of accessibility is generally ill-defined even though in some disciplines accessibility is defined more concretely than in others. Wayfinding is also a concept that is defined in multiple ways (Chapter 1.0) and as an activity occurs in multiple environmental settings. Thus, any phenomenon that requires a synthesis of multiple perspectives on a topic and aims to generate a unified definition of the phenomenon can benefit from this methodology.

The second requirement for using the methodology is that the knowledge to be synthesized are sets of existing text data. In this dissertation, the text data included the results paragraphs of research studies, online comments, survey responses, and paragraphs of technical guidelines within accessibility standards documents. Alone, none of these texts provided a clear picture of accessible wayfinding; however, when taken together, using a systematic method of text analysis, the information within these texts provided useful knowledge for ontology generation. If a phenomenon has been studied by multiple groups of people, is a topic of conversation among everyday people online and is the subject of legislation, then it is likely that many types of texts are associated with the phenomenon and this method could aid in their analysis.

Within the knowledge acquisition phase, there are two main steps: collecting the extant data and categorizing the data. Table 32 highlights methodological knowledge and decisions required to use the methodology for each step. To *collect extant data*, a utilizer should first know which disciplines study the phenomenon, aspects of the phenomenon in practice, and frameworks of policy that surround the phenomenon and its definition. This ensures that the varying perspectives on the phenomenon are all considered during data collection. Once sets of data are collected, utilizers must investigate the context of the data creation. Section 4.1 discusses the concept of data context and utilizes Charmaz’s (2006) questions for investigating the context of extant text data. These questions are important for understanding the perspective of each data source and what kinds of information can be gleaned from each source.

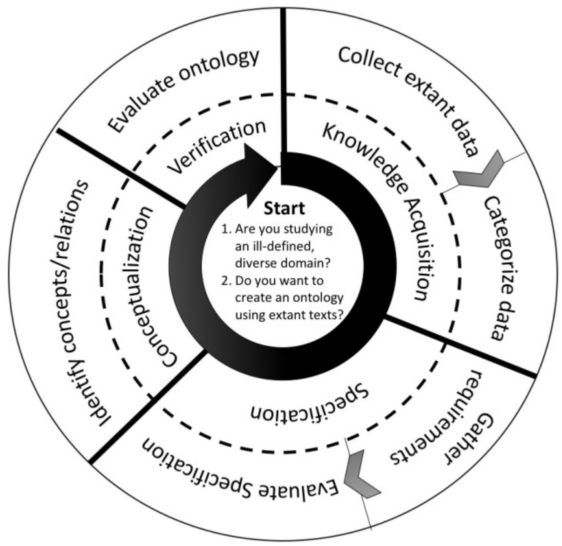


Figure 29 Workflow of the methodology

To filter out the most useful content, a set of inclusion criteria must be selected. This decision is an opportunity to fine-tune the aspects of the phenomenon that are of the most interest and to collect only those pieces of text from the datasets. Regardless of the method that is selected for text analysis in the second step, a set of inclusion criteria are required to break the initial, often large, set of texts into manageable pieces.

The second step is to *categorize the data* into groupings that are relevant to the research question(s) and potential concepts of the ontology. Qualitative content analysis (QCA) is the method used in the methodology for text analysis. In this method, as described in detail in Chapter 4.0 , a useful instrument is created from both a priori concepts that come from the research questions and by analyzing the content of the texts that meet the inclusion criteria. Knowing the content of the relevant data is critical to generating adequate categories for the coding process. Again, one requirement for a utilizer is that they want to generate an ontology from extant text data which cannot be accomplished without understanding the content of each data source in depth.

Early on the utilizer must decide which method of categorization will be used. A useful aspect of the methodology is its modularity regarding the method of categorization. This dissertation employed QCA but other utilizers may choose methods discussed in Janowicz (2010) including: using geostatistics to classify remotely sensed images; or using machine learning methods like Latent Dirichlet Allocation to analyze social media data. A significant consideration is the amount of interpretation required to place a piece of text within a category.

Table 32 Methodological knowledge and decisions

Step	Knowledge	Decision(s)
Collect extant data	• Know the phenomenon • Understand context of the data	• Select inclusion criteria
Categorize data	• Know content of the data	• Select categorization method • Evaluate categories
Gather requirements	• Know what the ontology should be able to answer	• Transform categories to concepts
Evaluate specification	• Understand ontology evaluation	• Select appropriate measures to compare requirements with collected knowledge
Identify concepts and relations	• Know the process(es) being defined in the ontology	• Adhere to a theory of reality • Select terminology • Select relation types
Evaluate ontology	• Understand ontology evaluation	• Select appropriate evaluation measures

If a utilizer wants to study accessible wayfinding, like this dissertation, using new text datasets, they can choose to use the method as it is described in this document or they could use the indicators (terms) for each category listed in the coding frame (Appendix A, page 207) to speed up the process. If the phenomenon requires less interpretation than accessible wayfinding, then a text mining method may be sufficient. On the other hand, if the phenomenon they are studying requires some interpretation to determine relevant categories then using QCA may be the best choice for the first round of analysis and then a more automated process can be designed using the indicators and decision rules developed during the rounds of QCA. The final decision related to categorizing the data is to evaluate the categories that are developed. In QCA, this is done by evaluating the reliability and validity of the coding frame (see Schreier 2007); in data mining, the use of baseline and test datasets and measures of accuracy are employed.

The specification phase of the methodology has two steps: gather requirements and evaluate the specification. The first step to *gather requirements* centers around creating an ontology requirements specification document (see Chapter 3.0). To create this kind of document, it is important to know what the ontology should answer. A utilizer should have some knowledge of the purpose of the ontology, who the intended users are and how they would use it. Beyond this, the utilizer needs to decide how to transform the categories into concepts. This dissertation used competency questions to achieve this step. The categories were used in the set of competency questions and then represented as terms in the pre-glossary. Finally, the pre-glossary was used as the basis for the concepts in the ontology. The result of the requirements gathering process of an ontology is called a specification.

The second step is to *evaluate the specification*. This step requires knowledge of how to evaluate an ontology including what measures are appropriate. Four measures were used to evaluate the specification: completeness, conciseness, unambiguity, and traceability (Chapter 3.0). These measures were appropriate for the phenomenon of accessible wayfinding because of the varying approaches to accessibility. The utilizer is encouraged to use these four measures to evaluate a specification for an ill-defined, diversely studied phenomenon.

Conceptualization is the third phase of the methodology. The key step in this phase is to *identify concepts and relations* from the pre-glossary. Ontologies often depict a process along with a set of concepts; therefore, it is necessary to know how the processes being defined work in the real world. In the case of accessible wayfinding, the activities described in Chapter 7.0 are mostly everyday actions and the built environment is made of tangible, recognizable spaces. To understand these basic concepts, the author looked at and moved through space. Thus, this methodology is best suited to designing an ontology of a phenomenon in which the basic concepts are well-understood.

Two main decisions are required in this step. Any ontology is designed to represent some aspect of reality; therefore, the utilizer must adhere to a theory of reality when identifying the concepts and relations. In this dissertation, the theory of commonsense reality was used. This theory allowed for the incorporation of multiple perspectives predicated on the notion that descriptions found in the text are part of everyday actions that all people with disabilities experience. Alternative theories are universal or cognitive theories of reality (see Chapter 3.0). Because utilizers of this methodology will be dealing with phenomenon with multiple interpretations and perspectives, universal theories of reality may not be useful; however, cognitive theories of reality may be useful when the phenomenon relates to a person's perception.

Phenomena can be represented using different terms and displaying different kinds of relationships between concepts. The second decision is to select terminology for the ontology. The work conducted in this dissertation included perspectives from multiple countries who have English as a common language; however, terms describing environmental objects and conditions are not uniform. The terminology selected for use in the dissertation was based on English terms used in the United States. This decision was made with regard to the researcher's experience living in the United States; thus, a researcher conducting the same study in Australia may have chosen Australian English as the base terminology. A utilizer should use terminology that is familiar and provide links to comparable terms used in other locations. This decision is complex and requires a thoughtful approach; some discussion of this issue is provided in Section 7.5.1. The last decision in this step is to determine what kinds of relationships are present between the concepts that define the phenomenon under study. Several types of relations were used in this dissertation to represent relationships between environmental objects, relationships between actions, and relationships between travelers. The most significant relationships, and the target of the dissertation, were the relationships between environmental objects or specific conditions of environmental objects and the actions they enable or hinder. Utilizers of the methodology should think carefully about each concept and how it relates to other concepts within the resulting ontology.

The verification phase focuses on evaluating how the ontology was constructed and if it matches the initial set of requirements found in the specification phase. Verification is one type of *ontology evaluation* and a utilizer should be aware of the differences between verification and validation which focuses on the representation of reality embedded in an ontology. Similar to the evaluation of the ontology specification, the evaluation of the ontology requires a selection of appropriate evaluation measures. In this dissertation, the competency questions designed during specification were used to evaluate if the ontology constructed can answer all or a portion of those questions. It is important to note that verifying the ontology using competency questions is a first and necessary step in verification, but verification is more powerful if the analysis of competency questions is combined with other measures. This is discussed further in Section 9.8.

8.2.2 Benefits of the process

The methodology designed for this dissertation has several benefits for understanding an ill-defined, diversely studied phenomenon and utilizing extant text data sources in ontology design. First, the use of QCA enables novice researchers to break multiple data sources into digestable parts. QCA accomplishes this by offering prescriptive guidelines on selecting relevant data and creating a coding frame to organize the diverse texts. QCA also eases the design of an ontology by preparing the knowledge to be conceptualized into a set of relevant categories.

The second benefit of the methodology is the use of data driven categories. Data driven categories have a foundation within one or more data sources which helps to legitimize the resulting concepts and relations within the ontology. Finally, using a data driven approach allows for conceptualization to be more traceable (i.e., to specific segments of text) which enables the design decisions to be more transparent.

The final benefit is the modularity of the workflow of the methodology, especially the choice of method for text analysis. In fact, any method of text analysis can be substituted as long as the knowledge and decisions required for each step are maintained. Other modifications could be included in the choice of evaluation measures applied to the specification and verification phases of the methodology.

8.2.3 Who can use this method

The most important criterion for utilizers is an appreciation for interdisciplinary perspectives. The methodology is best used for phenomena that are studied in different ways, using different methods, and relate to different aspects of everyday life. Anyone who wants to bring these varying ideas and practices together will have to pay attention to the nuances within different disciplines of study and differing experiences within the real world. Other considerations that have been mentioned in the previous section are people studying an ill-defined phenomenon, people studying a phenomenon that diverse groups study, and people who want to generate an ontology from extant text data.

8.2.4 Recommendations for future researchers

The following paragraphs discuss several recommendations for researchers who want to use all or a portion of the methodology.

8.2.4.1 Recommendation 1: Know the phenomenon Anyone utilizing the methodology should first know something about the threads of research and practice in the area they want to study. Ill-defined, diversely studied phenomena are often accompanied by complex webs of people and institutions working to understand or advance specific aspects of the phenomenon. It is advised at the start of the project that the utilizer become very familiar with these groups and their practices.

8.2.4.2 Recommendation 2: Analyze data context The data-driven nature of the methodology is a benefit for synthesizing varying perspectives; however, data are produced using different approaches, within different historical traditions, under different sets of constraints, for particular projects, and by different types of people. These realities make the analysis of data context a critical factor in effective utilization of data sources. Charmaz (2006) notes that texts are often produced for very different purposes and are positioned within social, economic, historical, cultural and situational contexts. This requires a clear identification of the context of each data source and constant attention to the presence of embedded meanings within the text.

8.2.4.3 Recommendation 3: Code in small, diverse sets The collection of multiple datasets can easily overwhelm the process of text analysis. The use of QCA, while prescriptive, does not offer guidance on how to break data into smaller sets for coding during the Pilot Phase. QCA does offer insights regarding the use of multiple datasets but is routinely used to code single sets of data that were designed by the researcher themselves. In this dissertation, a set of small pilot codings were conducted within the Pilot Phase. This reduced coding fatigue and allowed for a gradual revision of the coding frame. Upon reflection, it is recommended to include at least one segment from each different dataset in each round until the required amount of trial data has been coded.

8.2.4.4 Recommendation 4: Traceability is power The methodology could be used to construct an ontology without attaching the ontological concepts to the data used to generate them. This practice would defeat a core benefit of the methodology which is the ability to trace where each concept originates. This is a fundamental problem with many existing ontologies. Without the ability to trace the orign of a concept, future analysis and revisions of the meaning of concepts within an ontology is impossible at worst and inefficient at best. Allowing for the traceability of knowledge and therefore meaning can lead to the production of ontologies for more complex phenomenon and it is recommended that this be a core focus of those using the methodology.

8.2.4.5 Recommendation 5: Verify along the way Similar to the coding process, the conceptualization phase can also be overwhelming. Conducting conceptualization in small rounds and immediately verifying the concepts and relations can lead to more coverage of the ontology requirements (i.e., the competency questions) and affords revision of established concepts and relations given new requirements. In this dissertation, the conceptualization phase was conducted in several iterations; first for the environmental objects, second for the actions, third for the travelers, fourth for attributes of environmental objects, and fifth for the relations between objects/their attributes and actions.

Unfortunately, the verification phase was conducted after the entire ontology was designed. This made the task of identifying which terms in the pre-glossary were present within the final ontology but were represented by a different term or absorbed into a broader term harder to distinguish. Another issue relates to new terminology added during the process of defining the properties and relationships of concepts. By verifying the ontology at the end, there were many synonymous terms introduced that had equivalents in the pre-glossary. If verification was done earlier, then the appropriate term from the pre-glossary would have been selected instead of a synonym. Verifying the design decisions more often may reduce the likelihood that selected terms (to define properties and relationships) will deviate from terms in the pre-glossary. If the verification is done in small cycles, these design decisions can be documented which improves the transparency of the entire conceptualization process. Thus, it is recommended that verification be done often and after each round of conceptualization.

9.0 CONCLUSIONS AND FUTURE DIRECTIONS

This chapter concludes the dissertation by summarizing the project, reflecting on the methodology and key findings of the research, providing summary answers to the research questions, discussing the contributions of the dissertation, exploring implications and limitations of the research and outlining a set of future work that builds on the work accomplished in the dissertation.

9.1 SUMMARY OF THE PROJECT

This project began in early 2013 after the author got involved with the Personalized Accessibility Map (PAM) project (Karimi et al. 2014, Karimi et al. 2013). The PAM project focused on designing a wayfinding tool for personalized routing based on a set of criteria proposed by Kasemsuppakorn and Karimi (2009). During this project, it became clear that existing wayfinding and navigation tools lacked data to support wayfinding by people with disabilities and most accessible wayfinding tools were pilot projects in the prototype phase. At the same time, a growing number of collaborative maps were being created that concentrated on mapping the accessibility of places. These maps were designed and promoted by a diverse set of people and the criteria used to define accessibility within these systems was frequently unclear. These two encounters inspired the author to take a deep dive into the concept of accessibility, specifically how accessibility relates to the activity of wayfinding.

To accomplish this, the research design included five datasets representing different views on accessibility. One dataset provided perspectives related to public transportation, others offered data on the real conditions of accessibility in the world, and another provided an ideal view of accessibility for compliance with accessibility legislation. A qualitative method of analysis, Qualitative Content Analysis, was used to systematically code the data according to the research questions and bottom-up from the data itself. Next, the coded data were transformed into a set of competency questions, commonly used in ontology design, to set the requirements for an ontology that represents concepts related to the physical environment, actions performed in the environment during everyday movement, and the two target groups of this study, people with low to no vision and people who travel in wheelchairs. The competency questions also included a set of relationships between the objects, actions, and travelers and a novel type of relation specifically for representing accessibility, the mobility relations – enable and hinder. Finally, the current version of the ontology was verified and future evaluation steps were outlined.

9.2 REFLECTION ON THE METHODOLOGY

The methodology designed for this dissertation was novel in several ways. First, a diverse set of text data was collected, including a large set of findings from research literature. Existing studies on accessibility and wayfinding conduct small user studies, rely on standard guidelines, or derive requirements from wayfinding or orientation and mobility theories. Few studies synthesize the findings of existing literature or integrate multiple perspectives on accessibility into one investigation. Finally, as far as the author knows, no one has studied accessibility using collaboratively mapped comments.

The integration of these datasets was challenging due to the differing goals of the people, researchers and standards bodies that generated the content. They described the physical environment, and the populations they studied at varying levels of detail. The coding frame designed for this study aimed to account for these differences and synthesize the information into a coherent set of knowledge. In the main, this was accomplished; however, some ambiguity remains in the final version of the coding frame. For example, some of the data discuss accessibility related to indoor space. The coding frame includes specific categories like 'building', 'elevator', 'stairway', and 'doorway' but also more generic categories like 'indoor space' and 'service'. The goal of the dissertation was to generate the coding frame to account for the information within the datasets, leading to the inclusion of some general/catch-all categories, but future iterations of the coding frame should focus on an analysis of the segments coded into general categories and further differentiate these categories into more specific environments.

The second reason this methodology is novel is the use of QCA for the knowledge acquisition phase of the research. Other scholars have used qualitative methods for this process (Chapter 2.0) but none have employed QCA. This method is well suited for knowledge acquisition because it prescribes a systematic way to break the data into constituent parts that are of interest; in other words, it allows the researcher to reduce the data by focusing on specific aspects of the dataset and filtering the other parts away. Furthermore, QCA, like other qualitative methods, leads to the generation of a set of themes (categories) that are represented in the data. These categories are a perfect input to the specification of an ontology and the coding process allows for better traceability for the ontological concepts by connecting the category (i.e., a future concept in the ontology) to a piece of original data. Lastly, the QCA method is a good method for novice qualitative researchers because it provides a clear, prescriptive framework for how to design and test a coding frame. Coding frames designed using QCA can be based on a priori concepts, the data itself or a combination of the two; the process is quite flexible, which is a help to new researchers, especially those engaging in qualitative research for the first time.

The use of a qualitative method of analysis enabled rich descriptions of barriers and facilitators to accessibility; nevertheless, the interpretations of the data, and determinations and categorizations of people, environmental objects and actions represent the impressions and decisions of one researcher. Close attention was given to the triangulation of data and the researcher's own bias, but future evaluations of this work may uncover unintended biases or misinterpretations within the conceptualization.

9.3 ANSWERS TO RESEARCH QUESTIONS

The work was driven by three research questions. The first question focused on identifying important categories of wayfinding information needs, and barriers and facilitators to accessibility for the two target groups, people who travel in wheelchairs and people with low to no vision. The analysis showed that people with low to no vision and people who travel in wheelchairs have different core wayfinding information needs. People with low to no vision need wayfinding tools that aid in orienting themselves with and in the environment while people who travel in wheelchairs need wayfinding tools to aid in understanding the realities of physical access to objects within the environment.

The second question was concerned with comparing the views of three types of information providers on accessibility. The comparisons identified that all three information providers did not have the same goal when it came to providing information about accessibility. Two of the providers, people with disabilities and researchers commonly use qualitative language to *describe* accessibility while the other provider, standard guidelines, uses quantitative language to *define* accessibility. The last question explored how to use available information about accessibility and wayfinding to conceptualize accessibility for use in a wayfinding service. During this exploration, it became clear that accessibility is required when people interact with the environment to accomplish certain activities. Accordingly, within the ontology we need a relationship between a traveler and the activity that they want or need to perform. Following, a relation between the activity to be performed and an object in the environment where that action is required is also needed. With these two relations, we can account for any situation in which a traveler wants to perform an activity in the environment and determine if they *can* or *cannot* do that action given a specific environmental configuration.

9.4 CONTRIBUTIONS

The work conducted during this dissertation contributes to understanding accessibility in the context of wayfinding in several ways.

9.4.1 Contribution to body of knowledge

This dissertation synthesized available information (including literature and other datasets) on accessibility for multiple environments and multiple locations in the English-speaking world. Barriers and Facilitators were collected from five continents, in order of prevalence, North America, Europe, Oceania, Asia, Africa and South America. All available knowledge was conceptualized into a set of global barriers and facilitators for the ontology, but Chapter 7.0 also presented a detailed listing of the barriers and facilitators for each location in which they were found in the data. This set of local barriers and facilitators offers insights about the differences and commonalities between different locations and provides a potential view of accessibility worldwide. Several domains of research including people designing wayfinding, navigation and tourism services, and people exploring functional activities of everyday life, moving within the built environment and accessing tourist sites, have contributed knowledge regarding barriers and facilitators to accessibility. These studies generally focus on one or two groups of people with disabilities and one part of the environment (either indoor spaces or outdoor spaces) for one location in the world. Several researchers have assessed multiple locations in the world including Freeman and Selmi's work (Freeman and Selmi 2010) in Canada and France, and Packer's work in Hong Kong (Yau et al. 2004, Packer et al. 2007) and Australia (Packer et al. 2008), yet, none of these works focus on wayfinding. To date, only one study has synthesized existing literature on barriers and facilitators (Neis and Zielstra 2014).

9.4.2 Contribution to the development of methodology

The methodology designed for this work is also innovative. While qualitative analysis has been used to acquire knowledge for ontology design, no studies have used Qualitative Content Analysis as the qualitative method. The coding frame designed during the knowledge acquisition phase can be utilized by researchers interested in analyzing texts that include wayfinding information needs, or barriers and facilitators to accessibility or to generate an automated classification method which would enable larger sets of knowledge to be extracted. The use of competency questions is common in ontology design; however, the data-driven process used in this research is novel. Most competency questions are generated via interviews or focus groups. The ability to generate these questions from data may enable the use of the growing number of datasets available on the web or in institutional repositories.

9.4.3 Contribution to practice in the area

Researchers have pointed to a lack of information about accessibility in existing wayfinding services and hinted that understanding the wayfinding information needs of people with disabilities could lead to the improvement of these services. In Chapter 7.0 , a set of wayfinding information needs were extracted to support the design of the ontology. These needs represent potential queries that the two target groups would use in a wayfinding tool and could be used by developers of wayfinding services to design more *accessible* wayfinding services.

The ontology itself is the main contribution of the dissertation. It offers a set of concepts that describe objects in the built environment and actions performed at those objects. The objects themselves are related to one another within the ontology and have a set of typical properties that exemplify the object. The actions are related in a hierarchy with each object having a related main action. Concepts are also present for the two target groups. To my knowledge, these concepts, properties, and relations provide the most comprehensive view of accessibility to date. Due to the design of the action relations, a reasoner can be developed to assess the accessibility of a local object once its unique characteristics are associated with the main concepts. Furthermore, the ontology can be used as tool to learn about accessibility, especially in the context of wayfinding.

9.5 IMPLICATIONS

9.5.1 Implications for practice

Traveler groups. During the data analysis, it was challenging to find data associated with subcategories of the target groups, such as a person who is blind or a person who travels in a power wheelchair. This implies that researchers are not accounting for the full spectrum of disability within the groups they are studying and collaborative maps (and other online sites) are not providing the facility to attach these categorizations within the data collection process. This is likely due to the complex nature of disability, the availability of research participants and the willingness to share this information online. Another possible hurdle is the potential for invasive surveys about a person's physical condition within interviews or survey tools. Although these concerns represent real barriers to elucidating finer details of disability, reporting on wayfinding information needs and barriers and facilitators for more specific categories of people with disabilities would enhance our current understanding of how specific sub-groups experience the environment and conduct wayfinding. Additionally, most research regarding wayfinding information needs/requirements focuses on the two groups targeted in this dissertation. Given that these are not the only groups of people with disabilities who engage in wayfinding and everyday travel, a larger set of groups – even if they are studied as a broad group, e.g., people with deafness, people with autism – is warranted.

Differing needs. The fact that people with low to no vision and people who travel in wheelchairs have such different interactions with the environment leads to a different set of needs regarding wayfinding tools. While there are many prototypes and small scale systems that support wayfinding and navigation like BlindSquare and Trekker Breeze for people with low to no vision, and the Personalized Accessibility Map (Karimi et al. 2014b) and OSM's wheelchair routing application, most mainstream tools continue to lack features for people with disabilities. Google Maps has incorporated a haptic notification within the newest version of their application on smartphones, and although this is certainly promising, the application lacks information to help people with low to no vision get oriented to a new environment or people who travel in wheelchairs to learn about the specific conditions at place they want or need to go. One implication of this is the need for improved knowledge transfer (e.g., prototypes and research findings) between wayfinding researchers and developers of mainstream wayfinding tools so that these tools can better address the requirements identified by research.

9.5.2 Implications for policy makers

The purpose of accessibility legislation is to mandate the design of accessible structures and pedestrian environments and, in some cases, ensure equal access to employment, accommodation and other services. Standard guidelines are documents designed to interpret the legislation and provide prescriptive guidelines for implementation. Most standard guidelines are written using a universal design approach which some criticize provides a "least bad solution" (Gossett et al. 2009). The alternative would be to provide a best-case scenario for individual groups of people. Standard guidelines generally include a section with technical guidelines that specify acceptable measurements of specific environmental features and a scoping section that lists all the technical guidelines required for a particular feature or space. The use of actions to capture accessibility in this dissertation could be incorporated into standard guidelines in the form of scenarios. The scenarios could be oriented around common actions performed in public spaces and could include a section for different groups of people. In this way, the practice of universal design can continue but services and construction could also be designed with specific groups in mind.

9.6 LIMITATIONS

Like any research, this dissertation has several limitations.

9.6.1 Study population

This work focused on two target groups, people with low to no vision and people who travel in wheelchairs. These two groups were selected because they are the focus of much of the available information regarding wayfinding and accessibility within the built environment and the purpose of this study, which was to synthesize available information about accessibility into a comprehensive understanding of accessibility in the context of wayfinding. That said, the selected groups are only two of many groups of people with disabilities such as people with limited cognition, people with low to no hearing, or people using walkers and canes, among many other potential grouping characteristics.

Occasionally, specific levels of vision or types of wheelchairs were known, yet most of the data did not provide this granularity of information. More data was available for people who travel in wheelchairs. This may have influenced some of the insights gained in this work. Efforts were made during the analysis to account for both groups and their sub-groups, however, there may be other effects of this dataset that were not anticipated.

9.6.2 Conceptualization

Missing objects and actions. The determination of components of the built environment and objects and actions within the built environment was a data-driven process and even though a diverse set of data was collected, some components, objects or actions may not have been captured within the resulting conceptualization. While the actions were extracted from the data, the hierarchy of actions embedded in the ontology was constructed using logical inferences about moving through the environment. Given that the hierarchy of actions was not vetted by the two target groups, there may be actions or supporting actions for some environmental objects that are not covered.

Generalization. The definition of each traveler group involved characteristics that impact their interaction with the built environment such as the ability to perceive the environment using vision and movement through space within a wheelchair. Furthermore, the definitions of the target groups do not account for the causes of sight loss or need for wheelchair use like a specific medical condition or accidental circumstance. Buildings are complex objects within the built environment that are designed for specific purposes and include odd architectural artifacts. The conceptualization of buildings within this study was purposefully generalized to account for common elements such as entrances, rooms, hallways, elevators, and stairs. Thus, unique characteristics of buildings designed as fitness facilities or libraries, or including half-floors or courtyards are not captured. Pedestrian paths are an important component of outdoor spaces that include more formal constructions such as sidewalks and natural constructions such as trails. This dissertation limited the scope of the pedestrian path to formal constructions in proximity to built structures; consequently, the conceptualization does not apply to any type of pathway surrounded by a wooded area such as a walking path or trail.

9.7 FUTURE WORK

Many future works are possible. A few will be discussed here.

9.7.1 Refine the coding frame

The research utilized a coding frame to categorize the text data. The frame was kept simple to streamline the coding process and because this was my first use of qualitative content analysis. In its current form, the coding frame includes several general categories that can be further differentiated. During the ontology creation, a detailed set of barriers and facilitators were extracted. Using these and the attributes identified associated with them, the sub-categories of the barrier and facilitator dimensions can be improved. This will likely make the frame more useful for extracting specific barriers and facilitators in the future.

9.7.2 Expand the target groups

This study focused on two target groups. The research can easily be expanded to include an understanding of accessibility for other groups of people with disabilities. On the other side, a deeper look at the two target groups, specifically oriented toward expanding the knowledge of the characteristics of each group would allow more tailored wayfinding services to be designed.

9.7.3 Use cases

Two use cases will be discussed in this section, the use of the ontology to design a database for a wayfinding tool and the use of the ontology as a tool to teach accessibility concepts.

Understanding the barriers and facilitators to mobility and the wayfinding needs of people with disabilities can help prioritize the types of data that are necessary to support accessible wayfinding. There are two ways that the ontology can be used to design or expand a navigable database. First, the ontological concepts can be used to construct a metadata schema. Metadata describe many aspects of a set of data such as the history of the dataset, the measures used to collect the data, and the attributes included. Many metadata schemas exist for different domains of data like music, art, and digital objects. For accessible wayfinding (like any wayfinding), two types of datasets are required: a pedestrian network dataset and a POI dataset. A metadata schema for the pedestrian network data would include typical fields like the geometry and distance of each segment, but an accessible pedestrian network also requires data about the conditions of the sidewalks, walkways, bridges and tunnels that compose the network. The ontology includes attributes for sidewalks and pedestrian crossings that could be added to the pedestrian network database. These attributes would be listed (with acceptable values) in the metadata schema. Databases of POI would need to include latitude/longitude values, the country of relevance, and attributes related to buildings

Second, the concepts and relations that are part of the ontology can be specified in Unified Markup Language (UML) as an object model. UML is commonly used for database design and is advantageous because the object model is conceptual, allowing for flexibility of implementation. Depending on the type of database to be constructed, the UML diagram may be used directly (object database) or translated into a relational database tool (relational database). The concepts within the ontology become either objects or tables within the database and the attributes become attributes of the objects or columns in the table. One interesting work would be to implement the ontology along with a set of local conditions, such as objects within a neighborhood of Pittsburgh, to evaluate how the ontology performs at a local level.

Another use case is the use of the ontology as a tool to teach accessibility concepts. The mobility relationships within the ontology can be used most effectively within an interactive environment in which people can read about a concept in the ontology and its attributes, then given a certain attribute condition, learn whether this enables or hinders the movement of different travelers. The user of the website could traverse the ontology via relations between objects, actions, or travelers in addition to the mobility relations. Queries like: What hinders crossing the street? What enables access to a building? would be supported. The website will be the repository for all knowledge gained during this dissertation and special effort will be devoted to attaching provenance to each concept and relation in the ontology.

9.7.4 Further evaluation of the ontology

Both Vrandečić (2009) and Sabou and Fernandez (2012) distinguish between two kinds of ontology evaluation: verification (did we build the ontology correctly?) and validation (did we build the right ontology?). The ontology was verified during the dissertation work using the competency questions and a satisfactory level of verification was reached. Further verification will strengthen the ontology and highlight areas of future development. A next step in the verification would be to measure what Burton-Jones et al. (2005) define as interpretability; a measure that evaluates an ontology against WordNet, a lexical database of synsets. According to the WordNet website, WordNet contains "nouns, verbs, adjectives and adverbs [that] are grouped into sets of cognitive synonyms (synsets), each expressing a distinct concept". The purpose of this evaluation is to ensure that the terminology chosen to represent the concepts are interpretable. In other words, are they terms with a clear meaning that can be mapped to a comprehensive lexicon? Burton-Jones et al. (2005) define the interpretability (EI) measure as follows: "let C be the total number of terms used to define classes and properties in [the] ontology. Let W be the number of terms that have a sense listed in WordNet. Then EI=W/C". Thus, C will be all the terms in the derived ontology and W will be the subset of C that match a synset in WordNet. In the case that a term does not have a sense in WordNet, the provenance of the term will be investigated. There are two possible outcomes of the investigation, either a justification for keeping the term or changing the term will be written and added to the term's provenance information. If the term needs to be changed, the Oxford English Dictionary will be consulted as the reference for potential synonyms. In order for the ontology to be considered interpretable, 80% of the terms should be matched.

The second type of evaluation is validation. The ontology was constructed using a data-driven process by the researcher, thus, allowing people from the two target groups to explore and discuss the ontology in an interview or focus group would be a first step to validate the work. Evaluation approaches that utilize people are often more sophisticated than automatic methods and offer more valuable insight (Sabou and Fernandez 2012). For this evaluation step, the target populations under study, people who use wheelchairs and people with low to no vision, will be used as expert evaluators. In order to make the ontology accessible to these communities, the interactive website (discussed earlier as a teaching tool) containing all the concepts, their definitions and relationships is needed. The website will include all the information and provenance for each concept and relation in the ontology. To enable interaction by all communities of users, the website will be compliant with web accessibility standards. The tool AChecker (https://achecker.ca/checker/index.php) will be used to evaluate and fix the web accessibility of the website because it includes the largest number (nine) of standards for web accessibility among its competitors.

Focus groups are a common method to gather requirements from people (Section 3.1.1) for multiple areas of research related to accessibility of the environment. During the focus group, participants will spend the first half of the time interacting with the ontology individually and the second half discussing their observations with the researchers and each other. During the individual portion, the participants will be asked to interact with the concepts in the ontology and identify any false statements or false information they encounter. These will be recorded as they are found. Burton-Jones et al. (2005) present several measures of pragmatic quality for ontologies. One of these, Accuracy (PU), is relevant to this evaluation. Burton-Jones et al. (2005) define accuracy as: “let NS be the number of statements in ontology. Let F be the number of false statements. PU=F/NS. Requires evaluation by domain expert and/or truth maintenance system”. The false statements identified by the participants will be used as a measure of accuracy for the ontology.

9.8 SUMMARY

This dissertation aimed to take a deep dive into the concept of accessibility in the context of wayfinding using a set of five unique datasets to generate an ontology. The resulting ontology includes concepts related to the physical environment, actions performed in the environment, and two target groups, people with low to no vision and people who travel in wheelchairs, and a diverse set of relations including a special type of mobility relation to represent accessibility. The methodology designed for this dissertation enabled the synthesis of information from diverse datasets into a coherent set of knowledge and the development of a coding frame that can be used to incorporate a variety of new data into the ontology in the future. An exploration of three research questions revealed that the two target groups have different core wayfinding information needs, entities providing information about accessibility are driven by different goals, and accessibility can be captured using relations between a desired action and its associated environmental context and the person who wants to perform the action.

Contributions of the dissertation include a set of global barriers and facilitators to accessibility, a data-driven ontology design methodology, and an ontology that captures accessibility using a novel set of concepts and relations. The results of the research imply that increased knowledge transfer between researchers and developers is needed along with finer studies of the experiences of specific groups of people with disabilities as opposed to the category ‘people with disabilities’ as a whole. The limitations of the work related to the conceptualization of the target groups, and issues of generalization due to the scope of the conceptualization and the data-driven nature of the methodology. Finally, future works include refining the coding frame, using the ontology to design a database and a teaching tool, and further work on evaluating the conceptualization.

APPENDIX A

CODING FRAME

This appendix defines the core terms used in the study and presents the final version of the coding frame used in this research. Indicators within the examples are highlighted. If the indicator is the absence of context, the type of context that is missing is highlighted.

CORE TERMS

Built Environment: Spaces in the physical world, in which a traveller lives, works, passes through, travels along, and interacts with in any way, that are constructed by humans. This includes indoor and outdoor spaces and the transitions between these spaces.

Mobility: The ability to move through space given the affordances to interact with or pass through the built environment. Barriers and facilitators within the built environment affect mobility.

Barrier: A component of the built environment that hinders mobility (i.e., lacks affordance).

Facilitator: A component of the built environment that enables mobility.

Wayfinding: The activity of determining and planning a trip via actions such as location searching and route finding ahead of time and engaging in decision making in a planning mode; in other words, planning the trip.

Wayfinding Information Need: The information required by a traveler to make an informed choice about how they can purposefully move through the built environment.

OVERVIEW

As discussed in Chapter 3.0 , a coding frame was developed to categorize segments (i.e., segments) of text related to Wayfinding Information Needs, Barrier and Facilitators to Mobility and Actions in the built environment. A coding frame consists of dimensions, categories and subcategories; each dimension and its children are explained below in the Code Book. There are two types of dimensions used in this research, Context Dimensions and Dimensions of Interest.

The **Context Dimensions** are Location, Traveler, Source, and Physical Environment. These dimensions give supporting information about a segment, such as the location in the world, the type of traveller and environmental setting that a segment describes. The Source dimension provides information about the person who composed the text. For each segment, a selection for each context dimension is required, if the information is known.

The **Dimensions of Interest** are Wayfinding Information Need, Barriers, Facilitators and Actions. These dimensions are the focus of this dissertation. These dimensions are relevant to a segment, if the text includes an explicit request for information to support wayfinding or describes a barrier, facilitator or action related to an activity, object or space in the built environment. These dimensions are optional and a selection is not required for each segment.

Below (Figure 30) is a sample segment *"The exterior ramps were small, but the automatic doors were nice"*. The following paragraphs illustrate how the context dimensions and dimensions of interest are coded.

id-- 2146928140 Venue-- The Coast Inn, , British Columbia, Northern America Accessible-- limited Comment-- The exterior ramps were small, but the automatic doors are nice, and the interior shops have lips at the entrances.

Figure 30 Two segments from collaborative comments shared in OpenStreetMap

Context of Figure 30: 'North America-Canada' was selected for the Location dimension because British Columbia is listed as the location of the place being described by the comment. 'Wheelchair-general' was selected for the Traveler dimension because this comment was shared under the tag: *wheelchair:description* which is used in OSM to indicate a comment describing accessibility for a wheelchair. 'Public comment' was selected for the Source dimension because no information is known about the source other than the person shared the comment on a public website, OSM. 'Transition' was selected for the physical environment dimension because the text describes a ramp and automatic door at the entrance (i.e., the transition from outdoor to indoor space) to the Coast Inn.

Dimensions of interest in Figure 30: The text indicates that the ramps near the entrance were small (evidence of a barrier to the 'ramps') and that the automatic door openers were helpful (evidence of a facilitator to the 'entrance' doorway). The text does not indicate a request for information or describe an action on the ramp or at the entrance. Thus, for the dimensions of interest, a selection is not required because there may be no evidence, yet for context dimensions the information should be known.

The remainder of this appendix presents the coding frame used in the dissertation. Each dimension has a table that defines the dimension and its sub-categories, and provides indicators and decision rules to distinguish between similar categories.

DIMENSION 1 – LOCATION

Dimension *Category*	**Definitions, Examples, Decision Rules** <u>Sub-category</u>
Location **(6 categories)**	**Scope:** A unit of coding belongs in this dimension if the location context of the text is known. Location contexts are areas of the world the text is describing. Areas of the world are broken into continents, Africa, Asia, Europe, Oceania, North America, South America. Antarctica is excluded. **Indicators** for this dimension include: ‘countries in’ ‘cities in’ ‘regions in’ ‘states in’ ‘provinces in’ a given area of the world Note about **Examples**: the examples shown for this dimension are contextual units of coding. They give context to the other units of coding within a unit of analysis.
-africa	-africa **Definition:** this category applies if a unit of coding has a location context in a country, region, city, state or province in the continent of Africa. **Example:** “The purpose of this study was to describe the preliminary development and validation of a potential measure for assessing the accessibility of the built environment in <u>*Zambia*</u>.” (Lit-Banda-Chalwe12)
-asia	-asia **Definition:** this category applies if a unit of coding has a location context in a country, region, city, state or province in the continent of Asia. **Example:** “The project is funded by the Hong Kong Polytechnic University, and assisted by the Hong Kong Toilet Association and several non-governmental organizations, which are providing services to VIPs [visually impaired persons] in <u>*Hong Kong*</u>.” (Lit-Siu08)
-europe Subcategories include: <u>--united kingdom</u>	-europe **Definition:** this category applies if a unit of coding has a location context in a country, region, city, state or province in the continent of Europe.

	--united kingdom **Definition:** this category applies if a unit of coding has a location context in a region, city, state or province in England, Wales, Scotland or Northern Ireland. **Example:** **"**Interviews were undertaken with the child's mother in five cases, father in three cases and a grandmother in her role of main carer in one case. Three interviews were undertaken with both parents present. Children, although present during interviews, gave information in only two cases (child 5 and child 7). Nine lived in suburban, one in semi-rural and two in rural settings across the northeast of <u>*England*</u>." (Lit-Lawlor06)
-oceania Subcategories include: <u>--australia</u>	-oceania **Definition:** this category applies if a unit of coding has a location context in a country, region, city, state or province in the continent of Oceania. --australia **Definition:** this category applies if a unit of coding has a location context in a region, city, state or province in Australia. **Example:** "x, y, GMI_AD MIN, ADMIN_ NAME 51.232355, 151.204769, AUS-NSW, <u>*New South Wales*</u>" (OpenStreetMap)
-north America Subcategories include: <u>--united states</u>	-north america **Definition:** this category applies if a unit of coding has a location context in a country, region, city, state or province in the continent of North America. --united states **Definition:** this category applies if a unit of coding has a location context in a region, city, or state in The United States of America. **Example:** "A four-member participant team representing three impairment types: mobility impaired person using a wheelchair, mobility impaired person who was not a wheelchair user, visually impaired person, and a control with no known impairments, challenged a stratified random sample of 30 public buildings in Greater <u>*Boston*</u>."

-south america	-south america **Definition:** this category applies if a unit of coding has a location context in a country, region, city, state or province in the continent of South America. **Example:** "… to identify the level of user satisfaction in six libraries in the various study centers of the Federal University of Pernambuco in Recife, northeast *Brazil*, so as to identify the strengths and also weaknesses in these spatial structures." (Lit-Ferrer12)

DIMENSION 2 – TRAVELER

Dimension *Category*	**Definitions, Examples, Decision Rules** Sub-category
Traveler **(6 categories)**	**Scope:** A unit of coding belongs to this dimension if the group that the text is relevant for is known. This is called a group context. Groups of interest in this research are people with low to no vision and people who travel in wheelchairs. **Indicators** include: 'blindness' 'low vision' 'wheelchair' 'manual wheelchair' 'power chair' 'wheelchair user'
-vision Subcategories include: --blindness --low vision	-vision **Definition:** This category applies if the group context of a unit of coding is the vision group. --blindness **Definition:** This sub-category applies if the group context of a unit of coding is the vision group and there is evidence that it is applicable to people who are blind specifically. **Indicators** include: 'no vision' 'total blindness' **Decision Rule:** If it is unclear whether the text is relevant for blindness or low vision, but it is clear that it is relevant to the vision group, choose the sub-category low vision.

	Example: "As a person who is *blind*" (D-i42) --low vision **Definition:** This sub-category applies if the group context of a unit of coding is the vision group and there is evidence that it is applicable to people who have low vision. **Indicators** include: 'vision loss' 'limited vision' 'vision impairment' 'Braille or tactile characters' **Decision Rule #1:** If it is unclear whether the text is evidence for blindness or low vision, but it is clear that it is relevant to the vision group, choose this category. **Example:** "I have *low vision* so I use some visual cues." (C9b-34)
-wheelchair Subcategories include: --general --manual chair --power chair	**-wheelchair** **Definition:** This category applies if the group context of a unit of coding is the wheelchair group. --general **Definition:** This sub-category applies if the group context of a unit of coding is the wheelchair group. **Indicators** include: 'wheelchair user' 'mobility impairment' **Example:** "…sample of adult *wheelchair-users* in Boston, Massachusetts and Durham, North Carolina, USA." (Lit-Meyers02) --manual chair **Definition:** This sub-category applies if the group context of a unit of coding is the wheelchair group. **Indicators** include: 'manual wheelchair' 'manually propelled' 'manual chair' **Example:** "The wheelchair user, in his early 30s, was a paraplegic who used a *manual wheelchair*." (Lit-Thapar04)

	--power chair **Definition:** This sub-category applies if the group context of a unit of coding is the wheelchair group. **Indicators** include: ‘power wheelchair’ ‘automatic wheelchair’ **Example:** “back room (rented out for parties etc., not in regular use) is up 3 average-sized steps. owner has a homemade "ramp" that is quite steep and won't hold a *power chair*.” (OpenStreetMap)
-target groups	**-target groups** **Definition:** This category applies if the group context of a unit of coding is one of the target groups, either the wheelchair group or the vision group, but it is unclear which one a text snippit is discussing. For instance, in Example 1, researchers interview people with low to no vision and people with mobility impairments and report their findings often without delineating which group the finding relates to. **Example**: 1: “A qualitative study was conducted employing in-depth interviews and focus groups to explore the tourism experiences of *individuals with mobility or visual impairments*.” (Lit-Yau04) 2: “Further, interviews and surveys were conducted with … [agencies and] two rehabilitation hospitals, twelve travel agencies, and thirty-two *persons legally handicapped* who travel long distance at least once each year.” (Lit-Cavinato92)

DIMENSION 3 – SOURCE OF EVIDENCE

Dimension *Category*	**Definitions, Examples, Decision Rules** Sub-category
Source of evidence (10 categories)	**Scope:** A unit of coding belongs to this dimension if the source of the information being used as evidence is known. This is called the source context. Sources of evidence in this research are based on ‘who’ is saying the information. In some cases it is people with disabilities, in others it is a professional, and still in others it is a codified document.

	Indicators include: ‘affiliations’ ‘as a person with…’ ‘as a professional’ ‘survey’ ‘interview’ ‘participants said’
-access professional	-access professional **Definition:** This category applies if the source of a unit of coding is an access professional. Access professionals include people who work with people with disabilities or have advanced degrees in rehabilitation, nursing, architecture, occupational therapy, physical therapy, gerontology, and practitioners in clinical medical sciences or veterans affairs centers. **Decision Rule**: if the text is the result of analysis conducted by a researcher or professional and it is being relayed not as a finding but as a potential scenario or recommended best practice, this category applies. **Example:** “A second obstacle <u>*that may arise*</u> before the person enters the restaurant is the absence of a ramp.” (Lit-McClain93)
-tourism professional	-tourism professional **Definition:** This category applies if the source of a unit of coding is an tourism professional. Tourism professionals include people who have advanced degrees in business or tourism studies, and practitioners in travel agencies. **Decision Rule**: if the text is the result of analysis conducted by a researcher or professional and it is being relayed not as a finding but as a potential scenario or recommended best practice, this category applies. **Example:** “<u>*TGSIs assist people*</u> to use tactile markers to way-find by warning of upcoming dangers (roads, edge of railway platforms etc) and changes in direction (at the crossings on roads etc).” (Lit-Packer08)
-wayfinding professional	-wayfinding professional **Definition:** This category applies if the source of a unit of coding is a wayfinding professional. Wayfinding professionals include people who work with routing and navigation systems or have advanced degrees in computer science, or urban planning and practitioners in routing and navigation in industry. **Decision Rule**: if the text is the result of analysis conducted by a researcher or professional and it is being relayed not as a finding but as a potential scenario or recommended best practice, this category applies.

	Example: "*In a scenario* where a blind user wants to reach a new place from a subway station, the system would mention the location of, e.g., the surrounding streets, the church, the bank, the mail office, etc." (Lit-Kammoun10)
-person with a disability	-person with a disability **Definition:** This category applies if the source of a unit of coding is not a member of the group the text refers to (i.e., equivalent to the Traveler designation) but is a person with a disability. Groups of people with disabilities include the two target groups of this research, people with low to no hearing, people of advanced age, people who cannot walk far, people who use mobility aids such as canes, people with cognitive disabilities, people with learning disabilities, people with hand differences, among others. **Example:** "*I am a person with disabilities* and I think a major improvement to the fixed route bus system for disabled community members who must or want to travel during night time hours or on cloudy, rainy days would be bus stops that are well lit but don't require electricity for lighting." (Di4-s)
-person with a disability-member of target group	-person with a disability-member of target group **Definition:** This category applies if the source of a unit of coding is a member of the group the text refers to or it is clear that the person is talking about themselves. **Example:** "These steps lead the way for me to interact with friends. These steps stop me in *my tracks*. There is no ramp. These steps are *my enemy*. -Participant 7" (Lit-Newman10)
-standard	-standard **Definition:** This category applies if the source of a unit of coding is a standard guideline for accessibility. Examples include guidelines prepared for the Americans with Disabilities Act, Equality Act and Disability Discrimination Act. **Indicator:** if the text comes from a standard guideline document, this category applies. **Example:** "Edge protection is a small curb constructed on the side of the ramp that prevents a mobility device from rolling over the side and provides

	people with low or no vision with a detectable edge." (Standard-ADAAG)
-observation	-observation **Definition:** This category applies if the source of a unit of coding is a result from observing a person during a research study or in the real world. **Example:** "For example, alternative accessible entrances at seven buildings *facilitated access* for the wheelchair user" (Lit-Thapar04)
-public comment	-public comment **Definition:** This category applies if the source of a unit of coding is a public website but no other information about the person who composed the text is known. In the example, there is no indication of who wrote the comment or any other information than the comment itself, thus, the group context is missing. **Example:** "the interior shops have lips at the entrances." (OpenStreetMap)
-survey	-survey **Definition:** This category applies if the source of a unit of coding is a result from a research survey. **Example:** "The conclusion is supported by the great amount of environmental features for orientation named by *respondents of the survey*. Examples include tactilely sensible features such as curbs, stairs, fences, balustrades, round composition, and changes of ground composition." (Lit-Volkel08)
-interview	-interview **Definition:** This category applies if the source of a unit of coding is a result from an interview or focus group. **Example:** "*One participant reported* how difficult it was for her to cross a street neat a crossing because of limited sight. She had bad sight in one eye and said: When I am looking in the other direction a bus can arrive at the pedestrian crossing before I notice that. I have better overview on straight roads and it is easier for me to cross there." (Lit-Carlsson04)

DIMENSION 4 PHYSICAL ENVIRONMENT

Dimension Category	Definitions, Examples, Decision Rules Sub-category
Physical Environment (5 categories)	**Scope:** A unit of coding belongs to this dimension if the environment of the area or object being described is known. This is called the environment context. Environments include indoor space, outdoor space or the transition between indoor and outdoor spaces. **Indicators** include: 'indoor' 'outdoor' 'entering' 'leaving' 'inside' 'outside'
-indoor	-indoor **Definition:** This category applies if a unit of coding is relevant to or describes an indoor space. Indoor spaces are typically a structure like a building or a room. **Example:** "*inside* is spacious enough to move with a wheelchair; Chairs can be moved at tables" (OpenStreetMap)
-indoor/outdoor	-indoor-outdoor **Definition:** This category applies if a unit of coding is relevant to both indoor and outdoor space. It may describe an object or an area that is present in both indoor or outdoor spaces. In the example, there is no indication of what physical environment is being discussed and the text describes something applicable to both indoor and outdoor space, the environmental context is missing. **Example:** "suitable *lighting*" (Lit-Richards10)
-outdoor	-outdoor **Definition:** This category applies if a unit of coding is relevant to or describes an outdoor space. Outdoor spaces are typically streetscapes, yard areas, or open areas with walking paths like parks. Wilderness areas are not considered in this research. **Example:** "The type of surface on a *sidewalk* or walkway can affect drainage. When water pools, it can make pedestrian travel difficult and sometimes even dangerous. For example, pooled water can freeze in winter and can increase the chances of pedestrian slips and falls." (Standard-ADOA)

-transition	-transition **Definition:** This category applies if a unit of coding is relevant to or describes the movement or space between indoor and outdoor space or vice versa. **Example:** "*Door* is too marrow. Have to get both *doors* opened." (OpenStreetMap)
-transit vehicle	-transit vehicle **Definition:** This category applies if a unit of coding is relevant to entering a transit vehicle or the space within a transit vehicle. **Example:** "Inadequate space on many *trains* for wheelchair access to washrooms or food facilities." (Lit-Freeman10)

DIMENSION 5 – WAYFINDING INFORMATION NEED

Dimension *Category*	**Definitions, Examples, Decision Rules** Sub-category
Wayfinding Information Needs (15 categories)	**Scope:** A unit of coding belongs in this dimension if it describes a need for information about wayfinding or moving through indoor or outdoor environments. Wayfinding is the planning of a route from one place to another. Sometimes information is needed ahead of time and other times it is needed in situ. This dimension captures both types of information need. **Indicators** for this dimension include: 'explain' 'list' 'describe' 'information' 'search' 'need to know' 'tell me' 'give me' 'where is…?'
-about level of ambient noise	-about level of ambient noise **Definition:** This category applies if a unit of coding indicates a need for information about ambient noises in the environment. **Indicators** include: 'noise' 'ambient noise' 'loud'

	Example: 1: "It's sometimes *hard to tell* where you are especially if it's *very noisy* or there are a lot of obstacles to go around." (C8e-16);
-about availability of assistance services	-about availability of assistance services **Definition:** this category applies if a unit of coding indicates a need for information about the availability of assistance services for navigating or interacting with the environment. **Indicators** include: 'availability of' 'assistance' 'assistance services' 'aid' 'help' 'assistant' **Example:** 1: "*What is available* for *assistance*" (C8a-20); 2: "*availability of assistance* and presence of travel partners" (Lit-Yau04)
-about a building *Subcategories include:* --bathrooms --carpeting --elevators --entrances --layouts	-about a building **Definition:** This category applies if a unit of coding indicates a need for information about the general layout of a building or a specific aspect of a building such as the entrance, elevator, carpeting, or bathroom. **Indicators** for this category include: 'building' 'entrance' 'bathroom' 'layout' ' --bathrooms **Definition:** This sub-category applies if a unit of coding indicates a need for information about the bathroom(s) in a building or structure. **Example:** "They need to *identify information* on accessibility to … *toilets* …" (Lit-Yau04) --elevators **Definition:** This sub-category applies if a unit of coding indicates a need for information about the elevator(s) in a building or structure. **Example:** "Many *elevators* and hallways were not equipped with braille signs or voice indicators, necessitating one Canadian to wait in the hotel lobby more than one hour to be taken to her room after being checked in.

	When the concierge did take her to her room she had to continually *ask him* to tell her *where to find* the means to be independent, such as the location of the floor buttons in the elevator." (Lit-Freeman10) --entrance **Definition:** This sub-category applies if a unit of coding indicates a need for information about the entrance of a building or structure. **Example:** "*Finding* non-obvious *entrances* to buildings." (C8d-27); --layout **Definition:** This sub-category applies if a unit of coding indicates a need for information about the general layout of a building or structure. **Indicators:** 'open space' layout' **Example:** "If the *destination* has a lot of *open space* *finding my way* is more difficult." (C8e-29)
-about lighting	-about lighting **Definition:** this category applies if a unit of coding indicates a need for information about the lighting at a location or lighting of an object. **Indicators** include: 'lighting' 'well lit' 'illumination' **Example:** "Lighting | *Is* the street *lighted*?" (Lit-Neis14)
-about parking	-about parking **Definition:** This category applies if a unit of coding indicates a need for information about parking spaces, structures or lots. **Indicators** include: 'parking' 'garage' 'lot' 'street parking' **Example:** "additional *information* defined by wheelchair users | disabled *parking*" (Lit-Pressl10)

-about pathways *Subcategories include:* --general --hallways --pedestrian path	-about pathways **Definition:** This category applies if a unit of coding indicates a need for information about a pathway. Pathways are pedestrian paths or hallway paths. Pedestrian paths are outdoor features only; hallway paths are indoor features only. Pedestrian paths include the following (Kasemsuppakorn 2011, 14): sidewalk, pedestrian walkway, accessible path/ramp, crosswalk, pedestrian bridges, pedestrian tunnels, trails. This research considers crosswalk in a separate category: 'pedestrian crossing' and does not include trails. **Indicators** include: 'pedestrian' 'walkway' 'path' 'pathway' 'hallway' 'hall' 'sidewalk' 'pedestrian bridge' 'pedestrian tunnel' **Decision Rule #1:** If a unit of coding discusses the crosswalk feature of the pedestrian environment, use the category *'-about pedestrian crossing'* instead of this category. **Decision Rule #2:** If a unit of coding indicates the act of navigating or traveling along the path, or directions along a route, use the category *'-about a route'* instead of this category. --general **Definition:** This category applies if a unit of coding indicates a need for information about a pathway that is applicable to both hallways and pedestrian paths or is not specific enough to be placed into one of the other two subcategories. **Example:** None found. --hallways **Definition:** This category applies if a unit of coding indicates a need for information about a hallway path. **Example:** None found. --pedestrian paths **Definition:** This category applies if a unit of coding indicates a need for information about a pedestrian path. **Special Indicators for pedestrian path:** 'yellow bumps' 'tactile indicators' 'tactile warning'

	Example: "<u>*details about*</u> … <u>*sidewalks*</u>." (T9a-15);
-about pedestrian crossing	-about pedestrian crossing **Definition:** this category applies if a unit of coding indicates a need for information about a pedestrian crossing. It could be as simple as Example 1 or as detailed as Example 2. **Indicators** include: ‘crossing’ ‘intersection’ ‘signal’ **Example:** 1: "The tool would <u>*list*</u> <u>*intersections*</u>..." (T9a-13); 2: "I would like real time accurate announcement of approaching intersections with details about the type of intersection..." (T9a-15)
-about public objects	-about public objects **Definition:** this category applies if a unit of coding indicates a need for information about a public object in the environment. Public objects include drinking fountains, water fountains, light poles, trash cans, benches, parking meters, planter boxes, among other objects on the street or in a building. **Indicators** include: ‘fountain’ ‘light pole’ ‘trash can’ ‘bench’ ‘parking meter’ **Example:** “There is a device called a mini guide I believe that might be useful in some situations for <u>*finding verticle objects*</u>, since the dog I work is trained to <u>*avoid them*</u>.” (T7-4)
-about public transit	-about public transit **Definition:** this category applies if a unit of coding indicates a need for information about public transit. Public transit includes stops where transit vehicles can be boarded and vehicles such as trains, buses and trolleys. **Indicators** include: ‘transit’ ‘schedule’ ‘bus’ ‘train’ ‘stop’ ‘paratransit’ ‘transportation’ ‘transit route’ **Example:** 1: "<u>*Identifying*</u> the appropriate <u>*stop*</u> to deboard" (D-i12);

	2: "Getting … <u>*transit route info*</u> is sometimes difficult." (C8a-32);
-about routes *Subcategories:* <u>--general</u> <u>--enroute</u> <u>--directions</u> <u>--gradient</u> <u>--obstacle</u> <u>--landmarks</u>	-about routes **Definition:** this category applies if a unit of coding indicates a need for information about a navigation route. The requested information could be related to directions along a route, what to expect along the route, obstacles along a route, or landmarks along a route. A route is defined as a path between an origin and destination. It could be indoor-to-indoor, outdoor-to-outdoor, indoor-to-outdoor, or outdoor-to-indoor. <u>--general</u> **Definition:** this category applies if a unit of coding indicates a need for information about a navigation route but does not specify any details. **Example:** "It would be able to <u>*navigate*</u> inside buildings as well, <u>*providing details*</u> of the indoor environment as well." (T9a-10) <u>--what to expect enroute</u> **Definition:** this category applies if a unit of coding indicates a need for information about what to expect when traveling along a route. **Indicators** include: 'enroute' 'along the way' 'pass' **Example:** 1: "Give me <u>*information*</u> as to <u>*what I'm passing*</u> along the way." (T9a-7); 2: "<u>*knowing*</u> what to expect <u>*en route*</u>" (C8d-19); <u>--destinations</u> **Definition:** This category applies if a unit of coding indicates a need for information about a destination of a route or trip. It could be the terminal destination or a destination along the way. It also applies if the unit of coding indicates a need for information about 'destinations' in the sense of a point of interest or attraction in a city. **Indicator:** 'POI' 'attraction' 'restaurant' 'hotel' 'where I am going' 'destination' **Example:**

	1: "I'd be able to *travel to* a shopping mall and *know* where each store is in that mall" (T9a-19); 2: "I am thinking of the kind of *guide information* provided at conventions of blind people about the *hotels* and surrounding *neighborhoods*." (C8i-32) --directions **Definition:** this category applies if a unit of coding indicates a need for information about the decisions along a route. Decisions include turning, stopping, advancing. **Indicators** include: 'directions' 'navigate' 'turn-by-turn' **Example:** 1: "Turn-by-turn *directions*, directional *information*" (T9b-18); 2: "Inability *to access* clear *directions*." (C8i-31) --gradient **Definition:** this category applies if a unit of coding indicates a need for information about the gradient along a route. **Indicators** include: 'slope' 'gradient' 'incline' 'steepness' **Example:** "small *scarp* on the path" (Lit-Chen15) --obstacles **Definition:** this category applies if a unit of coding indicates a need for information about obstacles along a route. Obstacles block or inconvenience passage along a route. **Example:** "It would *guide me* from one point to another, avoiding *obstacles*" (T9a-10); --landmarks **Definition:** this category applies if a unit of coding indicates a need for information about landmarks. Landmarks are objects or experiences in the environment that help with orientation. Landmarks can be visual, olfactory, sonic, and tactile. **Indicators** include: 'smell' 'odor' 'olfactory' 'sonic' 'hear' 'sound'

	‘audio’ ‘noise’ ‘touch’ ‘feeling’ ‘tactile’ ‘reach’ ‘vision’ ‘visual’ ‘sight’ ‘see’ ‘look for’ **Example:** "The tool would *list* … *landmarks*." (T9a-13); "If I haven't been to the destination before, *I don't know* the *landmarks* to use." (C8e-29);
-about accommodations for service animals	-about accommodations for service animals **Definition:** this category applies if a unit of coding indicates a need for information about accommodations for service animals such as bathroom areas, or water areas. **Indicators** include: ‘service animal’ ‘dog’ ‘companion’ **Example:** “*Dog service users* need an App that identifies with map an ddirecetions locations where SD’s can do their *potty business*. This would be helpful in unfamiliar locations and airports when traveling.” (Dialogue)
-about street layout	-about street layout **Definition:** This category applies if a unit of coding indicates a need for information about the layout of the street and does not indicate a specific destination. **Indicators** include: ‘streetscape’ ‘layout’ ‘streets’ **Example:** 1: "I still feel I lack necessary *information* about *street layout* and such" (C8i-32); 2: "Also just *getting familiar* with the *general layout of a city* can be troublesome." (C8a-32)
-about tourism	-about tourism **Definition:** This category applies if a unit of coding indicates a need for information about tourist attractions or planning a trip involving more than one route. **Example:** 1: “need to identify *information* on accessibility to *scenic spots*” (Lit-

	Yau04) 2: "<u>*information*</u> availability and planning | books, <u>*travel brochures*</u>, publications | more detail needed as well as improved dissemination of information" (Lit-Cavinato92)
-about wayfinding	-about wayfinding **Definition:** This category applies if a unit of coding indicates a need for information about the wayfinding process. The wayfinding process includes the planning of a trip involving one route from an origin to one or more destinations. **Decision Rule:** If a unit of coding discusses information related to hotel accommodations or tourist destinations, use the category '*-about tourism*' instead of this category. **Example:** 1: "I find GPS useful because I get <u>*information*</u> I wouldn't otherwise have, such as names of <u>*intersections and landmarks*</u>." (TSurvey) 2: "variations in *street pavement* surfaces and smoothness, steep road inclines, curb boarder heights, narrow street or sidewalk widths and holes or gaps in the <u>*streets or sidewalks*</u>." (Lit-Menkens10)
-about weather	-about weather **Definition:** This category applies if a unit of coding indicates a need for information about the weather conditions during a trip. **Example:** None found.

DIMENSION 6 - BARRIERS

Dimension *Category*	**Definitions, Examples, Decision Rules** <u>Sub-category</u>
Barriers **(27 categories)**	**Scope:** This dimension applies if a unit of coding describes or indicates a barrier to mobility. Mobility is defined as the ability to move through space given the affordances to interact with or pass through the built

	environment. A barrier is a component of the environment that hinders mobility (i.e., lacks affordance). When choosing the appropriate category, data that describes a barrier TO some space or object is desired. For example, 'drinking fountain juts out into the sidewalk'. This is an example of a barrier TO the sidewalk not the drinking fountain. If the text were 'drinking fountain to high' then it is an example of a barrier TO a public object - the drinking fountain. **Indicators** include: 'barrier' 'block' 'hinder' 'prevent'
-to general mobility	-to general mobility **Definition:** This category applies if the unit of coding describes a barrier to general mobility that does not apply a specific space, object or time of travel and is not relevant to the act of wayfinding. In other words, this category applies if the unit of coding discusses barriers to 'getting around' in general. **Example:** 1: "Child 9 father: We were going to go to Edinburgh but decided not to because there are stairs everywhere and *you can't get around*. What would normally have taken 5 minutes would take 20, it was *impractical*." (Lit-Lawlor06) 2: "Restroom accessibility was a *global problem*. Only 60% of the restrooms were accessible" (Lit-McClain93)
-to nighttime mobility	-to nighttime mobility **Definition:** This category applies if the unit of coding describes a barrier to mobility that is only present at night. **Example:** "Everytime a wheelchair user *travels at night* they are at risk. Cars, bicycles, motor scooters all have lights to alert others to their presence. I *cannot* take my wheelchair on the streets at night and say for sure I will make it home safely." (Dialogue)
-to destination	-to destination **Definition:** This category applies if the unit of coding describes a barrier to finding a destination. **Example:** "If I haven't been to the destination before, I don't know the landmarks to

	use. If the <u>*destination*</u> has a lot of open space finding my way is more <u>*difficult*</u>." (Challenges Survey)
-to route	-to route **Definition:** This category applies if the unit of coding describes a barrier to following a route. **Example:** "obstacles have a strong influence on the success of <u>*navigational activities*</u>, especially for blind pedestrians. The effects of these barriers can be either to block the blind pedestrian, so he or she has to change the <u>*current path*</u>, or it is possible for him or her to encounter such an <u>*obstacle*</u> while continuing in the same path." (Lit-Chen15)
-to service	-to service **Definition:** This category applies if the unit of coding describes a barrier to a service, such as eating in a restaurant, or getting cash from a bank). **Example:** 1: "Counters for customer <u>*service*</u> <u>*extremely high*</u>" (OpenStreetMap) 2: "WA3: <u>*Restaurants*</u> are <u>*badly*</u> lit and dim and I really cannot see" (Lit-Parker 08)
-to wayfinding	-to wayfinding **Definition:** This category applies if the unit of coding describes a barrier to the process of wayfinding in general or sensory experiences without mentioning specific spaces or objects. **Example:** 1: "not knowing what to expect, <u>*no familiar or known landmarks*</u>" (C8e-19); 2: "poor lighting and poor design, or layout of the buildings, made it <u>*difficult to locate destinations*</u> that further aggravated these problems." (Lit-Thapar04)
-to SPACES *Sub-categories include:* <u>--indoor space</u> <u>--outdoor space</u> <u>--room</u>	-to SPACES **Definition:** This category applies if the unit of coding describes a barrier to a space. <u>--indoor space</u>

--bathroom --building --entrance/exit --hallway --hallway intersection --interior doorway --parking structure --pedestrian crossing --pedestrian path	**Definition:** This sub-category applies if the unit of coding describes a barrier to moving through indoor space in general but does not mention specific aspects or elements of the space. **Example:** "Challenges in *indoor space* |It *wouldn't have* a lot of *hard surfaces* with sound bouncing off them. I would have a lot of soft furnishings that absorb sound so that you can identify the source of sound more clearly." (Lit-Packer08) --outdoor space **Definition:** This sub-category applies if the unit of coding describes a barrier to outdoor space in general but does not mention specific aspects or elements of the space. **Example:** "Challenges in *outdoor space* |Total unfamiliarity and noise cover all of the difficulties for me." (C8e-31); "Depending on how familiar I was with the *outdoor spaces*, in may be *challenging* in reaching my destination. For example, being on a college campus with varying paths of travel." (C8e-34); --room **Definition:** This sub-category applies if the unit of coding describes a barrier to traveling through or within a room. **Example:** "The meeting *room* has *two steps* into it." (Standard-EA) --bathroom **Definition:** This sub-category applies if the unit of coding describes a barrier to maneuvering within a bathroom or using objects within a bathroom. **Example:** "*barriers* included *washrooms stall* that could not accommodate wheelchair users" (Lit-Ripat04) --building **Definition:** This sub-category applies if the unit of coding describes a barrier to a building in general but not specific aspects or objects within

the building, e.g. doorway or hallway.

Example:
1: "If the *destination has a lot of open space* finding my way is more *difficult*." (C8e-29);

2: "Open spaces are also challenging. *Finding elevators* is also *hard* in a new environment." (C8f-29);

--entrance/exit

Definition: This sub-category applies if the unit of coding describes a barrier to mobility when moving from indoor space to outdoor space, or outdoor space to indoor space. In other words, moving from inside a building to the outside and vice versa.

Indicators: 'threshold' 'going outside' 'going inside' 'entering a building'

Example:
1: "*Difficulty* in the change of sound cues *from indoor and outdoor* and vice versa. It takes some adjusting. All kinds of sound cues, even tactual cues and what you pick up through your shoes or you feet. An example for sound would be going from indoor to outdoor if its windy - that can provide a terrible challenge. Going from rug environment on the inside to Lord knows what you might hit on the outside." (C8j-31);

2: "steps or flooring differences" (C8j-40);

--hallway

Definition: This sub-category applies if the unit of coding describes a barrier to passage along a hallway within an indoor space.

Example:
"They like to use the bathroom *hallways* *as storage* for clothing racks." (OpenStreetMap)

--interior doorway

Definition: This sub-category applies if the unit of coding describes a barrier to mobility when moving through a doorway. This category applies if it is a doorway within indoor space. If the door way is between outdoor spaces, or from indoor space to outdoor space or vice versa, use the –entrance/exit sub-category.

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Example:
“I <u>don’t want to have to be the one</u> that only uses the <u>door</u> that’s locked, and therefore I’ll call ahead to make sure that the door is unlocked.” (Lit-Pusch04)

<u>--parking</u>

Definition: This sub-category applies if the unit of coding describes a barrier to traveling through or within a parking structure.

Example:
“<u>Uneven</u> pavement in <u>parking lot</u> nearby.” (OpenStreetMap)

<u>--pedestrian crossing</u>

Definition: This sub-category applies if the unit of coding describes a barrier to mobility when traveling through a pedestrian crossing.

Example:
“It would be much less expensive than <u>Audible signals</u> and would also be far less proan to <u>failure</u> then audible signals are.” (T9e-4);

<u>--pedestrian path</u>

Definition: This sub-category applies if the unit of coding describes a barrier to mobility when traveling along a pedestrian path. Pedestrian paths are outdoor features only. Pedestrian paths include the following (Kasemsuppakorn 2011, 14): sidewalk, pedestrian walkway, accessible path/ramp, crosswalk, pedestrian bridges, pedestrian tunnels, trails. This research considers crosswalk in a separate category: ‘pedestrian crossing’ and does not include trails.

Example:
1: “<u>Challenges</u> in outdoor space | “curb cuts, <u>sidewalk</u> surfaces” (C8b-20);

2: “<u>Sidewalk</u> contours -- sometimes need to go <u>much, much slower</u>.” (C8d-31);
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-to OBJECTS

Sub-categories include:
<u>--elevator</u>
<u>--public object</u>
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<td>
-to OBJECTS

Definition: This category applies if the unit of coding describes a barrier to using or interacting with an object in the environment.
</td>
</tr>
</table>

--ramp --seating --signage --stairway	--elevator **Definition:** This sub-category applies if the unit of coding describes a barrier to entering or riding in an elevator. **Example:** "*narrow lift*" (OpenStreetMap) --public object **Definition:** This sub-category applies if the unit of coding describes a barrier to interacting with or using a public object. Public objects include drinking fountains, water fountains, light poles, trash cans, benches, parking meters, planter boxes, among other objects on the street or in a building. **Example:** "*high telephones and drinking fountains*" (Lit-Thapar04) --ramp **Definition:** This sub-category applies if the unit of coding describes a barrier to using a ramp. **Example:** "405.10 Wet Conditions. *Landings* subject to wet conditions shall be designed to prevent the *accumulation of water*." (Standard-ADA) --seating **Definition:** This sub-category applies if the unit of coding describes a barrier to using a ramp. **Example:** "*unfortunately* all *seating* in wheelchair accessible indoor area is high top tables." (OpenStreetMap) --signage **Definition:** This sub-category applies if the unit of coding describes a barrier to interacting with or using a sign. **Example:** "Qualitative analysis showed that dim lighting on *signs* was cited as a *problem*, and that the print on sights was often *too small*." (Lit-Reid06)

	--stairway **Definition:** This sub-category applies if the unit of coding describes a barrier related to a stairway. **Example:** "*Non signalized* *stairs*" (Lit-Laakso12)
-to TRANSIT *Sub-categories include:* --transit stop --transit vehicle --transit (general)	-to TRANSIT **Definition:** This category applies if the unit of coding describes a barrier to using, riding, finding public transit. --transit stop **Definition:** This sub-category applies if the unit of coding describes a barrier at a public transit stop. **Example:** "I *have to roll through it* every single day to get to the *bus stop*." (Lit-Duggan) --transit vehicle **Definition:** This sub-category applies if the unit of coding describes a barrier at a public transit stop. **Example:** "Very smack area of curb in grassed area, so *bus* *can not* always *line up with curb* depending on how cars have parked." (OpenStreetMap) --transit (general) **Definition:** This sub-category applies if the unit of coding describes a barrier to mobility when taking public transit but does not specify a barrier at a transit stop or transit vehicle. Public transit includes: buses, trains and streetcars. **Example:** "participants described many *challenges* when using public transit including finding *bus stops*, knowing which bus to board, and when to disembark." (Lit-Hara13)

DIMENSION 7 – FACILITATORS

Dimension -category	**Definitions, Examples, Decision Rules** <u>--sub-category</u>
Facilitators **(27 categories)**	**Scope:** This dimension applies if a unit of coding describes or indicates a facilitator to mobility. Mobility is defined as the ability to move through space given the affordances to interact with or pass through the built environment. A facilitator is a component of the environment that enables mobility. When choosing the appropriate category, data that describes a facilitator TO some space or object is desired. For example, 'drinking fountain juts out into the sidewalk'. This is an example of a facilitator TO the sidewalk not the drinking fountain. If the text were 'drinking fountain to high' then it is an example of a facilitator TO a public object - the drinking fountain. **Indicators** include: 'facilitator' 'aid' 'help' 'enable' 'allow' 'support'
-to general mobility	-to general mobility **Definition:** This category applies if the unit of coding describes a facilitator to general mobility that does not apply a specific space, object or time of travel and is not relevant to the act of wayfinding. In other words, this category applies if the unit of coding discusses facilitators to 'getting around' in general. **Example:** "<u>*Community transportation*</u> begins with accessible buses, but doesn't end there. <u>*We need*</u> accessible sidewalks, accessible bus stops, crosswalks, and streets that are <u>*safe for ALL their users, regardless of mode of travel, or ability*</u>." (Dialogue-40)
-to nighttime mobility	-to nighttime mobility **Definition:** This category applies if the unit of coding describes a facilitator to mobility that is only present at night. **Example:** "I am a person with disabilities and I think a major <u>*improvement*</u> to the fixed route bus system for disabled community members who must or want to <u>*travel during night time hours*</u> or on cloudy, rainy days would be bus stops that are well lit but don't require electricity for lighting. Lights for night time security lighting should be provided by solar power

	batteries at the top of the bus shelter." (Di4-s)
-to destination	-to destination **Definition:** This category applies if the unit of coding describes a facilitator to finding a destination. **Example:** None found.
-to route	-to route **Definition:** This category applies if the unit of coding describes a facilitator to following a route. **Example:** "307.5 Required Clear Width. Protruding objects shall not reduce the *clear width* required for accessible *routes*." (Standard-ADA)
-to service	-to service **Definition:** This category applies if the unit of coding describes a barrier to a service, such as eating in a restaurant, or getting cash from a bank). **Example:** "*Lots of* floor room. *Bank machines* are a *good* height for wheelchair users and also have stability handles." (OpenStreetMap)
-to wayfinding	-to wayfinding **Definition:** This category applies if the unit of coding describes a facilitator to the process of wayfinding in general or sensory experiences without mentioning specific spaces or objects. **Example:** "The tool would list intersections and landmarks. It would also let me look at the intersections and landmarks when I was still at my home so I could *familiarize myself with the area before actually going out*." (Technology Survey)
-to SPACES *Sub-categories include:* --indoor space --outdoor space --room	-to SPACES **Definition:** This category applies if the unit of coding describes a facilitator to a space. --indoor space

--bathroom --building --entrance/exit --hallway --hallway intersection --interior doorway --parking structure --pedestrian crossing --pedestrian path	**Definition:** This sub-category applies if the unit of coding describes a facilitator to moving through indoor space in general but does not mention specific aspects or elements of the space. **Example:** "*I use sound a lot* *indoors*. Things like running water fountains, flushing commodes, humming lights, printers, phone ringing, etc. I also tap my metal-tipped cane a bit now and then for the echo effect." (Challenges Survey) --outdoor space **Definition:** This sub-category applies if the unit of coding describes a facilitator to outdoor space in general but does not mention specific aspects or elements of the space. **Example:** "*Outdoor* *landmarks* | poles, trees benches changes in sidewalks terraine" (Challenges-60) --room **Definition:** This sub-category applies if the unit of coding describes a facilitator to traveling through or within a room. **Example:** "*Light switches* at a *reasonable* height" (Lit-Darcy) --bathroom **Definition:** This sub-category applies if the unit of coding describes a facilitator to maneuvering within a bathroom or using objects within a bathroom. **Example:** "606.4 *Faucets*. Controls for faucets shall comply with 309. Hand-operated metering facuets shall remain open for 10 seconds *minimum*." (Standard-ADA) --building **Definition:** This sub-category applies if the unit of coding describes a facilitator to a building in general but not specific aspects or objects within the building, e.g. doorway or hallway. **Example:**

	"<u>*Lifts*</u> and <u>*plenty*</u> of disabled <u>*parking spaces*</u>." (OpenStreetMap) <u>--entrance/exit</u> **Definition:** This sub-category applies if the unit of coding describes a facilitator to mobility when moving from indoor space to outdoor space, or outdoor space to indoor space. In other words, moving from inside a building to the outside and vice versa. **Indicators**: 'threshold' 'going outside' 'going inside' 'entering a building' **Example:** "The shop has a <u>*flat*</u> <u>*entry*</u>" (OpenStreetMap) <u>--hallway</u> **Definition:** This sub-category applies if the unit of coding describes a facilitator to passage along a hallway within an indoor space. **Example:** "<u>*no clutter*</u> in <u>*hallway*</u>" (OpenStreetMap) <u>--interior doorway</u> **Definition:** This sub-category applies if the unit of coding describes a facilitator to mobility when moving through a doorway. This sub-category applies if it is a doorway within indoor space. If the door way is between outdoor spaces, or from indoor space to outdoor space or vice versa, use the <u>–entrance/exit</u> sub-sub-category. **Example:** "<u>*wide*</u> <u>*doors*</u>" (OpenStreetMap) <u>--parking</u> **Definition:** This sub-sub-category applies if the unit of coding describes a facilitator to traveling through or within a parking structure. **Example:** "<u>*Dedicated*</u> <u>*Blue Badge Bays*</u> on first level, Exit shops and Shopmobility has powered door. Lifts to shops." (OpenStreetMap) <u>--pedestrian crossing</u> **Definition:** This sub-category applies if the unit of coding describes a

	facilitator to mobility when traveling through a pedestrian crossing. **Example:** "<u>*crossing*</u> signals with wheelchair accessible, large buttons that can be pushed with <u>*little effort*</u>; sound messages and visual cues that let people know how much time they have to cross the street;" (Di4); <u>--pedestrian path</u> **Definition:** This sub-category applies if the unit of coding describes a facilitator to mobility when traveling along a pedestrian path. Pedestrian paths are outdoor features only. Pedestrian paths include the following (Kasemsuppakorn 2011, 14): sidewalk, pedestrian walkway, accessible path/ramp, crosswalk, pedestrian bridges, pedestrian tunnels, trails. This research considers crosswalk in a separate sub-category: 'pedestrian crossing' and does not include trails. **Example:** "as well as <u>*curb cuts*</u> at <u>*sidewalk junctions*</u> has a <u>*high impact*</u> on wheelchair <u>*mobility*</u>." (Lit-Kasemsuppakorn08)
-to OBJECTS *Sub-categories include:* <u>--elevator</u> <u>--public object</u> <u>--ramp</u> <u>--seating</u> <u>--signage</u> <u>--stairway</u>	-to OBJECTS **Definition:** This category applies if the unit of coding describes a facilitator to using or interacting with an object in the environment. <u>--elevator</u> **Definition:** This sub-category applies if the unit of coding describes a facilitator to entering or riding in an elevator. **Example:** "she had to continually ask him to tell her where to find he means <u>*to be independent*</u>, such as the location of the floor buttons in the <u>*elevator*</u>." (Lit-Freeman10) <u>--public object</u> **Definition:** This sub-category applies if the unit of coding describes a facilitator to interacting with or using a public object. Public objects include drinking fountains, water fountains, light poles, trash cans, benches, parking meters, planter boxes, among other objects on the street or in a building. **Example:** "<u>*items*</u> placed at an <u>*accessible height*</u> from a seated or wheelchair height"

	(Lit-Stark98) --ramp **Definition:** This sub-category applies if the unit of coding describes a facilitator to using a ramp. **Example:** "*Excellent* *ramp*, *low incline*" (OpenStreetMap) --seating **Definition:** This sub-category applies if the unit of coding describes a facilitator to using a ramp. **Example:** "Accessible tables must have enough *clearance under the table* to allow a person using a mobility device, such as a wheelchair, to *access the table*." (Standard-AODA) --signage **Definition:** This sub-category applies if the unit of coding describes a facilitator to interacting with or using a sign. **Example:** "If there are braille *signs* on the rooms the task is *easier*" (C8f-29); --stairway **Definition:** This sub-category applies if the unit of coding describes a facilitator related to a stairway. **Example:** "*clear edging* of *steps*" (Lit-Richards10)
-to TRANSIT Sub-categories include: --transit stop --transit vehicle --transit (general)	-to TRANSIT **Definition:** This category applies if the unit of coding describes a facilitator to using, riding, finding public transit. --transit stop **Definition:** This sub-category applies if the unit of coding describes a facilitator at a public transit stop. **Example:**

	"lifts to all platforms" (OpenStreetMap) --transit vehicle **Definition:** This sub-category applies if the unit of coding describes a facilitator at a public transit stop. **Example:** "We toured Bangkok in a lift-equipped bus." (Lit-Daniels08) --transit (general) **Definition:** This sub-category applies if the unit of coding describes a facilitator to mobility when taking public transit but does not specify a facilitator at a transit stop or transit vehicle. Public transit includes: buses, trains and streetcars. **Example:** "an announcement at the bus stop that lets people who arrive there know what direction the bus will be going, what main stops it will make, and how soon the next bus will arrive." (Di4-s)

DIMENSION 8 – ACTIONS

Dimension -category	**Definitions, Examples, Decision Rules** --sub-category
Actions **(27 categories)**	**Scope:** This dimension applies if a unit of coding describes or indicates an action related to mobility. Mobility is defined as the ability to move through space given the affordances to interact with or pass through the built environment. A facilitator is a component of the environment that enables mobility. When choosing the appropriate category, data that describes an action related to some space or object is desired. For example, 'drinking fountain blocks passage along the sidewalk'. This is an example of an action related to traveling along the sidewalk not using the drinking fountain. If the text were 'drinking fountain to high to drink from' then it is an example of an action related to using a public object - the drinking fountain. **Indicators** include: 'facilitator' 'aid' 'help' 'enable' 'allow' 'support'

-of general mobility	-of general mobility **Definition:** This category applies if the unit of coding describes an action related to general mobility that does not apply a specific space, object or time of travel and is not relevant to the act of wayfinding. In other words, this category applies if the unit of coding discusses facilitators to 'getting around' in general. **Example:** "Poor lighting and poor design, or layout of the buildings, made it difficult to <u>*locate destinations*</u> that further aggravated these problems." (Lit-Thapar04)
-of nighttime mobility	-of nighttime mobility **Definition:** This category applies if the unit of coding describes an action related to mobility that is only present at night. **Example:** "I am a person with disabilities and I think a major improvement to the fixed route bus system for disabled community members who must or want to <u>*travel during night time hours*</u> or on cloudy, rainy days would be bus stops that are well lit but don't require electricity for lighting. Lights for night time security lighting should be provided by solar power batteries at the top of the bus shelter." (Di4-s)
-to destination	-to destination **Definition:** This category applies if the unit of coding describes an action related to finding a destination. **Example:** *None found.*
-to route	-to route **Definition:** This category applies if the unit of coding describes a barrier to following a route. **Example:** "Another example specific to a blind travler is the verb ask, as in <u>*ask your dog*</u> to find the elevators on the left." (Lit-Kulyukin08)
-to service	-to service **Definition:** This category applies if the unit of coding describes a barrier

	to a service, such as eating in a restaurant, or getting cash from a bank). **Example:** "Fairly low shelving that is <u>*reachable while sitting*</u>" (OpenStreetMap)
-of wayfinding	-of wayfinding **Definition:** This category applies if the unit of coding describes an action related to the process of wayfinding in general or sensory experiences without mentioning specific spaces or objects. **Example:** "For example, if a person uses a cane, s/he can <u>*hear an echo*</u> from a shelter when walking by." (Lit-Hara13)
-in SPACES *Sub-categories include:* <u>--indoor space</u> <u>--outdoor space</u> <u>--room</u> <u>--bathroom</u> <u>--building</u> <u>--entrance/exit</u> <u>--hallway</u> <u>--hallway intersection</u> <u>--interior doorway</u> <u>--parking structure</u> <u>--pedestrian crossing</u> <u>--pedestrian path</u>	-in SPACES **Definition:** This category applies if the unit of coding describes an action related to a space. <u>--indoor space</u> **Definition:** This sub-category applies if the unit of coding describes an action related to moving through indoor space in general but does not mention specific aspects or elements of the space. **Example:** "Very open inside, a lot of room <u>*to maneuver*</u>." (OpenStreetMap) <u>--outdoor space</u> **Definition:** This sub-category applies if the unit of coding describes an action related to outdoor space in general but does not mention specific aspects or elements of the space. **Example:** "<u>*listening to traffic flow*</u>; accessible pedestrian signals when they exist; obstacles such as poles, signs garbage cans, etc.; different pavement types—sidewalk vs. road vs. driveway." (Challenges Survey) <u>--room</u> **Definition:** This sub-category applies if the unit of coding describes an action related to traveling through or within a room. **Example:** None found.

--bathroom

Definition: This sub-category applies if the unit of coding describes an action related to maneuvering within a bathroom or using objects within a bathroom.

Example:
"Bathroom is narrow, no handrails, can't *wheel underneath sink*." (OpenStreetMap)

--building

Definition: This sub-category applies if the unit of coding describes an action related to a building in general but not specific aspects or objects within the building, e.g. doorway or hallway.

Example:
"the toilet is upstairs and have to *catch the lift up* that is located outside on the corner next to nandos." (OpenStreetMap)

--entrance/exit

Definition: This sub-category applies if the unit of coding describes an action related to mobility when moving from indoor space to outdoor space, or outdoor space to indoor space. In other words, moving from inside a building to the outside and vice versa.

Indicators: 'threshold' 'going outside' 'going inside' 'entering a building'

Example:
"*push button outside* for entryway doors." (OpenStreetMap)

--hallway

Definition: This sub-category applies if the unit of coding describes an action related to passage along a hallway within an indoor space.

Example:
"During the mornings and the evening when the cabin stewards were cleaning up the cabins they would leave their carts in the narrow hallways. Most of the time my narrow adult chair would *just get past* their carts." (Lit-Daniels08)

	--interior doorway **Definition:** This sub-category applies if the unit of coding describes an action related to mobility when moving through a doorway. This sub-category applies if it is a doorway within indoor space. If the door way is between outdoor spaces, or from indoor space to outdoor space or vice versa, use the –entrance/exit sub-sub-category. **Example:** "Doors wide, however some require user to *pull to open*." (OpenStreetMap) --parking **Definition:** This sub-category applies if the unit of coding describes an action related to traveling through or within a parking structure. **Example:** "A primary obstacle to dining out is *finding a place to park* the car." (Lit-McClain93) --pedestrian crossing **Definition:** This sub-category applies if the unit of coding describes an action related to mobility when traveling through a pedestrian crossing. **Example:** "crossing signals with wheelchair accessible, *large buttons that can be pushed* with little effort; sound messages and visual cues that let people know how much time they have to cross the street;" (Di4); --pedestrian path **Definition:** This sub-category applies if the unit of coding describes an action related to mobility when traveling along a pedestrian path. Pedestrian paths are outdoor features only. Pedestrian paths include the following (Kasemsuppakorn 2011, 14): sidewalk, pedestrian walkway, accessible path/ramp, crosswalk, pedestrian bridges, pedestrian tunnels, trails. This research considers crosswalk in a separate sub-category: 'pedestrian crossing' and does not include trails. **Example:** "Uneven terrain between the huts makes *wheeling* difficult." (Lit-Magenuka14)

-at OBJECTS *Sub-categories include:* --elevator --public object --ramp --seating --signage --stairway	-at OBJECTS **Definition:** This category applies if the unit of coding describes an action related to using or interacting with an object in the environment. --elevator **Definition:** This sub-category applies if the unit of coding describes an action related to entering or riding in an elevator. **Example:** "Another commented that her hotel "had elevators so small that I feared I would not be able to *enter with my chair*."" (Lit-Daniels08) --public object **Definition:** This sub-category applies if the unit of coding describes an action related to interacting with or using a public object. Public objects include drinking fountains, water fountains, light poles, trash cans, benches, parking meters, planter boxes, among other objects on the street or in a building. **Example:** "Washroom located within restaurant and is accessible with grab bar included. Sink/soap dispenser may be a bit high, but room provided for *wheelchair to slide underneath*." (OpenStreetMap) --ramp **Definition:** This sub-category applies if the unit of coding describes an action related to using a ramp. **Example:** "Tonal contrast strips help people with reduced sight *visually detect the end of each step*." (Standard-AODA) --seating **Definition:** This sub-category applies if the unit of coding describes an action related to using seating in an indoor space. **Example:** "Shauna's family has found one theater that has seats left out throughout the theater so a *wheelchair can fit in*." (Lit-McClain98)

	<u>--signage</u> **Definition:** This sub-category applies if the unit of coding describes an action related to interacting with or using a sign. **Example:** “Seating area and accessible restroom reached via rear trash alley/kitchen entrance. No sign or info <u>*explaining this*</u> at front.” (OpenStreetMap-436) <u>--stairway</u> **Definition:** This sub-category applies if the unit of coding describes a facilitator related to a stairway. **Example:** “If handrails incorporating a raised dome button accordance with the requirements for stairway handrails in AS 1428.1 are provided to warn people who are blind or have a vision impairment that they are <u>*approaching a stairway*</u> or ramp.” (Standard-DDA)
-at TRANSIT *Sub-categories include:* <u>--transit stop</u> <u>--transit vehicle</u> <u>--transit (general)</u>	-at TRANSIT **Definition:** This category applies if the unit of coding describes an action related to using, riding, finding public transit. <u>--transit stop</u> **Definition:** This sub-category applies if the unit of coding describes a facilitator at a public transit stop. **Example:** “To <u>*find bus stops*</u>, participants mentioned using walking directions from transit trip planners.” (Lit-Hara13) <u>--transit vehicle</u> **Definition:** This sub-category applies if the unit of coding describes a facilitator at a public transit stop. **Example:** “When requested, operators must deploy or put in place the ramps, portable bridge plates or lifting devices that are used to help people with disabilities safely <u>*board and deboard vehicles*</u>.” (Standard-AODA) <u>--transit (general)</u>

	Definition: This sub-category applies if the unit of coding describes an action related to mobility when taking public transit but does not specify a facilitator at a transit stop or transit vehicle. Public transit includes: buses, trains and streetcars. **Example:** "an announcement at the bus stop that lets people who arrive there *know* what direction the bus will be going, what main stops it will make, and how soon the next bus will arrive." (Di4-s)

APPENDIX B

CODED DATA

This table includes all of the text segments coded in the dissertation (n=1605). The table is sorted by "Dataset" and then alphabetically by "Segment #".

Table 33 Coded Data

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
would assist individuals with mobility issues in knowing what paths to take and the like to get to/from a fixed route bus stop	Dialogue-1	NA-US	wheelchair-general	access professional	outdoor	pedestrian path	@	@	@	Dialogue
some streets are so narrow there are no sidewalks and I see regularly people in wheelchairs who are forced to be in the street in the wheelchair because they have no other options on the street where they live.	Dialogue-10	NA-US	wheelchair-general	PWD	outdoor	@	pedestrian path	@	@	Dialogue
Same issue is true for audible pedestrian signals. They're	Dialogue-11	NA-US	target groups	public comment	outdoor	@	pedestrian crossing	@	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
available, but no one seems to know how to set the volume consistently and so that it can be heard.										
For ped pedestrian crossing time, I believe most engineers follow the MUTCD requirement of using 3.5 fps unless as you point out they are aware of site specific conditions requiring a longer length which is also addressed by the MUTCD.	Dialogue-12	NA-US	target groups	public comment	outdoor	@	@	pedestrian crossing	@	Dialogue
We need more audible crosswalks, and just more crosswalks period. We also need more public transportation options such as limited and rapid buses, better frequencies, more light rail. We need also more ADA curb cuts.	Dialogue-13	NA-US	target groups	PWD	outdoor	@	@	outdoor space	@	Dialogue
I came across some appealing audible cross-walks in Arlington VA that were the first of their type I had experienced. As a casual observer, I wasn't aware of the meaning of the different sounds from one crosswalk to	Dialogue-14	NA-US	target groups	public comment	outdoor	@	@	pedestrian crossing	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
another, but it would certainly be useful to have the sound used provide additional information on the crosswalk (direction(s) of traffic, number of lanes to be crossed, odd or even block numbers, etc. come to mind).										
I agree the number of lanes to be crossed idea is a good one.	Dialogue-15	NA-US	target groups	PWD	outdoor	pedestrian crossing	@	@	@	Dialogue
One good thing I always tout of my former transit system is that they had some routes that could be deviated by request, to help riders who are unable to access the regular bus stop.	Dialogue-16	NA-US	target groups	PWD	outdoor	@	@	transit-general	@	Dialogue
As far as walkways- consideration when building new trails should be paramount. No fancy bricks smooth even trails for wheelchair and those with a mobile disability.	Dialogue-18	NA-US	wheelchair-general	public comment	outdoor	@	pedestrian path	pedestrian path	@	Dialogue
Placement of wheelchairs toward the front of a Paratransit bus does make for a MUCH smoother ride	Dialogue-19	NA-US	wheelchair-general	access professional	transit vehicle	@	@	transit vehicle	@	Dialogue
Then after the trip is made the user can go back and view the trip on a map that	Dialogue-2	NA-US	wheelchair-general	access professional	outdoor	route-general	@	@	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
allows the user to make notes on how ADA Accessible the route they just took was.										
It is increasingly common for large parking garages to provide signage at entrances advising parkers where in the garage there is parking capacity, accessible spaces, elevators, and such to help them avoid endless circling in search of an open spot that may or may not be there, or finding a spot only to realize it is not accessible or is too far from an accessible pathway to the final destination. Surface lots and on-street parking rarely have such features and even where this feature is present, it may not include accessibility information (disabled spaces, ramps/curb cuts, sidewalks, etc.).	Dialogue-20	NA-US	target groups	public comment	outdoor	@	parking	parking	parking	Dialogue
What is needed is a satellite based system for tracking availability of known surface and street parking spaces, including	Dialogue-21	NA-US	target groups	public comment	outdoor	parking	@	@	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
accessibility information and barriers for those with disabilities, for communication to mobile applications that provide driving directions to available parking and accessible pathways.										
Most lifts, ramps and, especially, systems for securing riders require the assistance of others and many systems lead to long delays in boarding and unloading, adversely affecting boarding time.	Dialogue-22	NA-US	wheelchair-general	public comment	transit vehicle	@	transit vehicle	@	transit vehicle	Dialogue
Every time a wheelchair user travels at night they are at risk. Cars, bicycles, motor scooters all have lights to alert others of their presence. I can not take my wheelchair on the streets at night and say for sure I will make it home safely There is a device, it is the wheelchair first upright overhead warning light and it is ideas like this that will make a difference in the lives of people with disabilities..	Dialogue-23	NA-US	wheelchair-general	member	outdoor	@	nighttime mobility	nighttime mobility	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
I think that wheelchair users are at risk operating their wheelchairs at night it is not enough to just be seen standing on bus stops but when pedestrian crossing crosswalks, and riding on street in dimly lit areas . Wheelchair users are the only devices on wheelchair that has no known identifiable device to be notice and used to alert others when a wheelchair user in traveling on dimly lit and dark streets .	Dialogue-24	NA-US	wheelchair-general	member	outdoor	@	nighttime mobility	nighttime mobility	@	Dialogue
So there are very few choices for transport. And almost all are undependable and lack any kind of professional care.	Dialogue-25	NA-US	wheelchair-power	member	outdoor	@	transit-general	@	@	Dialogue
Service dog users need an App that identifies with map and directions locations where SD's can do their potty business. This would be helpful in unfamiliar locations and airports when traveling.	Dialogue-26	NA-US	target groups	public comment	outdoor	service animals	@	@	@	Dialogue
bring up information on all of the available transportation options in the area where you are. For example, if	Dialogue-27	NA-US	target groups	public comment	outdoor	transit-general	@	@	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
someone came into Chicago, this app would provide information on the Chicago Transit Authority, Metra and Pace systems.										
it would tell you which routes to use to get there.	Dialogue-28	NA-US	target groups	public comment	outdoor	route-general	@	@	@	Dialogue
• Planning a safe route between the origin address and the nearest transit-stop or station • Identifying the actual transit-stop or station entrance • Navigating between a transit station entrance and the correct platform • Identifying which bus or train to board • Identifying the appropriate stop to deboard • Navigating between the vehicle and the most appropriate transit station exit • Planning and following the best and safest route between the transit-stop or station and the final destination	Dialogue-29	NA-US	low vision	public comment	outdoor	transit-general	transit-general	@	@	Dialogue
I brought the star rating into play since in my community it seems there are times when we do have sidewalks along a street but they may not be up to ADA	Dialogue-3	NA-US	wheelchair-general	access professional	outdoor	@	@	outdoor space	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
standards so technically the path would be accessible to wheelchairs but not fully up to ADA standards.										
Detailed network of a metropolitan area's streets with sufficient detail to pinpoint any physical address	Dialogue-30	NA-US	low vision	public comment	outdoor	street layout	@	@	@	Dialogue
Map of all transit routes within the metropolitan area with detailed schedules for each route	Dialogue-31	NA-US	low vision	public comment	outdoor	transit-general	@	@	@	Dialogue
Geocoded points for all bus stops and transit stations	Dialogue-32	NA-US	low vision	public comment	outdoor	transit-stop	@	@	@	Dialogue
Information about the accessibility of specific streets and segments of streets	Dialogue-33	NA-US	low vision	public comment	outdoor	street layout	@	@	@	Dialogue
Transit Pilot would present up to five travel itineraries based on user-defined priorities, including, but not limited to: fastest time, all bus, all rail, shortest walking distances, etc. The app would also provide walking directions between the user's origin and the nearest transit-stop or station and between the end point stop or station and the user's final destination. If there is	Dialogue-34	NA-US	low vision	public comment	outdoor	route-directions	@	@	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
accessibility-related information available for the user's path of travel between origin and transit or between transit and destination										
Level path-of-travel mode – This mode would conduct all trip-planning using accessible routes and would flag any path-of-travel which is either accessible or which may not be fully wheelchair accessible	Dialogue-36	NA-US	wheelchair-general	public comment	outdoor	pedestrian path	@	@	@	Dialogue
Large print and high contrast navigation information, such as real-time bus arrival times or pedestrian/transit step-by-step directions could be displayed to the user.	Dialogue-37	NA-US	target groups	public comment	outdoor	wayfinding	@	@	@	Dialogue
which would audibly identify the bus stop # (we have individual id #'s for each stop here in Denver, RTD) so they can locate exact location of and unfamiliar stop and so they can call the customer service line and use automated info to hear next 3 times for that route.	Dialogue-38	NA-US	target groups	public comment	outdoor	transit-stop	@	@	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
However, what if they are thrown into an un-familiar environment? One solution is to establish a virtual field of the new environment, containing the information of all possible obstacles for visually impaired people, such as stairs, blocks, traps, trees, and pedestrian crossing roads.	Dialogue-39	NA-US	low vision	public comment	outdoor	route-obstacles	pedestrian path	@	@	Dialogue
If it were me, that info would be useful to determine where to park to have the best accessibility.	Dialogue-4	NA-US	target groups	public comment	outdoor	parking	@	@	@	Dialogue
Community transportation begins with accessible buses, but doesn't end there. We need accessible sidewalks, accessible bus stops, crosswalks, and streets that are safe for ALL their users, regardless of mode of travel, or ability.	Dialogue-40	NA-US	target groups	access professional	outdoor	@	@	general mobility	@	Dialogue
Every significant transit new start or improvement project should include corridor improvements to include sidewalks, curb cuts, audible pedestrian signals, detectable warnings	Dialogue-41	NA-US	target groups	public comment	outdoor	@	@	pedestrian path	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
and other "complete streets" amenities										
Sidewalks have big cracks. Cut outs are damaged, pitted. Roads are lumpy. People in wheelchair feel every bump. Sometimes they can be thrown out.	Dialogue-42	NA-US	wheelchair-general	public comment	outdoor	@	pedestrian path	@	@	Dialogue
Safe and accessible crosswalks are an essential part of a complete street. Safe pedestrian crossings must be located at regular short intervals so pedestrians don't have to travel a great distance to locate a safe pedestrian crossing.	Dialogue-43	NA-US	target groups	public comment	outdoor	@	@	pedestrian path	@	Dialogue
I think a major improvement to the fixed route bus system for disabled community members who must or want to travel during night time hours or on cloudy, rainy days would be bus stops that are well lit but don't require electricity for lighting. Lights for night time security lighting should be provided	Dialogue-44	NA-US	target groups	PWD	outdoor	@	@	transit-stop	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
This needs to be part of a complete safe streets initiative that includes sidewalks with wide wheelchair cuts; pedestrian crossing signals with wheelchair accessible, large buttons that can be pushed with little effort; sound messages and visual cues that let people know how much time they have to cross the street; and an announcement at the bus stop that lets people who arrive there know what direction the bus will be going, what main stops it will make, and how soon the next bus will arrive.	Dialogue-45	NA-US	target groups	PWD	outdoor	@	@	general mobility	crossing	Dialogue
When I'm at the bus stop in the winter and it is dark, the bus sometimes doesn't see me and used to drive by. Now I hold my phone up with the screen lit up and the bus can see me better. I like the idea about lights at the bus stop.	Dialogue-46	NA-US	target groups	public comment	outdoor	@	nighttime mobility	@	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
• knowing when the bus you want is approaching in time to flag it • knowing that the operator has seen your effort to flag the bus • knowing when to alert the operator that you are approaching your destination • visibility of passengers who are in wheelchairs or who need to sit for other reasons • difficulty or impossibility of making eye contact to be certain that the bus should stop	Dialogue-47	NA-US	target groups	member	outdoor	@	transit-general	@	transit-general	Dialogue
As a person who is blind, I don't always need additional time to make the pedestrian crossing. I just need the pedestrian signal to be engaged. However, there are some intersections for which extra time would be very useful and add to my sense of safety when pedestrian crossing.	Dialogue-48	NA-US	blind	member	outdoor	@	@	pedestrian crossing	@	Dialogue
The current APS system results in a noisy, chaotic environment for everyone. The competing signals and messages are either not well heard,	Dialogue-49	NA-US	target groups	public comment	outdoor	@	pedestrian crossing	@	pedestrian crossing	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
and it can be difficult to discern between them.										
Consequently, it takes too long for paratransit or fixed route bus operators to secure the chair. Others aren't being properly secured at all.	Dialogue-5	NA-US	wheelchair-general	access professional	transit vehicle	@	transit vehicle	@	transit vehicle	Dialogue
Given this, the only form of the APS system that I have liked is one I have seen on one pedestrian crossing in Boulder. When one presses the button when one is interested in pedestrian crossing a street (we are all familiar with this concept), the button then announces the state of the signal and the direction and street that was requested. Since this is at the location of the button, it is quiet compared to the traditional APS.	Dialogue-50	NA-US	blind	access professional	outdoor	pedestrian crossing	@	pedestrian crossing	pedestrian crossing	Dialogue
Each transit agency currently maintains its own database of persons who are eligible for ADA services such as paratransit. When traveling, it can often	Dialogue-51	NA-US	target groups	access professional	outdoor	@	general mobility	@	@	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
be difficult or impossible to receive ADA services while visiting another transit agency.										
there is the mapping being done by communities and transit providers that includes information about routes, stops and stations, accessible pathways and features, etc.	Dialogue-52	NA-US	blind	member	outdoor	transit-general	@	@	@	Dialogue
An Affordable G.P.S device, to include bus routes, change. Bus alerts,and a way to get help fast in emergency, linked in the device. Maps, routes,Change in route alerts, and affordability.	Dialogue-53	NA-US	target groups	public comment	outdoor	transit-general	@	@	@	Dialogue
One of the more disorienting and distracting factors on rail platforms is noise. I most often think of this as I am standing in a station and a train is coming in, but that's not the only source of noise. I was recently in Los Angeles and was transferring trains on a platform in the middle of a freeway; the nonstop, intensive noise of freeway traffic was even more	Dialogue-54	NA-US	blind	member	outdoor	@	transit-stop	transit-stop	transit-stop	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
of a problem. It would be great if there was noise cancelling technology to offset some of this.										
You can see where each of the busses are at any point in time, and you can see how long it will be before the next bus arrives. This would be useful for those with mobility disabilities so they could time their approach to the bus stop.	Dialogue-55	NA-US	wheelchair-general	public comment	outdoor	transit-general	@	@	@	Dialogue
This issue is an important concern for transit providers, as it is a challenge to safely secure the many types of wheelchairs; with some of them, one cannot safely use the “tie-down” hooks or straps—they lack securement points.	Dialogue-6	NA-US	wheelchair-general	public comment	transit vehicle	@	transit vehicle	@	@	Dialogue
When a cross walk button is pushed it changes the length of time the light stays green. Ever saw a person who is using a wheelchair or on crutches try to cross 6 lanes of traffic? Some lights are so short even able-bodied	Dialogue-7	NA-US	wheelchair-general	public comment	outdoor	@	pedestrian crossing	pedestrian crossing	pedestrian crossing	Dialogue

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
people will have to run the last 1 to 1 1/2 lanes to get to the sidewalk safely. Lights are set for cars, not people. Suggest is that the light would stay green longer, only if the button is pushed.										
The buttons to punch to activate the pedestrian crossing signal need to be at a level easily reached by someone in a wheelchair and include an audible sound or announcement when it is safe to walk and when the light is about to change. Curb cuts need to be wide and the street where the crosswalk will be located needs to be free of dips or potholes and it needs to be well lighted.	Dialogue-8	NA-US	wheelchair-general	PWD	outdoor	@	pedestrian crossing	pedestrian crossing	pedestrian crossing	Dialogue
Having safe crosswalks is key to having safe bus stops and a safe public transportation system.	Dialogue-9	NA-US	wheelchair-general	PWD	outdoor	@	@	transit-stop	@	Dialogue
Moving one large wheel in one direction and the other in the opposite direction by an equal amount, as described by Goldsmith (1976) and illustrated in Fig.	Abraham-1	EU-UK	wheelchair-manual	access professional	indoor	@	@	@	general mobility	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
1, which is termed 'opposing-wheels movement'										
Holding one large wheel stationary and moving the other wheel, which is termed 'braked-wheel movement'.	Abraham-2	EU-UK	wheelchair-manual	access professional	indoor-outdoor	@	@	@	general mobility	Literature
manoeuvring on a wooden floor may be straightforward whereas manoeuvring on a deep pile carpet may be impossible.	Abraham-3	EU-UK	wheelchair-manual	access professional	indoor	@	indoor space	@	@	Literature
A final combination of movements to the large wheels is to move them in the same direction but by different amounts, which is termed 'double-wheels movement'.	Abraham-4	EU-UK	wheelchair-manual	access professional	indoor-outdoor	@	@	@	general mobility	Literature
Access to/Approaching the building (in relation to vicinity to parking area/drop off area) (seven items); Entering the building (Accessible entrance) (nine items); Usable Circulation/Reception area (five items); Usable Lifts/elevators (eight items); Usable toilet area (17 items); Usable Ramp and Rails (12 items); Usable parking spaces (three items)	Banda-Chalwe-1	AFRICA	wheelchair-general	interview	indoor-outdoor	@	@	building	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Another emphasis regards ramps and rails expressed by PWML who identified them separately from other features. Thus, elevating their importance as these are not part of the architectural practices and building requirements in Zambia	Banda-Chalwe-2	AFRICA	wheelchair-general	interview	transition	@	@	entrance	@	Literature
Of similar importance was lack of accessible transport and transportation services expressed by PWML in Zambia as being one of the major hindrances to their participation and accessing opportunities within the community	Banda-Chalwe-3	AFRICA	wheelchair-general	interview	outdoor	@	general mobility	@	@	Literature
The absence of curb cutouts, for example, pose pertinent permanent barrier to wheelchair users, indicating the need to include this item in access to/ approaching the building	Banda-Chalwe-4	AFRICA	wheelchair-general	interview	outdoor	@	pedestrian path	building	@	Literature
[The absence of curb cutouts, for example, pose pertinent permanent barrier to wheelchair users, indicating the need to include this item in]	Banda-Chalwe-5	AFRICA	wheelchair-general	interview	outdoor	@	pedestrian path	transit-general	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
using public transport										
Sure, there are lots of ramps.	Bayne-1	NA-US	wheelchair-general	member	indoor	@	@	indoor space	@	Literature
in every facility I've ever visited or lived in, the bathroom sink isn't wheelchair accessible. Just try to shave or brush your teeth when the sink is way up there. You can't.	Bayne-2	NA-US	wheelchair-general	member	indoor	@	bathroom	@	bathroom	Literature
I'm on the first floor and fortunate enough to have a beautiful outdoor patio but my wheelchair is too wide to negotiate the doors, so I can't wheel myself out onto it.	Bayne-3	NA-US	wheelchair-general	member	transition	@	entrance	@	entrance	Literature
both the gradient and length of slopes were found to cause especial difficulty for wheelchair users. Some surface types were also considered problematic: for example, gravel, cobbles and uneven paving slabs. Dropped kerbs, gullies and drains that were not flush all caused problems, whilst the slope, limited turning circle and surface of ramps	Beale-1	EU-UK	wheelchair-general	observation	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
were frequently cited as barriers.										
mobile street furniture (e.g. rubbish bins, placard boards) frequently caused difficulties.	Beale-2	EU-UK	wheelchair-general	observation	outdoor	@	pedestrian path	@	@	Literature
Areas of paving, for example, were described as 'fairly uneven' by users, whilst brickwork was described as 'uneven in some areas, causing stoppages'. In relation to tarmac, comments included 'old tarmac that is full of holes can be quite difficult'; grass is described as 'a poor surface'; gravel provoked comments such as 'impossible', 'always terrible' and 'awful—even with an electric chair'	Beale-3	EU-UK	wheelchair-general	observation	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The presence of drop kerbs was considered to be crucial for wheelchair access, though their effect clearly varied considerably. Factors determining their degree of impedance included surface characteristics, orientation, slope and the type of lip at the edge of the road. Whether or not there is a matching drop kerb on the other side of the road is also important.	Beale-4	EU-UK	wheelchair-general	survey	outdoor	@	pedestrian crossing	pedestrian crossing	@	Literature
Steps and high kerbs were universally considered as severe or prohibitive	Beale-5	EU-UK	wheelchair-general	survey	outdoor	@	pedestrian path	@	@	Literature
Curb ramps were present at almost all (98.7%) of the intersections assessed. For most wheelchair users, even a curb ramp with some problems is preferable to managing a curb (usually *15 cm high in our city) without a ramp.	Bennett-1	NA-CAN	wheelchair-general	observation	outdoor	@	@	pedestrian crossing	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Of the curb ramps, only about half (53.8%) provided a direct line of travel from the sidewalk onto the crosswalk. This was often because the curb ramp was of the diagonal type, with two sidewalks sharing the access to the same curb ramp (Figure 5). Even with very wide diagonal curb ramps that wrapped around a corner, a wheelchair user would need to change direction to approach the ramp–gutter transition squarely.	Bennett-2	NA-CAN	wheelchair-general	observation	outdoor	@	pedestrian crossing	@	ramp	Literature
The greater the counterslope of the gutter, the more abrupt the transition is from the curb to the gutter or vice versa. Some of the gutter slopes were negative values (i.e., the slope of the gutter was in the same direction as the slope of the curb ramp), which would not be expected to cause problems at the transition.	Bennett-3	NA-CAN	wheelchair-general	observation	outdoor	@	@	ramp	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Only about one-quarter (26.9%) of the curb ramps had a smooth transition (13 mm) from the curb ramp to the gutter. The mean value of the lip heights was 19.1 mm and values ranged from 0 to 38.5 mm. Even a 13 mm lip can interrupt the forward movement of a wheelchair and cause a tip or fall.	Bennett-4	NA-CAN	wheelchair-general	observation	outdoor	@	pedestrian crossing	@	ramp	Literature
the collection of water, ice and debris at the bottom of a curb ramp can present accessibility barriers and danger for wheelchair users and pedestrians alike. However, there are design options (e.g., the use of drainage grates on both sides of the curb ramp) that can minimise this constraint.	Bennett-5	NA-CAN	wheelchair-general	observation	outdoor	@	ramp	ramp	@	Literature
Of particular note are the relatively high numbers of people who need but do not have such safety-enhancing features as grab bars installed in bathroom (15.2%).	Bishop-1	NA-US	wheelchair-general	survey	indoor	@	@	bathroom	@	Literature
Approximately 25% of the sample indicated that theyneed a wheelchair accessible	Bishop-2	NA-US	wheelchair-general	survey	transition	@	@	entrance	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
exterior entrance and/or ramp to their entrance										
The vast majority of wheelchair users (90%) considering buses 'difficult' or 'very difficult' to use because of the high step to get on board combined with the lack of ramps (72%).	Bromley-1	EU-UK	wheelchair-general	interview	transit vehicle	@	transit vehicle	transit vehicle	transit vehicle	Literature
There was also the need for better information about facilities for disabled people within the city centre. At present, available information relates to car parking and disabled toilets, but there is negligible in-store information or details on the location of barriers and obstacles for the mobility impaired.	Bromley-10	EU-UK	wheelchair-general	interview	outdoor	route-obstacles	@	@	@	Literature
Inside shops, many other problems are evident, for example, heavy doors, cluttered aisles, inaccessible shelves and narrow checkouts.	Bromley-11	EU-UK	wheelchair-general	interview	indoor	@	service	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
For example, of the 30 respondents who parked their car at the Shopmobility car park, a large majority (86%), found car parking to be either 'very easy' (47%) or 'easy' (40%). By contrast, of those who parked in non-specific locations around the city centre, 78% found car parking to be 'difficult' (30%) or 'very difficult' (48%), largely because of the lack of appropriate spaces.	Bromley-2	EU-UK	wheelchair-general	interview	outdoor	@	parking	@	@	Literature
Three obstacles: people on pavements, getting into shops and the lack of dropped kerbs; were considered 'major' or 'prohibitive' by more than 60% (Table 1). The next most serious group of obstacles all fall within the public realm, and include high kerbs, steps, and uneven surfaces (including the deliberately planned cobbled areas).	Bromley-3	EU-UK	wheelchair-general	interview	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Particular problem stores can be identified with respect to features such as narrow doorways and aisles, and inconsiderate placement of stock. In addition, changing rooms are viewed as being 'difficult' or 'very difficult' to use by 62% of respondents, while shelf height is described as 'difficult' or 'very difficult' by 45%	Bromley-4	EU-UK	wheelchair-general	interview	indoor	@	service	@	@	Literature
Crowded pavements present a major challenge to over half of wheelchair users (55%).	Bromley-5	EU-UK	wheelchair-general	interview	outdoor	@	pedestrian path	@	@	Literature
The reasons given for the difficulties at the periphery include the lack of dropped kerbs and the poor-up-keep of pavements. As one wheelchair user articulated: ''The Kingsway [peripheral street] is a real sod of a place. The road's too wide, it's too busy, there are no real pedestrian crossing places, the pavement's poor and it deserves to be knocked down!'' (Female, 60+ years).	Bromley-6	EU-UK	wheelchair-general	member	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
improving public space in Swansea city centre included more dropped kerbs (21%), improving the quality of pavements (13%) as well as removing steps.	Bromley-7	EU-UK	wheelchair-general	interview	outdoor	@	@	pedestrian path	@	Literature
Parking could be facilitated both by better policing of the parking bays (11%) or through the provision of more parking spaces (10%).	Bromley-8	EU-UK	wheelchair-general	interview	outdoor	@	@	parking	@	Literature
One of these is a modification to the car parking charge system so that a disabled person could move his/her car from car park to car park without more than a single payment	Bromley-9	EU-UK	wheelchair-general	interview	outdoor	@	@	parking	@	Literature
put a lower shag carpet on the floor (30%), extend or motorize drape pulls (27.2%)	Burnett-1	NA-US	target groups	survey	indoor	@	@	room	@	Literature
widen hallways in and out of room (41%)	Burnett-2	NA-US	target groups	survey	indoor	@	@	hallway	@	Literature
change the direction doors swing open (30.1%)	Burnett-3	NA-US	target groups	survey	transition	@	interior doorway	interior doorway	interior doorway	Literature
light switch too far from bed (37.8%), too much furniture (46.8%), and phone too far from bed (23.7%).	Burnett-4	NA-US	target groups	survey	indoor	@	room	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Vision was of importance to discover irregularities as well. As one participant said: I can only see with one eye and therefore I have difficulties discovering irregularities in the surface. Other participants with severe loss of sight as well as other functional limitations agreed and told of how they had fallen several times as a result of irregularities.	Carlsson-1	EU	low vision	interview	transit vehicle	@	entrance	@	@	Literature
Kerbs, steps, and stairs were examples of such usability problems, and participants with severe loss of sight or difficulties in bending and kneeling reported these problems. For example, a participant with both of these limitations said: Yes, the kerbs are so high. Suddenly I tumble down and then I cannot climb so high.	Carlsson-2	EU	low vision	interview	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
outdoor environment general usability problems seemed to be long distance, irregular walking surface, and high kerbs. Participantswith severe loss of sight as well as participants with difficulty bending and kneeling, and participants with one functional limitation as well as several functional limitations reported these usability problems.	Carlsson-3	EU	low vision	interview	outdoor	@	pedestrian path	@	@	Literature
Another barrier reported by one of the persons with severe loss of sight and one of the persons using a rollator was signs or posts in the pathway. They established that it was good to have lighted pathways, but the poles, e.g. lampposts, could be an environmental barrier. The woman with severe loss of sight said: The poles in the pathway are difficulty to see, usually they are grey. Especially difficult when it is cloudy.	Carlsson-4	EU	low vision	interview	outdoor	@	pedestrian path	pedestrian path	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Different focus groups reported the absence of weather protection as a barrier as well, because several days a year it is windy and sometimes raining as well. They would not run the risk of missing their bus and therefore they wanted to be in time, resulting in a waiting time of five minutes or more at the bus stop.	Carlsson-5	EU	target groups	interview	outdoor	@	transit-stop	transit-stop	transit-stop	Literature
one participant reported how difficult it was for her to cross a street near a pedestrian crossing because of limited sight. She had bad sight in one eye and said: When I am looking in the other direction a bus can arrive at the pedestrian crossing before I notice that. I have better overview on straight roads and it is easier for me to cross there.	Carlsson-6	EU	low vision	interview	outdoor	@	transit-general	pedestrian crossing	pedestrian crossing	Literature
One participant with severe loss of sight and difficulties in handling and fingering experienced all the kerbs as too demanding and reported: Nowadays	Carlsson-7	EU	low vision	interview	outdoor	@	pedestrian path	pedestrian crossing	pedestrian crossing	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
when I am walking to the bus stop, I walk on the roadway.										
the requirements of the blind largely include common geospatial information (e.g., the direction of the path	Chen-1	ASIA	blind	wayfinding professional	outdoor	route-directions	@	@	@	Literature
even when using transportation, he must know the paths to catch the bus	Chen-10	ASIA	blind	wayfinding professional	outdoor	transit-general	@	@	@	Literature
the correct entrances for both the school and the classroom.	Chen-11	ASIA	blind	wayfinding professional	transition	building-entrance	@	@	@	Literature
the person with visual impairments should also be informed of obstacles on the sidewalks, and some special features and surface irregularities (e.g., a small sharp slope).	Chen-12	ASIA	blind	wayfinding professional	outdoor	pedestrian path	pedestrian path	@	@	Literature
When specifically walking in an urban space, one of the most common problems for the blind is obstacles on the path (Pavey, Dodgson, Douglas, & Clements, 2009; Polzerova & Fraser, 2009).	Chen-14	ASIA	blind	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature
the obstacle is permanent (e.g., a lamppost) or	Chen-15	ASIA	blind	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
temporary (e.g., a temporary bulletin board or a construction barrier).										
Researchers have noted that an obstacle that temporarily blocks the path is more dangerous to the blind, especially if these temporary obstacles appear in familiar areas (Barbeau, Winters, Georggi, Labrador, & Perez, 2010; Nuernberger, 2008; Rice, Hammill, Aburizaiza, Schwarz, & Jacobson, 2011, 2012).	Chen-16	ASIA	blind	wayfinding professional	outdoor	@	pedestrian path	@	pedestrian path	Literature
Thus, detailed information on transportation is very important to the blind, especially for long travel in the city.	Chen-17	ASIA	blind	wayfinding professional	outdoor	transit-general	@	@	@	Literature
feature type of bus stop can provide more semantic information on the buses (e.g., bus direction and frequency).	Chen-18	ASIA	blind	wayfinding professional	outdoor	transit-stop	@	@	@	Literature
The semantic description of the appearance features (e.g., shape or material) often provides the blind with a conceptual mental image of the environment or	Chen-19	ASIA	blind	wayfinding professional	outdoor	building-general	@	pedestrian path	pedestrian path	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
objects. It can be used by blind travelers to estimate travel distances, help ensure safety and allow 'shorelining' to take place (Golledge et al., 1998).										
the entrance of the building	Chen-2	ASIA	blind	wayfinding professional	transition	building-entrance	@	@	@	Literature
For many objects with special functions (e.g., a shop or a bank), the business hours (e.g., opening time, closing time, and work days) are very important characteristics.	Chen-20	ASIA	blind	wayfinding professional	outdoor	route-destination	@	@	@	Literature
the locations of the pedestrian crossing	Chen-3	ASIA	blind	wayfinding professional	outdoor	pedestrian crossing	@	@	@	Literature
bus stop	Chen-4	ASIA	blind	wayfinding professional	outdoor	transit-stop	@	@	@	Literature
details of the specific information (e.g., the position of the lamppost	Chen-5	ASIA	blind	wayfinding professional	outdoor	route-obstacles	@	@	@	Literature
the length of the handrail	Chen-6	ASIA	blind	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature
the width of the street	Chen-7	ASIA	blind	wayfinding professional	outdoor	street layout	@	@	@	Literature
the small scarp on the path	Chen-8	ASIA	blind	wayfinding professional	outdoor	route-gradient	@	@	@	Literature
he should at least be aware of the correct paths to the classroom	Chen-9	ASIA	blind	wayfinding professional	outdoor	wayfinding	@	@	@	Literature
One of the main obstacles found in Oaxaca was entering the building, with accessibility ranging	Crowe-1	NA	wheelchair-general	observation	transition	@	building	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
from 25% to 50%										
Many public restrooms were up a flight or two of stairs, had small entrance doors unable to accommodate a wheelchair, or had extremely small interiors.	Crowe-2	NA	wheelchair-general	observation	indoor	@	bathroom	@	@	Literature
For example, if a customer wanted a certain type of fruit, he or she would point to the fruit and the employee would package the product and hand it directly to the customer. The aisles were wide and negotiable to a person in a wheelchair. Almost anything needed for daily consumption was present in the central market. This would allow individuals with mobility limitations to shop for the majority of their needs at one accessible facility.	Crowe-3	NA	wheelchair-general	observation	indoor	@	@	service	service	Literature
Oaxaca has several specially marked wheelchair parking spaces on city streets. However, because the curbs beside the spaces could be up to 3 feet above the city	Crowe-4	NA	wheelchair-general	observation	outdoor	@	pedestrian path	parking	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
street, the person using the wheelchair would be unable to access the sidewalk and would be required to use the street for mobility.										
Unfortunately, public buses are impossible to use in a wheelchair due to the multiple stair access	Crowe-5	NA	wheelchair-general	observation	transit vehicle	@	entrance	@	@	Literature
For example, it was found that some facilities in Oaxaca would have been accessible if it had not been for store displays being placed in the middle of an otherwise accessible entrance or a restaurant table positioned close to an accessible door.	Crowe-6	NA	wheelchair-general	observation	transition	@	entrance	@	@	Literature
some Oaxacan churches had moveable temporary wooden ramps built. However, these were always placed in an upright position away from the entrance. This required a person using a wheelchair to depend on another person to move the ramp into the correct position for access to the church.	Crowe-7	NA	wheelchair-general	observation	transition	@	entrance	entrance	entrance	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Another traveler, in explaining her mobility barriers, said of her travel companion "She can help me get up a curb or 1 step".	Daniels-1	@	wheelchair-manual	member	outdoor	@	pedestrian path	@	@	Literature
One traveler wrote "I am sure that there are good places to eat but we didn't do so well in that department. Many restaurants are either up or down a flight of steps."	Daniels-10	@	target groups	interview	transition	@	entrance	@	entrance	Literature
Another commented that her hotel "had elevtors so small that I feared I would not be able to enter with my chair."	Daniels-11	@	wheelchair-general	member	indoor	@	elevator	@	elevator	Literature
"The room was spacious…"	Daniels-12	@	wheelchair-general	member	indoor	@	@	indoor space	@	Literature
"…and the bathroom was very accessible with a roll in shower with a built in shower bench" were frequent	Daniels-13	@	wheelchair-general	member	indoor	@	@	bathroom	bathroom	Literature
wide doors	Daniels-14	@	wheelchair-general	member	transition	@	@	interior doorway	@	Literature
A traveler to Denmark explained that "the lack of curb cuts, the rain channels fashioned into sidewalks, and the heat took a toll."	Daniels-15	EU	target groups	interview	outdoor	@	pedestrian path	@	@	Literature
Travelers also spoke of unpleasantries sich as "dirt and sewage that sticks to wheels and hands"	Daniels-16	@	target groups	interview	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
difficulties with wind and altitude	Daniels-17	@	target groups	interview	outdoor	@	outdoor space	@	@	Literature
commenting on deliberately constructed access, one traveler wrote, "There is a paved walk of about 100 feet from the parking lot to viewing area."	Daniels-18	@	target groups	interview	outdoor	@	@	pedestrian path	@	Literature
"...we found ourselves stranded in St. Thomas-in a gravel parking lot-gravel 8 inches deep (try pushing a wheelchair through that)…"	Daniels-19	NA	wheelchair-manual	member	outdoor	@	parking	@	@	Literature
"During the mornings and the evenings when the cabin stewards were cleaning up the cabins they would leave their carts in the narrow hallways. Most of the time my narrow adult chair would just get past their carts."	Daniels-2	@	wheelchair-manual	member	indoor	@	hallway	@	hallway	Literature
"...He did not understand the attemp to explain in English that I was in a wheelchair and needed to use an elevator ..."	Daniels-20	EU	wheelchair-general	member	indoor	@	@	transit-stop	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
"…He rolled my chair up into a metal "box", locked my wheels, and closed and locked me in with the fourth metal side of the box. He then mounted his seat and drove me automatic lawnmower style to our train carriage where he lowered an electric ramp that could be adjusted to the height of the train, and out I rolled into my seat."	Daniels-21	EU	wheelchair-general	member	indoor	@	@	transit-stop	transit vehicle	Literature
several travelers made a point of noting with delight that "Able-bodied people don't park in disabled parking bays!	Daniels-22	@	target groups	interview	outdoor	@	@	parking	@	Literature
Another traveler who stopped at a lake in the Canadian Rockies stated that, "The people who worked there were very willing to help getting from a chair in and out of the canoe."	Daniels-3	NA-CAN	wheelchair-general	member	outdoor	@	@	service	@	Literature
Several of the travelers with disabilities commented on crowded streets, elevators and sites. One wrote of an airport where "…the	Daniels-4	@	wheelchair-general	member	indoor	@	indoor space	@	indoor space	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
crowds that jammed all available space made it difficult for me to maneuver my wheelchair."										
Another reflected on the difficulties of trying to leave a ship when her husband's wheelchair became stuck in the gangway, "A hoard of bodies-a virtual wall of people-came down the gangway, bumping into my husband and his chair."	Daniels-5	@	wheelchair-general	observation	transit vehicle	@	entrance	@	service	Literature
One traveler wrote that when confronted with a turnstile on the way to an excursion, a group of strangers lifted her husband and his chair "high into the air and over the turnstile and lowered him gently down."	Daniels-6	@	wheelchair-general	observation	indoor	@	transit stop	general mobility	@	Literature
"The train ride-not accessible by definition," "A small bus-unfortunately not adapted," and "Although a boarding chair was rumored to exist, it could never be found" were common. One traveler noted, "Most tour (sic) are not accessible because of	Daniels-7	@	target groups	member	transit vehicle	@	transit vehicle	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
the bus. Public transporation is also impossible."										
"One of the tram cars had been built without seats to accommodate wheelchairs,"	Daniels-8	@	wheelchair-general	interview	transit vehicle	@	transit vehicle	@	@	Literature
"We toured Bangkok in a lift-equipped bus."	Daniels-9	ASIA	wheelchair-general	interview	transit vehicle	@	@	transit vehicle	@	Literature
Also, 'what to do/ where to go' brochures do not state what is or is not accessible for people in wheelchairs.	Darcy-1	OA-AU	wheelchair-general	member	indoor-outdoor	tourism	@	@	@	Literature
Arrived in Canberra at 8pm to find that the 4-star motel with a disabled unit has two steps to gain entry…plus hob and sliding screen on shower, great info, great holiday. I guess there are no politicians in wheelchairs (Qn 439 Pg 346).	Darcy-10	OA-AU	wheelchair-general	member	transition	@	entrance	@	@	Literature
upon arrival there we discovered the door was not wide enough to fit my wheelchair, the step which I was told was only four inches high was in fact closer to 14	Darcy-11	OA-AU	wheelchair-general	member	transition	@	entrance	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
inches high.										
there was no way possible to get to the bed or even move inside with the wheelchair.	Darcy-12	OA-AU	wheelchair-general	member	indoor	@	indoor space	@	indoor space	Literature
Door heights or door handles are a real pain. As a person who has very limited hand function, I find it difficult to operate those mini cards entry door locks.…I have had to punch a hole in the top of the card and put a little bit of string through it so I can hook my finger in and whip it out. If they have got a lever handle door knob on the outside, I can get in…that's if the door closer isn't too heavy but even with the Crown Plaza Canberra, the inside door knob is round so I can't get out.	Darcy-13	OA-AU	wheelchair-general	member	transition	@	interior doorway	@	interior doorway	Literature
Light switches at a reasonable height	Darcy-14	OA-AU	wheelchair-general	member	indoor	@	@	room	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
I was delighted to see the Crown Plaza had taken out their previously low desk, a fixed desk, and put in a table that has 700mm clearance underneath so I was able to wheel in. That was a perfect height for me to access my meal or writing or doing whatever I needed to do there	Darcy-15	OA-AU	wheelchair-general	member	indoor	@	@	seating	seating	Literature
when I got there the door to the bathroom opened inward and it opened straight in onto the toilet. Once you got in there with a wheelchair, you couldn't shut it behind you because there wasn't enough room. You couldn't get onto the toilet so I had to get them to take the door off the bathroom just so I could use the bathroom and the shower…It was meant to be a disabled room.	Darcy-16	OA-AU	wheelchair-general	member	transition	@	bathroom	@	@	Literature
Parking; Drop off points at reception; Continuous pathways - * from parking or drop off throughout all hotel facilities and to the room;	Darcy-17	OA-AU	target groups	interview	indoor-outdoor	@	@	service	@	Literature
Kerb ramps throughout grounds	Darcy-18	OA-AU	target groups	interview	outdoor	@	@	pedestrian path	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Door widths; Door stops weight; D type door handles;	Darcy-19	OA-AU	target groups	interview	transition	@	@	interior doorway	@	Literature
It seems if you use a wheelchair, you cannot browse through holiday literature and decide on a holiday that takes your fancy. You must decide on a destination, gather all the information required and if not suitable, start again. If a service provides comprehensive information, we are not aware of it.	Darcy-2	OA-AU	wheelchair-general	member	indoor-outdoor	tourism	@	@	@	Literature
Reception counter height; Assistance with luggage if required; Table height in restaurants	Darcy-20	OA-AU	target groups	interview	indoor	@	@	service	@	Literature
Circulation space in corridor; Circulation space in all rooms;	Darcy-21	OA-AU	target groups	interview	indoor	@	@	indoor space	@	Literature
Access signage; Directional signage;	Darcy-22	OA-AU	target groups	interview	indoor-outdoor	@	@	building	@	Literature
Good lighting levels	Darcy-23	OA-AU	target groups	interview	indoor-outdoor	@	@	building	@	Literature
Slip resistant surfaces	Darcy-24	OA-AU	target groups	interview	indoor	@	@	indoor space	@	Literature
No steps into rooms (<5mm)	Darcy-25	OA-AU	target groups	interview	transition	@	@	interior doorway	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Lever taps; Access to room controls from bed; Hobless roll in showers; Mirror location; Hand basin positioning and bench space for toiletries; • Space under the hand basin; Adequate shower chair or bench; Location of handrails; Toilet height and positioning (distance from walls and front clearance from obstructions); Hand held shower hose and length of hose; Non-slip floor surface;	Darcy-26	OA-AU	target groups	interview	indoor	@	@	bathroom	@	Literature
A roll in shower, a hand held hose, I need a sink that I can actually get my knees under, rather than having facia boards underneath the sink and vanity so you can't wheel under the sink. Otherwise if I try and clean my teeth, have a wash, do what ever, I finish up getting my shirt and my trousers very wet… And I need the razor plug to be in an accessible position rather than over behind the sink or up too high (Don Pg 149-153).	Darcy-27	OA-AU	wheelchair-general	member	indoor	@	bathroom	bathroom	bathroom	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
I would love to know that at Cootamundra there's a theme park and it's accessible and the motel is totally accessible. Have some way of looking that up on the net… (Tony Pg 386).	Darcy-28	OA-AU	wheelchair-general	member	indoor-outdoor	tourism	@	@	@	Literature
The critical elements involve accurate and detailed accommodation-specific and destinationspecific information.	Darcy-3	OA-AU	target groups	interview	indoor-outdoor	tourism	@	@	@	Literature
I'd get there and there was a small step in	Darcy-4	OA-AU	wheelchair-general	member	transition	@	entrance	@	@	Literature
one I got to and the actual toilet was behind the bathroom door and I had to get them to take the door off! (Don Pg 248).	Darcy-5	OA-AU	wheelchair-general	member	transition	@	bathroom	@	@	Literature
everything accommodated for disabled accommodation except the two foot steps into the building which made a total height of almost four feet.	Darcy-6	EU	wheelchair-general	member	transition	@	entrance	@	@	Literature
My wife dragged me up there and then to get to the reception there was another couple of steps!	Darcy-7	EU	wheelchair-general	member	indoor	@	indoor space	@	@	Literature
We get in the lift and the lift wouldn't hold me - it was too small…just stuck in Paris, nowhere to	Darcy-8	EU	wheelchair-general	member	indoor	@	elevator	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
stay, nothing.										
when I got onto the boat and saw the flight of stairs I had to be lifted down, that was a little worrying (Annabel Pg 335).	Darcy-9	OA-AU	wheelchair-general	member	transit vehicle	@	entrance	@	stairway	Literature
Building Accessibility: Curb ramp; Door (auto or manual)	Ding-1	NA-US	wheelchair-general	interview	transition	building-general	@	@	@	Literature
Sidewalk: Sidewalk condition (cracks, potholes, materials); Sidewalk congestion (pedestrian traffic); Sidewalk geometry (clear width, grade, cross-slope, step)	Ding-2	NA-US	wheelchair-general	interview	outdoor	pedestrian path	@	@	@	Literature
Curb: Curb (height). Curb cuts (width, slope). Landing (length)	Ding-3	NA-US	wheelchair-general	interview	outdoor	pedestrian path	@	@	@	Literature
Lighting: Visibility	Ding-4	NA-US	wheelchair-general	interview	outdoor	lighting	@	@	@	Literature
Handicap Parking: Parking space (width); Passenger loading zone (width)	Ding-5	NA-US	wheelchair-general	interview	indoor-outdoor	parking	@	@	@	Literature
Bus: Bus stop accessibility; Bus route accessibility	Ding-6	NA-US	wheelchair-general	interview	outdoor	transit-general	@	@	@	Literature
I can't roll on the sidewalk; I have to roll on the streets because the sidewalks are so cracked up and messed up in my neighbourhood that I can't roll on the	Duggan-1	NA-US	wheelchair-general	member	outdoor	@	pedestrian path	@	pedestrian path	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
sidewalk										
And then when I get to the cutaway, it's been like this since June, there's trash and water and mud	Duggan-2	NA-US	wheelchair-general	member	outdoor	@	pedestrian path	@	@	Literature
I have to roll through it every single day (activity) to get to the bus stop	Duggan-3	NA-US	wheelchair-general	member	outdoor	@	transit-stop	@	pedestrian path	Literature
And then when we got there it was a bad part of Dearborn where it was not accessible (physical environment). I couldn't get in (stress appraisal: threat; activity restrictions). That was really upsetting to me (stress appraisal: threat). . . . It was upstairs, up a flight of stairs—the wedding reception	Duggan-4	NA-US	wheelchair-general	member	transition	@	entrance	@	entrance	Literature
For the average scooter user, driving in an environment built to these absolute minimum dimensions would be frustrating and time-consuming, possibly leading to damage of the environment or scooter.	Dutta-1	NA-CAN	wheelchair-power	observation	indoor	@	indoor space	@	@	Literature
We usually got a room on the ground	Evans-1	ASIA	wheelchair-manual	member	transition	@	@	entrance	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
floor.										
Streets in the cities we visited in India were very narrow and extremely congested. Sidewalks were a nonexistent dream and when they did exist, they were full of holes.	Evans-2	ASIA	wheelchair-manual	member	outdoor	@	outdoor space	outdoor space	@	Literature
Unfortunately, they were on the 4th floor of a building with no elevator.	Evans-3	ASIA	wheelchair-manual	member	indoor	@	building	building	@	Literature
It is also examined that even in a subway, which is the most convenient to disabled people, a wheelchair user cannot enter the shopping centre as ordinary citizens because any elevator or ramp is provided on some stations.	Evcil-1	ASIA	wheelchair-general	observation	transition	@	service	@	@	Literature
During the observation, it is found very narrow sidewalk, prolapsed paving stones and obstacles on the sidewalks such as advertisement boards and pots of flowers or parking stoppers.	Evcil-2	ASIA	wheelchair-general	observation	outdoor	@	pedestrian path	@	@	Literature
ramps are provided on sidewalk with deficiencies such as inadequate landing area at ramps and inclination of ramps	Evcil-3	ASIA	wheelchair-general	observation	outdoor	@	ramp	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
(more than ratio 1–12).										
Five of them have incomplied entrance such as steep ramps or steps from sidewalk to building entrance.	Evcil-4	ASIA	wheelchair-general	observation	transition	@	entrance	@	@	Literature
The other 17 buildings provide inadequate dimension on cashier (too high counter) and counter dimension (too narrow passway).	Evcil-5	ASIA	wheelchair-general	observation	indoor	@	service	@	@	Literature
Eleven toilets are incompliant because of some deficiencies such as narrow doors (less than 100 cm) and higher sink (more than 88 cm above floor).	Evcil-6	ASIA	wheelchair-general	observation	indoor	@	bathroom	@	@	Literature
in the libraries of the Centre for Applied Social Sciences (CCSA in Portuguese), the route with this tactile floor heads nowhere, and ends at a part of the service counter that does not have a workstation for the librarians, which makes it difficult to attend to and creates constraints in attending to visually impaired users.	Ferrer-1	SA	low vision	observation	indoor	@	service	indoor space	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
it has a set of levels, creating a kind of set of "half-floors" with 1.0 m difference between them. Thus, it is necessary to create stairs and ramps that allow free access to all the environments.	Ferrer-2	SA	target groups	observation	indoor	@	@	indoor space	@	Literature
the building has two floors, of which the upper one is designed for group study rooms and the area for individual study. The only form of access to this floor is by stairs. There is no elevator or equivalent equipment, which would allow access for wheelchair users and users with low mobility, thus segregating the entry into this space of the built environment.	Ferrer-3	SA	wheelchair-general	observation	indoor	@	building	@	@	Literature
Accessibility on some trains was complicated by inadequate signage (both braille and oral)	Freeman-1	EU	low vision	interview	transit vehicle	@	transit vehicle	@	@	Literature
inadequate space on many trains for wheelchair access to washrooms or food facilities	Freeman-2	EU	wheelchair-general	interview	transit vehicle	@	indoor space	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Many elevators and hallways were not equipped with braille signs or voice indicators, necessitating one Canadian to wait in the hotel lobby more than one hour to be taken to her room after being checked in.	Freeman-3	NA-CAN	low vision	interview	indoor	@	building	@	@	Literature
she had to continually ask him to tell her where to find the means to be independent, such as the location of the floor buttons in the elevator.	Freeman-4	NA-CAN	low vision	interview	indoor	@	service	elevator	@	Literature
tables that are not adapted for those in wheelchairs, including both the tables used for eating and the counters where food is kept for buffets. Other problems included the very close spacing of the tables, meaning those with wheelchairs were relegated to the outside tables close to the door, if they were able to be accommodated at all.	Freeman-5	EU	wheelchair-general	interview	indoor	@	seating	@	@	Literature
elevators with doors at front and rear to improve the flow of traffic generally and eliminate the need to	Gossett-1	NA-US	wheelchair-general	interview	indoor	@	@	elevator	elevator	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
turn for those with mobility impairments.										
bright light is needed by those with vision impairments.	Gossett-2	NA-US	low vision	access professional	indoor	@	@	general mobility	@	Literature
A pull-in drive area with loading/ unloading spaces for both cars and vans allows for safe access by both manual and power chair users. The curb at the drop-off area merges seamlessly into the sidewalk, which was designed to rise on a 1:20 grade from the building's corners to the entryway.	Gossett-3	NA-US	wheelchair-general	interview	outdoor	@	@	building	@	Literature
People with low vision who are not cane-users have slipped off the side of the ramp while walking down the sidewalk. To improve safety, the building owners have stacked orange cones lining the ramp and are awaiting approval from the city to get a railing put up alongside the ramp.	Gossett-4	NA-US	low vision	interview	outdoor	@	ramp	ramp	ramp	Literature
Carpet minimizes noise, offsetting occasional loud noises.	Gossett-5	NA-US	low vision	interview	indoor	@	general mobility	indoor space	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
carpet can pose problems for wheelchair users by causing their chairs to 'pull' like a car out of alignment.	Gossett-6	NA-US	wheelchair-general	interview	indoor	@	indoor space	@	indoor space	Literature
The elevator system was designed to include two separate elevators that are large enough for multiple wheelchair users with doors wide enough for two chairs to pass. In addition, the elevators have openings on both sides so wheelchair users are not required to make a 180 degree turn to exit the elevator.	Gossett-7	NA-US	wheelchair-general	access professional	indoor	@	@	elevator	elevator	Literature
The elevators also include visual and audio cuing as required by the Americans with Disabilities Act of 1990.	Gossett-8	NA-US	low vision	interview	indoor	@	@	elevator	@	Literature
Major environmental barriers to exercise at fitness centres were: no seats large enough to transfer to on the strength and aerobic equipment; no types of gloves or wraps available to assist with gripping exercise equipment; and no specialized exercise equipment for people of varying	Gross-1	EU-UK	target groups	observation	indoor	@	service	@	service	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
physical abilities. Additional limitations of fitness facilities were lack of floor space to access exercise equipment.										
Eleven participants could not easily read street signs due to their visual impairment.	Hara-1	NA	low vision	interview	outdoor	@	wayfinding	@	signage	Literature
When asked about which route-landmarks at bus stops are most important to navigation, participants identified shelters and benches as the most helpful followed by trash cans, newspaper bins, grass shoulders, and other non-visual indicators. A few also mentioned knowing the shape of the bus stop pole (e.g., thin vs. thick, two-column vs. one).	Hara-10	NA	low vision	interview	outdoor	transit-stop	@	transit-stop	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
I look for route-landmarks... like a bus shelter at a certain place... or if there's a hedge, like bushes in front of a certain place and right by those bushes there's a newspaper rack or something like that then I know that it's my stop. If it's in front of a coffee shop…if there's a hotdog stand there, then I know that the bus stop is in front of the hot dog stand, you smell it… Noises too, you know different sounds. (P14, 55, blind)	Hara-11	NA	low vision	member	outdoor	route-landmarks	@	transit-stop	wayfinding	Literature
These applications provided either real-time or scheduled arrival information	Hara-12	NA	low vision	interview	outdoor	transit-general	@	@	@	Literature
Most participants said that having information about route-landmarks would enable them to use transit more easily (even five participants who could sometimes read street signs).	Hara-13	NA	low vision	interview	outdoor	route-landmarks	@	transit-general	@	Literature
For most participants, public transit was critical for daily mobility. One woman, for example, stated that the lack of accessible public	Hara-2	NA	low vision	interview	outdoor	@	@	general mobility	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
transit "played into her decision" to retire.										
participants described many challenges when using public transit including finding bus stops, knowing which bus to board, and when to disembark.	Hara-3	NA	low vision	interview	outdoor	transit-general	transit-general	@	transit-general	Literature
half of the participants experienced difficulty finding the exact location of bus stops when travelling. Difficulties included determining the specific location of a bus stop (e.g., near-side of intersection, half-way down the block)	Hara-4	NA	low vision	interview	outdoor	transit-stop	transit-stop	@	transit-stop	Literature
Because bus stop designs and placement can vary widely within a city— from stops with a myriad of physical route-landmarks (e.g., shelters, benches, trash cans, and newspaper boxes) to stops with only a pole—one participant said with frustration: There's really no rhyme or reason of where they put bus	Hara-5	NA	low vision	member	outdoor	@	transit-stop	transit-stop	transit-stop	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
stops. And there's no way to…tell where a bus stop [is], 'cause you don't ever know where the pole is, or how it's marked, or... anything like that. (P3, age=63, blind)										
For this participant, the main reason he did not use public transit was because of the challenges he faced in finding bus stops. Another participant noted that some stops in his city were hard to find because they had no non-visual route-landmarks, only painted curbs. Many noted that consistent stop locations and route-landmarks would significantly help them overcome this accessibility challenge. For both blind and low-vision participants, finding an unfamiliar stop took a lot of time and, as one participant explained, required adjusting expectations to reduce stress: I think	Hara-6	NA	low vision	member	outdoor	@	transit-stop	transit-stop	transit-stop	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
also just not to worry about it so much. Just not stress out about it. Just know that it will be new and it will take a little more time to figure it out. (P14, 55, blind)										
To find bus stops, participants mentioned using walking directions from transit trip planners	Hara-7	NA	low vision	interview	outdoor	route-directions	@	@	transit-stop	Literature
Ten participants (53%) reported asking pedestrians or other transit riders for information—a strategy only available when others are present (i.e., more difficult at night or in more rural areas).	Hara-8	NA	low vision	interview	outdoor	transit-general	nighttime mobility	@	@	Literature
For example, if a person uses a cane, s/he can hear an echo from a shelter when walking by.	Hara-9	NA	low vision	interview	outdoor	@	@	transit-stop	wayfinding	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Other layers, which are vital to the project, to name a few, such as location of trees, fire hydrants, utility poles, bike racks, steps, traffic lights etc were mapped using DGPS.	Helal-1	NA	low vision	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature
Problems with doors (for instance, they were either too heavy and/or not wide enough for a person using a wheelchair to enter)	Hernandez-1	NA-US	wheelchair-general	observation	transition	@	entrance	@	@	Literature
'A lot of the aisles are so close together that if you push her down an aisle all the clothes come off (Participant B).	Hewitt-Taylor-1	EU-UK	wheelchair-general	interview	indoor	@	service	@	service	Literature
'If she wants new clothes I have to buy three sizes and bring them home because the changing rooms aren't actually set up for disabled people. Very few of them ha ve got seats, very few of them have got rails, and they're not always big enough to put a wheelchair in either	Hewitt-Taylor-2	EU-UK	wheelchair-general	interview	indoor	@	service	@	@	Literature
'The disabled changing room at [shop name] is usually full of stock. I've said to them: "This is a disabled changing room, why	Hewitt-Taylor-3	EU-UK	wheelchair-general	interview	indoor	@	service	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
is it full of stock ? " and the answer is: "That's where we've been told to put it"' (Participant B).										
We can't go on public transport because some of the buses have got drop steps but some haven't, and you can't guarantee which you'll get' (Participant E).	Hewitt-Taylor-4	EU-UK	target groups	interview	transit vehicle	@	entrance	@	@	Literature
'Trains have only got a few disabled places and when they've gone you can't get on, but you can't book a place. So it could be a case of we're all going up to London for the day and we get to the station and we can't go' (Participant E).	Hewitt-Taylor-5	EU-UK	wheelchair-general	interview	transit vehicle	@	indoor space	@	@	Literature
'...you can't use all the underground stations. Because it's all stairs and escalators and you can't put wheelchairs on those.. .or ifyou do they don't like it'(Participant E).	Hewitt-Taylor-6	EU-UK	wheelchair-general	interview	indoor	@	transit-stop	@	@	Literature
The message, which informs the user of their whereabouts by describing the area, junctions, streets and pedestrian crossings	Hine-1	EU-UK	low vision	wayfinding professional	outdoor	street layout	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
information about shops, telephones, ATMs, clinics, etc. can be stored on the device	Hine-2	EU-UK	low vision	wayfinding professional	outdoor	wayfinding	@	@	@	Literature
For instance, a person with residual vision would need more detailed information about a transparent glass bus shelter	Hine-3	EU-UK	low vision	wayfinding professional	outdoor	transit-stop	transit-stop	@	@	Literature
which a long-cane user would potentially identify through their ability to use aural and tactile clues.	Hine-4	EU-UK	low vision	wayfinding professional	outdoor	@	@	general mobility	@	Literature
where users often find reversing difficult to accomplish safely. For example, backing out of elevators is a significant problem for older drivers.	Holliday-1	NA-CAN	wheelchair-general	survey	indoor	@	elevator	@	@	Literature
These findings suggest that while a powered wheelchair may enter into a space, the occupant may have limited reach access and may only be able to exit the space, without collisions, by driving in reverse.	Holliday-2	NA-CAN	wheelchair-power	observation	indoor	@	indoor space	@	indoor space	Literature
staircases,	Israeli-1	ASIA	wheelchair-general	survey	indoor	building-general	@	@	@	Literature
elevators	Israeli-2	ASIA	wheelchair-general	survey	indoor	elevator	@	@	@	Literature
parking	Israeli-3	ASIA	wheelchair-general	survey	indoor-outdoor	parking	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
(accessible) sidewalks	Israeli-4	ASIA	wheelchair-general	survey	outdoor	pedestrian path	@	@	@	Literature
access ramps	Israeli-5	ASIA	wheelchair-general	survey	transition	building-entrance	@	@	@	Literature
restrooms	Israeli-6	ASIA	wheelchair-general	survey	indoor	building-bathroom	@	@	@	Literature
elevators were the most significant factor for disabled tourists' accessibility	Israeli-7	ASIA	wheelchair-general	survey	indoor	@	@	building	@	Literature
only 2 of the facilities provided exercise machines that allowed for a seat or bench to be removed for wheelchair access.	Johnson-1	NA-US	wheelchair-general	observation	indoor	@	service	@	@	Literature
adequate restroom stall door width, insulated covering for abrasive surfaces and hot water pipes underneath the sink, and accessible showers	Johnson-2	NA-US	target groups	observation	indoor	@	@	bathroom	@	Literature
When examining the exterior entrances/doors domain, a majority of the fitness facilities required the manual opening of doors, with only 2 facilities equipped with automatic door entry. Only one of the fitness facilities provided posted signage to a more accessible entry. This finding was troublesome, especially if	Johnson-3	NA-US	target groups	observation	transition	@	entrance	entrance	entrance	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
individuals with disabilities are unable to open the manually controlled doors due to door pressure or lack of strength.										
1. Points of Interest (POI): Places or objects that are potential destinations. They also are useful or interesting places to allow a better understanding of the environment while traveling (e.g. public buildings, shops, etc.).	Kammoun-1	EU	blind	interview	outdoor	building-general	@	@	@	Literature
2. route-landmarks (LM): Locations that can be detected by the user in order to confirm its own position within the itinerary (e.g. changes in the ground texture, telephone poles, traffic lights, etc.)	Kammoun-2	EU	blind	interview	outdoor	route-landmarks	@	@	@	Literature
3. Walking Areas (WA): All the possible pedestrian paths as defined in [10] (e.g. sidewalks, and pedestrian crossings).	Kammoun-3	EU	blind	interview	outdoor	pedestrian path	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
In order to reach the same destination, blind pedestrians may choose one of the four different paths represented by different colors. Some of them are shorter or have less turns but maybe less suitable for blind pedestrians (e.g. absence of pedestrian crossing).	Kammoun-4	EU	blind	wayfinding professional	outdoor	pedestrian crossing	route	route	@	Literature
And sidewalk width is essential to allow fluidity of movement while using a white cane or a guide dog. We considered that maximal width is equal to 5 meters, and we attributed costs to sidewalk width that range from 1 to 5	Kammoun-5	EU	blind	wayfinding professional	outdoor	@	@	pedestrian path	@	Literature
pedestrian crossing the road is really challenging for a Blind, and is dangerous in absence of pedestrian crossing. Hence, we penalized road pedestrian crossing in general, and we added extra penalties in absence of pedestrian crossing and accessible traffic light.	Kammoun-6	EU	blind	wayfinding professional	outdoor	@	pedestrian path	@	pedestrian path	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
In a typical scenario, the system would mention that the paving of the sidewalk is going to change. The user can feel it and is confident about the path he is following.	Kammoun-7	EU	blind	wayfinding professional	outdoor	pedestrian path	@	wayfinding	@	Literature
In a scenario where a blind user wants to reach a new place from a subway station, the system would mention the location of, e.g., the surrounding streets, the church, the bank, the mail office, etc.	Kammoun-8	EU	blind	wayfinding professional	outdoor	street layout	@	@	@	Literature
The mobility domain encompasses those elements which enable traversing the building both horizontally and vertically. Horizontal elements contain hallway segments and nodes, which connect the hallway segments and vertical elements contain elevators, stairways, and escalators.	Karimi-1	NA-US	target groups	wayfinding professional	indoor	@	@	building	building	Literature
wheelchair users cannot pass through every segment in the sidewalk network because of such obstacles as stairs or slope in the sidewalk.	Kasemsuppakorn-1	NA-US	wheelchair-general	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
some wheelchair users hesitate to travel along sidewalks with steep slopes	Kasemsuppakorn-2	NA-US	wheelchair-general	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature
others prefer sidewalk conditions with very few cracks.	Kasemsuppakorn-3	NA-US	wheelchair-general	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature
Obstacles are composed of steps, cracks, manholes, and uneven surface. Each obstacle is represented on the corresponding sidewalk segment as a point and the impedance score of that obstacle is recorded in the attribute table. All these obstacles on the sidewalk segments are taken into account to calculate the sidewalk's condition.	Kasemsuppakorn-4	NA-US	wheelchair-general	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature
This was necessary because the existence of accessible entrances	Kasemsuppakorn-5	NA-US	wheelchair-general	wayfinding professional	outdoor	@	@	building	@	Literature
as well as curb cuts at sidewalk junctions has a high impact on wheelchair mobility.	Kasemsuppakorn-6	NA-US	wheelchair-general	wayfinding professional	outdoor	@	@	pedestrian path	@	Literature
Soft loose sand or gravel, wet clay, and irregular surfaces such as cobblestones can significantly impede wheelchair movement [cite ADAAG].	Kasemsuppakorn-7	NA-US	wheelchair-general	wayfinding professional	outdoor	@	pedestrian path	@	pedestrian path	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The majority of participants lived in single-family homes or apartments or condominiums and reported that there were several steps with railing at the entrance to their homes.	Keysor-1	NA-US	wheelchair-general	survey	transition	@	entrance	@	@	Literature
the participants reported stairs inside their main living area.	Keysor-2	NA-US	wheelchair-general	survey	indoor	@	indoor space	@	@	Literature
participants reported uneven sidewalks or other walking areas,	Keysor-3	NA-US	wheelchair-general	survey	outdoor	@	pedestrian path	@	@	Literature
The availability of more transportation facilitators was associated with increased community participation (P .06)	Keysor-4	NA-US	wheelchair-general	survey	outdoor	@	@	general mobility	@	Literature
Problems with sidewalk pavement, Problems with puddles or poor drainage, Problems with construction, Problems with snow removal, Problems with curb cuts, Narrow sidewalks, Attitudes of the public, Problems with scaffolding, Problems with noise, Problems with crosswalks	Kirchner-1	NA-US	low vision	survey	outdoor	@	pedestrian path	@	@	Literature
Lack of curb cuts	Kirchner-2	NA-US	wheelchair-general	survey	outdoor	@	pedestrian path	@	@	Literature
Too much street furniture	Kirchner-3	NA-US	low vision	survey	outdoor	@	pedestrian path	@	@	Literature
Open manholes or	Kirchner-4	NA-US	low vision	survey	outdoor	@	pedestrian	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
basement doors							path			
Problems with hills	Kirchner-5	NA-US	wheelchair-manual	survey	outdoor	@	pedestrian path	@	@	Literature
Problems with sidewalk pavement and puddles/poor drainage were the most frequently mentioned environmental barriers, by 90% and 80%, respectively. More than 60% identified problems with construction, snow removal, and curb cuts. About 50% experienced narrow sidewalks, public attitudes, scaffolding, and crosswalks as environmental barriers.	Kirchner-6	NA-US	wheelchair-general	survey	outdoor	@	pedestrian path	@	@	Literature
three were highest among manual wheelchair users. The need for curb cuts was a particularly strong finding for this group, and all the manual wheelchair users reported poor sidewalk pavement quality as a barrier.	Kirchner-7	NA-US	wheelchair-manual	survey	outdoor	@	pedestrian path	@	@	Literature
The next largest sub-category for objects is touch (31 objects). The three objects most referenced in this category were walls (5 descriptions), buttons	Kulyukin-1	NA-US	low vision	survey	indoor	@	@	route	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
(4 descriptions), and railings (3 descriptions).										
The third largest category was sound (28 objects). Examples of objects in this category are water fountains (2 descriptions), echoes (2 descriptions), and doors (2 descriptions).	Kulyukin-2	NA-US	low vision	survey	indoor	@	@	route	@	Literature
The three most used verbs of movement are turn (16 descriptions), walk (14 descriptions), and go (9 descriptions).	Kulyukin-3	NA-US	low vision	survey	indoor	@	@	@	route	Literature
The verbs shoreline (1 description) and trail (2 descriptions) are two commands which reflect a distinct action or method of travel that blind people may need to perform that sighted travelers do not. Shorelining, or trailing, is the act of following the connecting edge of two objects. An example of shorelining indoors is using a cane to follow where a floor and wall meet	Kulyukin-4	NA-US	blind	survey	indoor	@	@	route	route	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Another example specific to a blind traveler is the verb ask, as in ask your dog to find the elevators on the left.	Kulyukin-5	NA-US	blind	survey	indoor	@	@	@	route	Literature
They pointed out that protruding objects with sharp edges such as cabinet handles should be avoided.	Kutintara-1	ASIA	low vision	interview	indoor	@	indoor space	@	@	Literature
They needed clear space in a kitchen without any obstacles.	Kutintara-2	ASIA	low vision	interview	indoor	@	@	indoor space	@	Literature
To prevent slip and falls, non slippery materials should be used on kitchen floor even if the floor is wet.	Kutintara-3	ASIA	low vision	interview	indoor	@	@	indoor space	@	Literature
The low vision persons needed contrasting bright colored stickers on appliance controls.	Kutintara-4	ASIA	low vision	interview	indoor	@	@	public object	@	Literature
a wide range of accessibility information is available, including information on streets (type, surface, smoothness, tactile paving)	Laakso11-1	EU	target groups	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature
Stairs, escalators, and lifts/elevators	Laakso11-10	EU	target groups	wayfinding professional	outdoor	elevator	@	@	@	Literature
pedestrian crossings and traffic lights with audible pedestrian signals	Laakso11-11	EU	target groups	wayfinding professional	outdoor	pedestrian crossing	@	@	@	Literature
Pedestrian subways and overpasses	Laakso11-12	EU	target groups	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Public transportation stops and stations	Laakso11-13	EU	target groups	wayfinding professional	outdoor	transit-stop	@	@	@	Literature
route-landmarks: visible and sonic	Laakso11-14	EU	target groups	wayfinding professional	outdoor	route-landmarks	@	@	@	Literature
Streetlights (or absence thereof)	Laakso11-16	EU	target groups	wayfinding professional	outdoor	lighting	@	@	@	Literature
Obstacles, high curbs, construction sites; Current information on maintenance, especially in winter	Laakso11-17	EU	target groups	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature
For visually impaired pedestrians, road signs are generally not accessible, which hinders their orientation; clearly visible or sonic route-landmarks, however, could be used to help these pedestrians orient themselves. For example, water fountains, basins, and natural creeks, ditches, and rivers with running water providing constant sound can all serve as sonic route-landmarks for visually impaired hikers in a park (Laakso and Sarjakoski 2010).	Laakso11-18	EU	target groups	wayfinding professional	outdoor	route-landmarks	general mobility	general mobility	general mobility	Literature
steps (number of steps, handrails)	Laakso11-2	EU	target groups	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature
bridges and tunnels (height, width)	Laakso11-3	EU	target groups	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature
pedestrian crossings (traffic lights, pedestrian islands)	Laakso11-4	EU	target groups	wayfinding professional	outdoor	pedestrian crossing	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
public transportation stops and stations	Laakso11-5	EU	target groups	wayfinding professional	outdoor	transit-stop	@	@	@	Literature
route-landmarks such as towers, fountains, and benches.	Laakso11-6	EU	target groups	wayfinding professional	outdoor	route-landmarks	@	@	@	Literature
to see additional information related to these locations, such as accessibility information (e.g., steep slopes, stairs, traffic lights without audible pedestrian signals).	Laakso11-7	EU	target groups	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature
These guidelines include the availability of information; low-floor buses, trains, and trams; raised and step-less stops; elevators or escalators at stations; suitable materials and colours at stops and stations; and continuous maintenance, including snow removal and sanding in winter (HSL 2010).	Laakso11-8	EU	target groups	wayfinding professional	outdoor	transit-general	@	@	@	Literature
Surface of the road and tactile paving; Height profiles of roads, or at least indications where slopes are >5%; Lateral inclination of roads, if >2% f Width of walkways/gateways, if <2m	Laakso11-9	EU	target groups	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The user group of users with visual impairments pointed us to the importance of information suited to pedestrians, open areas and security.	Laakso12-1	EU	low vision	interview	outdoor	street layout	@	@	@	Literature
Zebra pedestrian crossing with traffic island; Poorly signalised zebra pedestrian crossing	Laakso12-10	EU	low vision	access professional	outdoor	@	pedestrian crossing	@	@	Literature
Non signalised stairs	Laakso12-11	EU	low vision	access professional	outdoor	@	stairway	@	@	Literature
Unsuitable lighting	Laakso12-12	EU	low vision	access professional	outdoor	@	pedestrian path	@	@	Literature
Pavement without kerb	Laakso12-13	EU	low vision	access professional	outdoor	@	pedestrian path	@	@	Literature
Zebra pedestrian crossings regulated by traffic light with simultaneous green light for pedestrians and amber for vehicles; Traffic light with short period of green light	Laakso12-14	EU	blind	access professional	outdoor	@	pedestrian crossing	@	@	Literature
Information about timetables, number and direction of the next arriving metro.	Laakso12-15	EU	low vision	wayfinding professional	outdoor	transit-general	@	@	@	Literature
Sonic tags should provide information about the conditions of the road.	Laakso12-16	EU	low vision	interview	outdoor	pedestrian path	@	@	@	Literature
Rich information service (route guidance with information about rest places etc.).	Laakso12-17	EU	low vision	wayfinding professional	outdoor	route-directions	@	@	@	Literature
Location of train platforms.	Laakso12-18	EU	low vision	interview	outdoor	transit-stop	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The device tells additional information related to the POI.	Laakso12-19	EU	low vision	interview	outdoor	route-destination	@	@	@	Literature
Directions and orientation	Laakso12-2	EU	low vision	interview	outdoor	route-directions	@	@	@	Literature
The device tells if the path is difficult to walk on (e.g. because of ice or water).	Laakso12-20	EU	low vision	interview	outdoor	route-obstacles	route	@	@	Literature
the user is conducting a virtual walk-through of the complete route i.e. thus knowing ahead when to turn, which streets to cross before turning etc., thus already having a rough mental map of the route to travel	Laakso12-21	EU	low vision	interview	outdoor	route-enroute	@	@	route	Literature
1. Orienting oneself in the environment. 2. Choosing the route. 3. Keeping on the right track. 4. Recognizing that the destination has been reached.	Laakso12-22	EU	low vision	interview	outdoor	@	@	route	route	Literature
The requested data included detailed information about public transport	Laakso12-23	EU	low vision	interview	outdoor	transit-general	@	@	@	Literature
as well as conventional points of interest information in the scenario, being a tourist in a city.	Laakso12-24	EU	low vision	interview	outdoor	route-destination	@	@	@	Literature
Furthermore, virtual corridors were requested, to make it possible to e.g. cross	Laakso12-25	EU	low vision	interview	outdoor	@	outdoor space	@	outdoor space	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
a large square without getting lost.										
Both groups [people with visual impairments and elderly people] pointed out the importance of route-landmarks	Laakso12-26	EU	low vision	interview	outdoor	route-landmarks	@	@	@	Literature
context information such as houses, house numbers and other things in the environment.	Laakso12-27	EU	low vision	interview	outdoor	street layout	@	@	@	Literature
People with visual impairments could use ambient sounds as route-landmarks.	Laakso12-28	EU	low vision	interview	outdoor	@	@	route	@	Literature
People with visual impairments could familiarise themselves with the area in advance and also find audible route-landmarks in order to obtain help in recognising places.	Laakso12-29	EU	low vision	interview	outdoor	@	@	route	@	Literature
route-landmarks	Laakso12-3	EU	low vision	interview	outdoor	route-landmarks	@	@	@	Literature
Locations, including route-landmarks and points of interests	Laakso12-30	EU	low vision	wayfinding professional	outdoor	route-landmarks	@	@	@	Literature
Information about the environment with different levels of detail	Laakso12-31	EU	low vision	interview	outdoor	street layout	@	@	@	Literature
Height information, including height differences and slopes	Laakso12-32	EU	low vision	interview	outdoor	pedestrian path	@	@	@	Literature
Distances, directions	Laakso12-33	EU	low vision	interview	outdoor	route-	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
and orientation						directions				
Availability of and access to public transportation	Laakso12-34	EU	low vision	wayfinding professional	outdoor	transit-general	@	@	@	Literature
related attribute information like the condition of the surface shown with different colours and classification of the danger potential to walk or bicycle on a route are of major importance.	Laakso12-35	EU	low vision	interview	outdoor	pedestrian path	@	@	@	Literature
Some examples on attribute information increasing the accessibility are: • surface of the road, • condition of the road, • street names, • width of the walkway, if less than 2m, and • lateral inclination of the road, if more than 2%.	Laakso12-36	EU	low vision	wayfinding professional	outdoor	pedestrian path	@	pedestrian path	@	Literature
For example, for users with visual impairments the location of a safe pedestrian crossing with acoustic traffic lights is important and many common objects appear as obstacles, such as traffic signs and rubbish bins.	Laakso12-37	EU	low vision	wayfinding professional	outdoor	pedestrian crossing	pedestrian path	pedestrian crossing	@	Literature
• streetlight lamp posts • rubbish bins, plant boxes • location	Laakso12-38	EU	low vision	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
of outdoor restaurant seating • construction sites • high kerbstones										
Building entrances should be mapped with their exact location.	Laakso12-39	EU	low vision	wayfinding professional	transition	building-entrance	@	@	@	Literature
Locations and distances	Laakso12-4	EU	low vision	interview	outdoor	route-enroute	@	@	@	Literature
the following attribute information has a high importance for people with visual impairments: • traffic light (yes/no) • traffic lights with button and/or audible signals (yes/no) • traffic light with simultaneous green light for pedestrians and amber for vehicles • traffic light with short period of green light • traffic island • signalised with tactile markings (yes/no/incorrectly).	Laakso12-40	EU	low vision	interview	outdoor	pedestrian crossing	@	@	@	Literature
tactile paving, especially non signalised stairs, and pedestrian crossings	Laakso12-41	EU	low vision	wayfinding professional	outdoor	pedestrian path	pedestrian path	@	@	Literature
kerbstones, especially sidewalks without kerb.	Laakso12-42	EU	low vision	interview	outdoor	pedestrian path	pedestrian path	@	@	Literature
In addition, all obstacles or insurmountable blocks in walking area produce an immediate danger and are of first	Laakso12-43	EU	low vision	interview	outdoor	route-obstacles	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
priority to be mapped. These features include construction works, scaffoldings, bollards, bars and similar.										
Information about the environment	Laakso12-5	EU	low vision	interview	outdoor	street layout	@	@	@	Literature
Public transport	Laakso12-6	EU	low vision	interview	outdoor	transit-general	@	@	@	Literature
Terrace; Cycle way; Scaffolding	Laakso12-7	EU	low vision	access professional	outdoor	@	pedestrian path	@	@	Literature
Traffic light without audible signals	Laakso12-8	EU	low vision	access professional	outdoor	@	pedestrian crossing	@	@	Literature
Public works	Laakso12-9	EU	low vision	access professional	outdoor	@	pedestrian path	@	@	Literature
Considering the floorplan of homes, among people who use wheelchairs or scooters, about one third live in homes that are entirely on one floor	LaPlante-1	NA-US	wheelchair-general	survey	indoor	@	@	indoor space	@	Literature
Accessibility features, including ramps, are much more prevalent among users of wheeled mobility devices than people with disabilities who do not use mobility devices	LaPlante-2	NA-US	wheelchair-general	survey	indoor	@	@	indoor space	@	Literature
Wheelchair users, with almost a third having accessible parking or railings, are twice as likely to have them present in their residences.	LaPlante-3	NA-US	wheelchair-general	survey	indoor-outdoor	@	@	general mobility	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Ramps and bathroom modifications are even more frequently present among wheelchair users										
One in five wheelchair users have widened doorways or hallways	LaPlante-4	NA-US	wheelchair-general	survey	indoor	@	@	indoor space	@	Literature
The most common unmet needs among wheelchair users are automatic or easy-to-open doors and elevators, lifts, or stair glides	LaPlante-5	NA-US	wheelchair-general	survey	indoor-outdoor	@	@	building	@	Literature
Also, about half of users of wheeled mobility devices have difficulty entering or leaving their homes, which is often caused by steps and stairs in entryways, but can also be caused by narrow approaches and doorways, or steep or irregular pathways.	LaPlante-6	NA-US	wheelchair-general	survey	transition	@	entrance	@	@	Literature
About 80 percent of Wheeled mobility device users say that public transportation is difficult to use or get to	LaPlante-7	NA-US	wheelchair-general	survey	outdoor	@	general mobility	@	@	Literature
Child 2 mother: Talking about shops: ‘Sometimes obviously the steps to get in and out can be a problem’.	Lawlor-1	EU-UK	wheelchair-general	interview	transition	@	entrance	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Child 1 mother: 'The GP has a slope up into the surgery, the doors aren't good because the first door opens inward and the second door opens outward into the foyer so that's very difficult to deal with'.	Lawlor-2	EU-UK	wheelchair-general	interview	transition	@	interior doorway	@	@	Literature
Child 9 father: 'We were going to go to Edinburgh but decided not to because there are stairs everywhere and you can't get around. What would normally have taken 5 minutes would take 20, it was impractical'.	Lawlor-3	EU-UK	wheelchair-general	interview	outdoor	@	outdoor space	@	@	Literature
They had a ramp at the normal railway station	Lawlor-4	EU	wheelchair-general	interview	indoor-outdoor	@	@	transit-stop	@	Literature
a wheelchair place reserved and when we got to the boat they took her on, there was a disabled toilet and a wheelchair lift'.	Lawlor-5	EU-UK	wheelchair-general	interview	transit vehicle	@	@	transit vehicle	@	Literature
Child 5 father: 'Parking at the shops is terrible; a lot of people use the disabled spaces. Builders' wagons use them. Traffic wardens just ignore it.	Lawlor-6	EU-UK	wheelchair-general	interview	outdoor	@	parking	@	@	Literature
Public transport was used infrequently because of barriers to	Lawlor-7	EU-UK	wheelchair-general	interview	transit vehicle	@	transit vehicle	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
access such as steps, narrow aisles and lack of lifts.										
Barriers specific to the metro were gaps between train and platform and stairs to the platforms at some stations.	Lawlor-8	EU-UK	wheelchair-general	interview	indoor	@	transit-stop	@	@	Literature
analyses of participant responses provide evidence that traction is improved when the ramps were treated with truncated domes.	Lee-1	NA-US	wheelchair-general	observation	outdoor	@	@	ramp	ramp	Literature
for manual chair users, upward traversal of ramps with truncated domes required more effort than power chair users, particularly when negotiating the ramp installed with domes in a diagonal array.	Lee-2	NA-US	wheelchair-manual	observation	outdoor	@	ramp	@	ramp	Literature
manual chair participants expressed that the truncated domes were particularly beneficial for downward ramp travel.	Lee-3	NA-US	wheelchair-manual	observation	outdoor	@	@	ramp	@	Literature
18% stated that ramp navigation was “very difficult but I can ascend all ramps.”	Lemaire-1	NA-CAN	wheelchair-general	survey	outdoor	@	pedestrian path	@	ramp	Literature
However, almost half the subjects sometimes required assistance for ramp ascent during winter,	Lemaire-2	NA-CAN	wheelchair-general	survey	outdoor	@	ramp	@	ramp	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
with 18% sometimes requiring assistance with winter ramp descent.										
Most subjects (80%) reported using handrails as a strategy for winter ramp navigation,	Lemaire-3	NA-CAN	wheelchair-general	survey	outdoor	@	@	ramp	@	Literature
All respondents included snow and ice conditions as general	Lemaire-4	NA-CAN	wheelchair-general	survey	outdoor	@	ramp	@	@	Literature
The lack of handrails, or slippery handrails, was reported as a barrier by 60% of respondents. The lack of handrails on sidewalks and similar inclined surfaces was considered a major barrier if these surfaces were not adequately cleared of snow and/or ice.	Lemaire-5	NA-CAN	wheelchair-general	survey	outdoor	@	ramp	@	@	Literature
subjects reported difficulty transitioning from level ground to an incline because of snow buildup at the bottom of the exterior ramps.	Lemaire-6	NA-CAN	wheelchair-general	survey	outdoor	@	ramp	@	ramp	Literature
Snow conditions produced a very different situation across ramp grades. The 1:10 grade was insurmountable for many subjects without assistance.	Lemaire-7	NA-CAN	wheelchair-manual	observation	outdoor	@	ramp	@	ramp	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
As mentioned previously, the main issue was the front wheels becoming embedded in the snow.										
Two handrails are recommended for exterior ramps, for both propulsion and wheelchair extraction from ruts and other snowrelated obstacles. Railing design issues are important, considering the enhanced roles for controlling descent, obstacle extraction, and propulsion. Important factors include allowing unobstructed grip throughout the ramp length (i.e., no posts blocking the hand when using the rails to control descent) and ensuring railings are free of snow and ice.	Lemaire-8	NA-CAN	wheelchair-general	survey	outdoor	@	handrail	handrail	ramp	Literature
The path leading to the doorway is either steep as in shacks and huts or there are steps around the house, making it virtually impossible for them to enter or get out on their own.	Magenuka-1	AFRICA	wheelchair-general	interview	transition	@	entrance	@	entrance	Literature
Doors are narrow.	Magenuka-2	AFRICA	wheelchair-general	interview	transition	@	entrance	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Uneven terrain between the huts makes wheeling difficult.	Magenuka-3	AFRICA	wheelchair-general	interview	outdoor	@	pedestrian path	@	pedestrian path	Literature
According to Tim Marshall, an SCI person, "Toilet – that is the most critical thing. If you have got a loo you can get to, then the rest more or less follows" (Thomas & Mulherm 1994:68).	Magenuka-4	AFRICA	wheelchair-general	member	indoor	@	@	general mobility	@	Literature
As if the trouble getting there was not enough, you find the door to the toilet small and the wheelchair cannot turn around.	Magenuka-5	AFRICA	wheelchair-general	member	transition	@	bathroom	@	bathroom	Literature
there are virtually no roads. The existent bumpy strips and rough terrain hurt when one is driven over them.	Magenuka-6	AFRICA	wheelchair-general	interview	outdoor	@	pedestrian path	@	pedestrian path	Literature
There is no form of adapted public transport yet to accommodate wheelchair users. No legislation to make provision for them to travel in comfort.	Magenuka-7	AFRICA	wheelchair-general	access professional	outdoor	@	general mobility	@	@	Literature
87.5% of the buildings have at least one accessible route that provides safe and comfortable access for people with reduced mobility, between the	Manuel-Sa-1	EU	wheelchair-general	access professional	indoor-outdoor	@	@	building	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
road and the main entrance/exit										
in 87.5% of the cases, it is possible to perform a 360º rotation in the inner atrium. In 75% of the cases there are specific manoeuvre areas that allow a 360º rotation or to change the direction by 180° in T, a norm that should be observed when the width of landings, galleries or corridors is less than 1.5 me-	Manuel-Sa-2	EU	wheelchair-general	access professional	indoor	@	@	indoor space	@	Literature
None of the buildings' staircases had steps with non-slip strips and visual markers, with a distance of no less than 0.04 meters from the step nosing, and only 87.5% had a curvature radius of the step nosing between 0.005 and 0.01 meters. Only in 28.6% of cases in which the stairs bridged rises greater than 0.4m were there handrails on both sides of the staircase. At the top of the stairs, handrails should extend at least	Manuel-Sa-3	EU	target groups	access professional	indoor	@	stairway	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
0.3 meters beyond the last step, and handrails should extend beyond the first step in a length equal to the size of the tread of the step										
This bump on the floor is also found in 75% of interior doors (raised runners, thresholds or sills).	Manuel-Sa-4	EU	target groups	access professional	transition	@	interior doorway	@	@	Literature
81.8% of the cases the doors of toilets/cubicles are sliding or hinged opening outwards; in 90.9% of the cases they had devices for operating doors at a height of between 0.8 and 1.1 meters, and a distance from the outer edge of the door of no less than 0.05 meters, with doorway widths of no less than 0.77 meters in 72.7% of the cases.	Manuel-Sa-5	EU	wheelchair-general	access professional	indoor	@	@	bathroom	entrance	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
for a 50 year old man in a manual self-propelling chair, the route was fraught with difficulties. Throughout the trip, road pedestrian crossing was a problem; each of the main roads was very busy and the nature and positioning of the dropped kerbs meant that manoeuvring was difficult.	Matthews-1	EU-UK	wheelchair-manual	observation	outdoor	@	pedestrian crossing	@	@	Literature
Gutters . . . getting wheels trapped in gullies is very problematic . . .	Matthews-10	EU-UK	wheelchair-general	member	outdoor	@	pedestrian path	@	pedestrian path	Literature
Surfaces . . . I mean there's some people that can't cross cobbles because they haven't got enough strength to cross it . . . The cobbles are dreadful, especially when its been raining. Cobbles aren't as bad as gravel . . . the only problem with cobbles is if you are in any pain . . . it jolts all the time . . . Gravel is impossible. . . . it gets caught in the wheels. Poorly laid (surface) are a nightmare.	Matthews-11	EU-UK	wheelchair-general	member	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Cambers: The other thing that can be a real pain is when pavements are on a camber . . . the pavement going towards Debenhams . . . is on a hell of a slope and trying to push yourself along that . . . is a nightmare.	Matthews-12	EU-UK	wheelchair-general	member	outdoor	@	pedestrian path	@	pedestrian path	Literature
[Cambers:] I can’t get down to the shops on my own because of the high cambers.	Matthews-13	EU-UK	wheelchair-general	member	outdoor	@	pedestrian path	@	@	Literature
Ramps: Buildings built to the old regs, they used to say 1 in 12 yet now the recommendation is more like 1 in 20, which can be impossible to incorporate because it would need a very, very long ramp.; . . . the hardest bit is the turning circle . . . Very slippery surfaces . . . coming down. . . . once you slide you have got no control at all. Ramps are more of a problem than anything . . . if you haven’t got a lot of tread on your tyres.	Matthews-14	EU-UK	wheelchair-general	member	outdoor	@	ramp	@	ramp	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Gratings and drains: The other things I find is the gratings and . . . the things over the drain holes . . . if you go down a hill and there are gratings going down . . . not . . . across, when you go over it . . . if your chair has little wheels on it can throw you out.	Matthews-15	EU-UK	wheelchair-general	member	outdoor	@	pedestrian path	@	pedestrian path	Literature
Toilets: A lot of toilets don't give you enough room to turn around in.	Matthews-16	EU-UK	wheelchair-general	member	indoor	@	bathroom	@	@	Literature
[Toilets:] The problem can be the door on them, if they've got a heavy door . . . you've got to batter your way in.	Matthews-17	EU-UK	wheelchair-general	member	transition	@	bathroom	@	@	Literature
[Toilets:] What I would like to see mapped is disabled toilets.	Matthews-18	EU-UK	wheelchair-general	member	indoor	building-bathroom	@	@	@	Literature
Poor pathway maintenance: The biggest problem I have . . . is broken bottles . . . I have punctures and if you are sitting in your wheelchair there's nothing you can do about it.	Matthews-19	EU-UK	wheelchair-general	member	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The narrowness of one of the main access roads caused considerable frustration. Pavements were often uneven and poorly maintained. Temporary street furniture had to be circumnavigated. Often there was little room to pass and pedestrians largely assumed the right of way. The uphill journey was tiring and before attempting to cross the Market Square a rest was needed. The cobbles were slippery and difficult to negotiate; they caused pain and discomfort.	Matthews-2	EU-UK	wheelchair-manual	observation	outdoor	@	pedestrian path	@	pedestrian path	Literature
Street furniture and narrow streets: The good stuff is about the fixed architecture, it's the mobile stuff or what other people call mobile street furniture that is difficult to get past.; It's the shops putting out advertising and sandwich boards . . . which causes problems. Another thing is when shop display all their stuff like a market and taking up pavements .	Matthews-20	EU-UK	wheelchair-general	member	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
. .; . . . the other problem is the pavements are narrow and its got lots of people coming along there and it is difficult to get by . . . like if you meet a pushchair . . . (Bollards) Some wheelchairs are wider than others.										
Pedestrianization . . . this thing about pedestrianization in towns which is happening everywhere . . . it is wonderful for pedestrians and they want to keep cars out of the town centre, yet I think it is a terrible crisis for disabled people. They are even trying to stop Orange Badge people getting there . . .	Matthews-21	EU-UK	wheelchair-general	member	outdoor	@	parking	@	@	Literature
Car parking: There are parking spaces where there aren't any dropped kerbs; I wouldn't use that one because it's a hell of a push to the town centre; I think the biggest nightmare with car parks is where they have dropped the kerb so	Matthews-22	EU-UK	wheelchair-general	member	outdoor	@	parking	@	parking	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
that you can get onto the pavement, yet nine times out of ten you get there and you find you can't actually get on it because a car has parked in the space; Bays aren't wide enough.										
There was nowhere we could park in the disabled parking in the Parade which was delegated for us because there were delivery vans, security vans . . . all occupying the spaces.	Matthews-23	EU-UK	wheelchair-general	member	outdoor	@	parking	@	@	Literature
we came back to do our shopping and we couldn't get to the shops because the goods were stacked everywhere. So I leave him outside	Matthews-24	EU-UK	wheelchair-general	member	indoor	@	indoor space	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The [major department store] has put mini-ramps, mini-lifts, brilliant, but you get in and you can't budge because all the cosmetics things when you go in . . . are all stacked and you can't get through. They have to move them just to let you get through to the lift. You get to the restaurant, a brand new shop that's been altered to fit the disabled . . . five steps down! Eventually somebody says there's a mini-lift and it's right in the corner . . . at the corner is a franchise shop absolutely stacked because its Christmas . . . so for us to get to the lift this girl has to move all her things . . . we get to the lift and the only way out is through ladies pants, bras and underskirts and you have to push him into it! We get to the restaurant and it's full. There's no way we can get in . . . I said to the waiter: 'we can't get in, can you tell us where the toilet is please?' He	Matthews-25	EU-UK	wheelchair-general	member	transition	@	building	building	indoor space	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
said: 'we haven't got a disabled toilet'. I said: 'you must have, this store's been revamped for the disabled'. We ask again. No, I'd have to go back out of the store across the road and into the shopping centre . . .										
there's a notice that says you can get access to the toilet by the security man. So I got a disabled key for the toilet, which doesn't fit because they had all the locks changed.	Matthews-26	EU-UK	wheelchair-general	member	indoor	@	bathroom	@	@	Literature
Often it is simple features, such as uneven surfaces and high kerbs, that prove to be the most decisive obstacles and which deny wheelchair users the	Matthews-3	EU-UK	wheelchair-general	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
opportunity to participate in urban life.										
Kerbs: You can't come down a kerb in an electric wheelchair . . . well, you can but its quite tricky . . . you've got to come down backwards . . . The specification on this says its about five inches, that you can go down five inches, but to get down a five inch kerb is difficult . . . its horrifying. . . .	Matthews-4	EU-UK	wheelchair-power	member	outdoor	@	pedestrian crossing	@	pedestrian crossing	Literature
Dropped kerbs . . . they can be more of a problem than if it wasn't dropped at all because you don't realize that there's a bit where you stop . . .; We've got some dropped kerbs that are rounded and they are on a camber, its alright if it's a straight camber because you can go down it, but if it is a sideways camber where it is going down that is awful, you feel as if you are going into traffic almost.	Matthews-5	EU-UK	wheelchair-general	member	outdoor	@	pedestrian crossing	@	pedestrian crossing	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Road pedestrian crossing places: Most towns . . . at pedestrian crossings . . . have tiny little dots on the ground to indicate to the blind that they are pedestrian crossing . . . bumps on those tiny wheels at the front . . . can throw them (wheelchair users) out . . .	Matthews-6	EU-UK	wheelchair-general	member	outdoor	@	pedestrian crossing	@	pedestrian crossing	Literature
[Road pedestrian crossing places:] . . . especially if you are going across a road and there isn't a parallel dropped kerb and you are sort of wandering down the road waiting for the next opportunity . . .	Matthews-7	EU-UK	wheelchair-general	member	outdoor	@	pedestrian crossing	@	pedestrian crossing	Literature
[Road pedestrian crossing places:] . . . most streets have dropped kerbs, most you can cross, then you find one you can't and you've got to go down the street, around somebody's drive, up somebody's drive the other side and then back along the main road.	Matthews-8	EU-UK	wheelchair-general	member	outdoor	@	pedestrian crossing	pedestrian crossing	pedestrian crossing	Literature
[Road pedestrian crossing places:] . . . you sometimes get these central reservations where there is no dropped	Matthews-9	EU-UK	wheelchair-general	member	outdoor	@	pedestrian crossing	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
kerb, I tend to go around them but that is some sort of risk with the traffic.										
A primary obstacle to dining out is flllding a place to park the car.	McClain93-1	NA-US	wheelchair-general	access professional	outdoor	@	service	@	parking	Literature
restaurants that provided spaces clearly identified the spaces and made them the required 96 in. wide, but approximately one fourth of them failed to place parking spaces close to the accessible entrance, and two thirds of them did not provide an adjacent access aisle of 60 in. fOt" loading.	McClain93-2	NA-US	wheelchair-general	access professional	outdoor	@	parking	parking	@	Literature
A second obstacle that may arise before the person enters the restaurant is the absence of a ramp.	McClain93-3	NA-US	wheelchair-general	access professional	transition	@	entrance	@	@	Literature
Most restaurants complied with the ramp width specifications, but some had problems with the incline and landing area (see Table 1) Handrails are required on ramps only if the I'amp is 72 in. or longer. In this study, 11 ramps required handrails,	McClain93-4	NA-US	wheelchair-general	access professional	transition	@	ramp	ramp	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
but onlv 1 had them.										
only one out of three of the restaurants had tables that allowed adequate knee clearance for those in wheelchairs. Even when table size was appropriate, one fourth of the 120 restaurants in this study needed guidance about arranging tables so that aisles allow easy access to them.	McClain93-5	NA-US	wheelchair-general	access professional	indoor	@	seating	@	@	Literature
to total denial of services (if unahle to park or exit the car, navigate the ramp, or enter the establishment).	McClain93-6	NA-US	wheelchair-general	access professional	indoor-outdoor	@	service	@	service	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
when they arrived, they found the accessible seating was behind glass and away from the group. Angry and embarrased, Mrs. Smith ended up carrying Shauna to a seat close to the group. This was not the first auditorium where the Smiths found that they had to carry Shauna to access seating. Mike similarly reiterated feelings that people who use wheelchairs get stuffed into a corner segregated from everyone else. If he wants to sit with friends at a theater, they have to sit with him in the area set aside for wheelchair users, and he does not want to go through the hassle. At theaters, he has to sit in the back row on the aisles, but prefers to find the seat he wants, sit be the aisle, fold up his chair, and hang on, because at some theaters, they do not like your chair in the aisle so the ushers try to take it away.	McClain98-1	NA-US	wheelchair-general	interview	indoor	@	service	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Shauna's mom said the elevators in the parking garage do not always work so she is forced to wheel around out in the elements.	McClain98-10	NA-US	wheelchair-general	interview	indoor	@	parking	@	@	Literature
He cannot get into the building to pay for the gas. The ramps are often short and steep, with no level spot for him to stop on when he opens the door, so he must wait for someone to hold the door open for him.	McClain98-11	NA-US	wheelchair-general	interview	transition	@	entrance	@	entrance	Literature
Once he is at the hotel or motel, Mike has found the parking spaces are often not in the same vicinity as the wheelchair-accessible rooms. Because he can carry only one bag at a time, he has to make several long trips from the car to his room, which can become a big hassle.	McClain98-12	NA-US	wheelchair-general	interview	indoor-outdoor	@	service	@	service	Literature
Motel roomsare not that accessible either. From the height of the thermostat and lights, to the remote that is glued to the tables, Mike has problems. If there are two double beds, there may not be enough room	McClain98-13	NA-US	wheelchair-general	interview	indoor	@	room	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
between the beds for the wheelchair in order to transfer onto the bed.										
Some facilities have only small problems that could be easily fixed such as lowering towls and soap dispensers that are out of reach.	McClain98-14	NA-US	wheelchair-general	interview	indoor	@	bathroom	@	bathroom	Literature
some restrooms do not come equipped with grab bars, the doorways are not wide enough, or the tub, toilet, and sink are too widely separated, so that she is constantly traveling across the room. Mike has found bathroom doors that swing the wrong way and toilets that are too high (making transfer difficult).	McClain98-15	NA-US	wheelchair-general	interview	indoor	@	bathroom	@	bathroom	Literature
she continues to face ramps that are too steep or narrow, doors that are too heavy	McClain98-2	NA-US	wheelchair-general	interview	transition	@	entrance	@	@	Literature
a scarcity of parking spaces	McClain98-3	NA-US	wheelchair-general	interview	outdoor	@	service	@	@	Literature
she has been encouraged to find some theaters installing electric door openers	McClain98-4	NA-US	wheelchair-general	interview	transition	@	@	entrance	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
she likes the lifts that she has found in one place (although they are not always working)	McClain98-5	NA-US	wheelchair-general	interview	indoor	@	elevator	building	@	Literature
Shauna's family has found one theater that has seats left out througout the theater so a wheelchair can fit in	McClain98-6	NA-US	wheelchair-general	interview	indoor	@	@	service	seating	Literature
Mrs. Jones reported that one theater in the city has a lowered ticket booth.	McClain98-7	NA-US	wheelchair-general	interview	indoor	@	@	service	@	Literature
Mrs. Jones often must get in the car on the passanger side and slide across the car because of a shortage of accessible wheelchair space on the driver's side. She often finds parking spaces are too narrow or not optimally spaced.	McClain98-8	NA-US	wheelchair-general	interview	indoor-outdoor	@	parking	@	parking	Literature
She also reported problems with the visibility of the parking signs.	McClain98-9	NA-US	wheelchair-general	interview	indoor-outdoor	@	parking	@	@	Literature
It also illustrated the extent to which both groups make use of environmental sounds either as a primary means to determine position or to confirm information obtained through other means.	Mehigan-1	EU-UK	blind	interview	indoor-outdoor	@	@	general mobility	general mobility	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
For example, many of those interviewed reported using manholes as route-markers: they were able to distinguish aurally between the different manholes (silence, various degrees of water flow, etc.), whilst walking across a manhole is easily distinguishable from walking over solid ground.	Mehigan-2	EU-UK	blind	interview	outdoor	@	@	route	route	Literature
Most participants reported that the area which causes them most difficulty is the Honan Plaza, a large, open space with little variation in terrain and few useful sources of sound.	Mehigan-3	EU-UK	blind	interview	outdoor	@	outdoor space	@	@	Literature
The results of the study reflect that the wheelchair users main problems are unannounced road or sidewalk construction	Menkens-1	EU	wheelchair-general	interview	outdoor	@	pedestrian path	@	@	Literature
Street and Walkway Pavement Details	Menkens-10	EU	wheelchair-general	interview	outdoor	pedestrian path	@	@	@	Literature
Restaurants, Shops, Leisure Facilities	Menkens-11	EU	wheelchair-general	interview	outdoor	tourism	@	@	@	Literature
Handicapped Parking	Menkens-12	EU	wheelchair-general	interview	indoor-outdoor	parking	@	@	@	Literature
Public Transport Information	Menkens-13	EU	wheelchair-general	interview	outdoor	transit-general	@	@	@	Literature
ATMs	Menkens-14	EU	wheelchair-general	interview	outdoor	wayfinding	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
variations in street pavement surfaces and smoothness, steep road inclines, curb boarder heights, narrow street or sidewalk widths and holes or gaps in the streets or sidewalks.	Menkens-2	EU	wheelchair-general	interview	outdoor	@	pedestrian path	@	@	Literature
Narrow doors at Shops and Public Facilities	Menkens-3	EU	wheelchair-general	interview	indoor	@	entrance	@	@	Literature
No elevators or No Ramps	Menkens-4	EU	wheelchair-general	interview	indoor	@	building	@	@	Literature
Street and Walkway Width, Incline and Curb Heights	Menkens-5	EU	wheelchair-general	interview	outdoor	pedestrian path	@	@	@	Literature
Accessibility Information of Public Facilities and all POIs	Menkens-6	EU	wheelchair-general	interview	outdoor	route-destination	@	@	@	Literature
Accurate Travel Distance and Time	Menkens-7	EU	wheelchair-general	interview	outdoor	route-general	@	@	@	Literature
Up-to-date Construction Information	Menkens-8	EU	wheelchair-general	interview	outdoor	pedestrian path	@	@	@	Literature
Ramps, elevators	Menkens-9	EU	wheelchair-general	interview	indoor-outdoor	building-general	@	@	@	Literature
narrow aisles,	Meyers-1	NA-US	wheelchair-general	interview	indoor	@	indoor space	@	@	Literature
bad weather	Meyers-10	NA-US	wheelchair-general	interview	outdoor	@	outdoor space	@	@	Literature
accessible transportation	Meyers-11	NA-US	wheelchair-general	interview	outdoor	@	@	general mobility	@	Literature
good weather	Meyers-12	NA-US	wheelchair-general	interview	outdoor	@	@	outdoor space	@	Literature
accessible parking	Meyers-13	NA-US	wheelchair-general	interview	outdoor	@	@	building	@	Literature
level or graded terrain	Meyers-14	NA-US	wheelchair-general	interview	outdoor	@	@	pedestrian path	@	Literature
no ramps	Meyers-2	NA-US	wheelchair-general	interview	transition	@	entrance	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
ramps too steep	Meyers-3	NA-US	wheelchair-general	interview	transition	@	ramp	@	@	Literature
bad weather or climate	Meyers-4	NA-US	wheelchair-general	interview	outdoor	@	outdoor space	@	@	Literature
door handles or door pressure	Meyers-5	NA-US	wheelchair-general	interview	transition	@	entrance	@	@	Literature
no curbcuts or blocked cuts,	Meyers-6	NA-US	wheelchair-general	interview	outdoor	@	pedestrian path	@	@	Literature
inaccessible bathrooms	Meyers-7	NA-US	wheelchair-general	interview	indoor	@	building	@	@	Literature
no parking	Meyers-8	NA-US	wheelchair-general	interview	outdoor	@	building	@	@	Literature
obstructed travel	Meyers-9	NA-US	wheelchair-general	interview	outdoor	@	pedestrian path	@	@	Literature
gap, which includes gaps, steps, stairs and similar accessibility barriers, together with the corresponding facilities, such as ramps, curb cuts and handrails;	Miri-1	EU	target groups	wayfinding professional	outdoor	@	pedestrian path	pedestrian path	@	Literature
cross, which consists of all the facilities and the barriers related to pedestrian crossing, e.g., the presence or absence of zebra pedestrian crossing, traffic lights, audible traffic lights;	Miri-2	EU	target groups	wayfinding professional	outdoor	@	pedestrian crossing	pedestrian crossing	@	Literature
obstruction, which contains all the obstructions and the protruding elements that can block or limit the way. It includes traffic lights, traffic signs, trees and garbage bins;	Miri-3	EU	target groups	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
surface, this category consists of descriptions of pathways and ramp surfaces that can represent an accessibility barrier, such as a uneven road surface;	Miri-4	EU	target groups	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature
bus stop, which contains all the facilities and barriers that can affect a bus stop, such as platform height, pavement of the platform, distance between the platform and the bus floor, distance between the bus stop and the closest pedestrian crossing, large-print, high-contrast, and non-glare informational signs, braille and tactile information regarding available service, acoustic cues and speakers that announce vehicle identification information [13];	Miri-5	EU	target groups	wayfinding professional	outdoor	@	transit-stop	transit-stop	@	Literature
bus, which consists of descriptions of facilities and barriers that can affect a bus (such as steps, lift or ramps, kneeler features, wheelchair anchorage, largeprint, high-contrast, and non-glare	Miri-6	EU	target groups	wayfinding professional	transit vehicle	@	transit vehicle	transit vehicle	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
informational signs, braille and tactile information, acoustic stop announcements, ticket vending machines with braille and large-print markings, or audible output devices [13]).										
Some features that are considered highly important to ensure autonomy to the visually impaired, as Braille signs on doors indicating the apartment number and tactile floors that lead guests with visual impairments to the room, were not found in any of the hotels in the sample. This relevance was related by the people with visual impairment in interviews.	Nascimento-1	SA	low vision	interview	indoor	@	@	indoor space	@	Literature
only 12% of them have visual signaling in contrasting colors and size appropriate for people with low vision.	Nascimento-2	SA	low vision	observation	indoor	@	indoor space	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
As for overhead obstacles, such as marquees, signs, fire extinguishers on walls, awnings and vegetation, only 29% of the researched hotels keep them at a height greater than 2.10 m. But none of the hotels has warning tactile floor under this furniture, putting guests with visual impairments to an accident-risky situation.	Nascimento-3	SA	low vision	observation	indoor	@	hallway	hallway	@	Literature
The others do not have an accessible surrounding, especially those in Ponta Negra beach which are often located on steep streets with of sidewalks in a bad state.	Nascimento-4	SA	low vision	observation	indoor	@	building	@	@	Literature
negligence involved at the time of installation of the elevator button panel, where, besides symbols of which the dimensions are smaller than 16 mm, making it difficult to be used by a person with low vision, the Braille indication is used incorrectly.	Nascimento-5	SA	low vision	observation	indoor	@	elevator	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Type of street Sidewalk; (Sidewalk) Width; (Sidewalk) Surface; (Sidewalk) Smoothness; (Sidewalk) Slope/Incline; (Sidewalk) Camber; (Sidewalk) Curb/Kerb; (Sidewalk) Curvature; Lighting; Tactile Paving Steps; Step height; Ramp; Handrail	Neis-1	EU	target groups	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature
pedestrian crossing	Neis-2	EU	target groups	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature
Inaccessibility of the home entrance—for example, having steps at the entrance—predicted injurious falls in our model.	Nelson-1	NA-US	wheelchair-general	interview	transition	@	entrance	@	@	Literature
The most frequent barrier in the natural environment was related to climate, specifically wind and rain.	Newman-1	NA-US	wheelchair-general	interview	outdoor	@	outdoor space	@	@	Literature
Participants also identified the challenges of navigating around overgrown landscaping that blocked accessible pathways.	Newman-2	NA-US	wheelchair-general	interview	outdoor	@	pedestrian path	@	pedestrian path	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
This was the only spot I could find. You need an extra 3 foot beyond the end of your ramp on the van, and, and if you don't have…let's say about at least 5 foot space from that yellow line to the curb, you're going to run into a curb, and then that's a problem. – Participant 8	Newman-3	NA-US	wheelchair-general	member	outdoor	@	parking	@	parking	Literature
What I'm showing here in this neighborhood, it's not an affluent neighborhood. You've got a series of really bad sidewalks, no curb cuts, bad curb cuts. But then you go to the more affluent or more populated neighborhood downtown, and they're great. – Participant 2	Newman-4	NA-US	wheelchair-general	member	outdoor	@	pedestrian path	@	@	Literature
These steps lead to the way for me to interact with friends. These steps stop me in my tracks. There is no ramp. These steps are my enemy. – Participant 7	Newman-5	NA-US	wheelchair-general	member	transition	@	entrance	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
That's heaven for somebody in a wheelchair. It is huge. I don't have to worry about bumping into the sink … there's plenty of room for my wheelchair to get in there … they've got grab bars up there and everything. And when you close the door it's almost big enough to do a small figure eight in there, because I did. – Participant 3	Newman-6	NA-US	wheelchair-general	member	indoor	@	@	bathroom	bathroom	Literature
I deal with pressure sores a whole lot, and in order for the doctor to see the pressure sore I'd have to be up on that table … And with just him talking to me and taking my word … I think it's not an accurate diagnosis of what he's going to put down in his chart … and there might be an infection there, and he never gets to see it because I never get up on the table. – Participant 8	Newman-7	NA-US	wheelchair-general	member	indoor	@	service	@	service	Literature
This is the first time I've been on a table that raises up and down, and I can place myself from the wheelchair onto the	Newman-8	NA-US	wheelchair-general	member	indoor	@	@	service	service	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
table and actually get positioned for my examination, so that was, that was very exciting										
lack of auditory elevator cues	Packer07-1	ASIA	low vision	interview	indoor	@	elevator	@	@	Literature
For example, the best parking spaces are reserved for them	Packer07-2	ASIA	target groups	interview	outdoor	@	@	general mobility	@	Literature
they could go into the lift first. But in [name removed], you could see people with disabilities waiting for the lift on the 19th floor for half an hour because the lift is always full. They don't have a chance to get in. And if they don't have the lift, they couldn't get out of the building. But still, no one would get out and let them in . . . It implies that public education is not enough.	Packer07-3	ASIA	target groups	interview	indoor	@	building	building	elevator	Literature
People with mobility impairments, however, tempered their desire to see new places, based on presence of extreme conditions such as ice and snow that would pose safety or mobility barriers.	Packer07-4	ASIA	target groups	interview	outdoor	@	outdoor space	@	@	Literature
Lack of specific information regarding	Packer07-5	ASIA	target groups	interview	indoor-outdoor	tourism	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
accommodation										
transportation	Packer07-6	ASIA	target groups	interview	outdoor	transit-general	@	@	@	Literature
available assistance	Packer07-7	ASIA	target groups	interview	indoor-outdoor	assistance	@	@	@	Literature
NSW: My ideal hotel would have a lift with spoken announcements and tactile indicators … tactile information on the lift buttons. It wouldn't be in a lobby full of about eight lifts where it's really difficult to discern exactly which lift has just arrived.	Packer08-1	OA-AU	low vision	member	indoor	@	elevator	elevator	elevator	Literature
NSW3: I travel with a Guide Dog and most hotels are not really set up for Guide Dog travel. Unfortunately it's still the case that a lot of accommodation providers don't realise that they have to take the dog. It tends to be the smaller single operators, not the big ones. And I don't think that has ever happened to me personally, but I'm aware of the fact that it's quite a frequent occurrence. I have certainly experienced [it] in relation to hospitality mainly …	Packer08-10	OA-AU	low vision	member	indoor	@	service	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
restaurants and cafes.										
Areas on board the transport and at the transport terminus/airport should be well lit and free of objects which could hinder a guest's path.	Packer08-11	OA-AU	low vision	tourism professional	indoor-outdoor	@	@	transit-general	@	Literature
Signage/information on board transport and at transport terminus/airport should be in large print and appropriate contrast (AS1428 standards).; Where appropriate, information should be tactile, and auditory (eg voice-activated messages that state the next transport stop; an audio channel to listen to journey details on plane and long distance train travel).	Packer08-12	OA-AU	low vision	tourism professional	indoor-outdoor	@	@	signage	transit-general	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Provide information that describes: transport routes; stops; timetables; and seating options for passengers and their Guide Dogs.	Packer08-13	OA-AU	low vision	tourism professional	indoor-outdoor	@	@	transit-general	@	Literature
On a bus, tram or in a taxi • Ensure that seats allocated for a passenger with a disability are used for this purpose. • Be patient if a passenger hails you and asks for information; they often can't see the signage on your vehicle. • Ask the passenger if they would like to be informed of arrival at their stop. • Seat a Guide Dog at the feet of the owner. • Ensure passenger is seated before moving the vehicle. • If in a taxi, allow the passenger to sit in the front and ask if they would like a commentary on the route you are taking.	Packer08-14	OA-AU	low vision	tourism professional	transit vehicle	@	@	transit-general	transit vehicle	Literature
Ensure ground surfaces are slip resistant and where appropriate, install Tactile Ground Surface Indicators (TGSIs). Note that surfaces (floors, counters) and	Packer08-15	OA-AU	low vision	tourism professional	indoor	@	@	transit-stop	indoor space	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
walls/doors which are high gloss or glass can be disorientating for a person with vision impairment.										
It wouldn't have a lot of hard surfaces with sound bouncing off them. It would have a lot of soft furnishings that absorb sound so that you can identify the source of sound more clearly	Packer08-2	OA-AU	low vision	member	indoor	@	indoor space	indoor space	general mobility	Literature
It would have tactile numbering on the door of the room so that I could more easily identify my door. I have my own strategies for doing things like that, but that would certainly be very helpful.	Packer08-3	OA-AU	low vision	member	transition	@	@	interior doorway	interior doorway	Literature
The other thing my ideal hotel would have, is the emergency egress information (that's on the back of the door) in a form that I could read. Because every now and then, I think well, 'God, what if there is a fire or some reason to leave the hotel quickly'. There's no way on earth that I'll know where to go and there's no record whatever in the hotel	Packer08-4	OA-AU	low vision	member	indoor	building-layout	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
register that the person in room such and such is vision impaired.										
WA3: Restaurants are badly lit and dim and I really cannot see	Packer08-5	OA-AU	low vision	member	indoor	@	service	@	@	Literature
Uneven surfaces can cause trips/falls, which are compounded by overhangs on pathways that can cause head injury.	Packer08-6	OA-AU	low vision	tourism professional	outdoor	@	pedestrian path	@	pedestrian path	Literature
TGSIs assist people to use tactile markers to way-find by warning of upcoming dangers (roads, edge of railway platforms etc) and changes in direction (at the pedestrian crossings on roads etc).	Packer08-7	OA-AU	low vision	tourism professional	outdoor	@	general mobility	general mobility	@	Literature
I suppose it's unlikely that it would not have a large open space for its foyer, because they all do, but ideally it would have some identifiable path from the entrance doors to the reception and that might be that the floor of the hotel	Packer08-8	OA-AU	low vision	member	indoor	@	indoor space	indoor space	indoor space	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
foyer was marble, but there was a carpet that took you from the entrance doors to the reception desk. I don’t really care what it is, just that it is identifiable.										
That the street entrance was not too complicated or had too many stairs (I mean stairs are ok, but you know, not a huge flight of stairs), not revolving glass doors that are always very difficult to negotiate as a vision impairment person.	Packer08-9	OA-AU	low vision	member	transition	@	entrance	@	entrance	Literature
Participants expressed their need for reliable, up-to-date information about the physical obstacles they might face, noting that difficulties arising from the physical environment might be a barrier to the museum experience, especially when it was a person's first visit to a museum.	Poria-1	ASIA	target groups	interview	outdoor	route-obstacles	@	@	@	Literature
The interviewees expressed interest in the physical obstacles they have to face in terms of access by public transportation	Poria-2	ASIA	target groups	interview	outdoor	transit-general	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
(e.g., bus or taxi) or by foot.										
In a few cases only, related to small museums, participants complained that although there were special parking spaces, there was often no ramp between the road the the sidewalk. In addition, the participants noted that disabled parking spaces should be larger and wider, to allow for opening the car door and removing the wheelchair.	Poria-3	ASIA	wheelchair-general	interview	outdoor	@	parking	parking	parking	Literature
that people use counterfeit parking permits and occupy their parking space	Poria-4	ASIA	target groups	interview	outdoor	@	parking	@	@	Literature
this wheelchair access entrance is often located at a distance from the main entrance, so as to avoid the need to climb stairs. However, participants commented that "their" entrances are less esthetic and sometimes not clean. Additionally, some participants indicated	Poria-5	ASIA	wheelchair-general	interview	transition	@	entrance	building	entrance	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
that entering the site not from its main entrance differentiates them from others, leading to a sense of exclusion and seclusion.										
participants reported that in small museums the toilets for the disabled are often locked (to avoid others from using them) and you should know in advance whom to approach in order to get the keys.	Poria-6	ASIA	target groups	interview	indoor	@	bathroom	@	bathroom	Literature
people in wheelchairs referred to elements of the physical environment, such as the height of the counters (at the cashier, information desk, carphone-rental station, and shops). This height creates a sense of separation that prevents comfortable communication as they cannot see the face of the person they talk to.	Poria-7	ASIA	wheelchair-general	interview	indoor	@	service	@	service	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Those moving on wheelchairs indicated that they cannot look at the exhibits presented in the staircases and the corridors even if a stair lift is available. Another issue is the height of the exhibits displayed. Participants mentioned that they find it difficult to see the exhibits and read the interpretive signage.	Poria-8	ASIA	wheelchair-general	interview	indoor	@	service	stairway	signage	Literature
During discussions whith [sp] blind people, differences occur between old and young people but particularly between people blind by birth and people who became blind later in their life. The latter have more problems to determine their course.	Pressl06-1	EU	blind	interview	indoor-outdoor	@	route	@	route	Literature
Particular sources of danger are objects which do not touch the ground but reach into the pavement at face level. Such objects cannot be sensed by the white cane. Some examples are postboxes, traffic signs, and gates.	Pressl06-2	EU	blind	interview	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
A further, precarious circumstance is a bicycle lane at the pavement.	Pressl06-3	EU	blind	interview	outdoor	@	pedestrian path	@	@	Literature
bus and train stops with exit at the lane	Pressl10-1	EU	low vision	survey	outdoor	transit-stop	@	@	@	Literature
rails at street	Pressl10-10	EU	wheelchair-general	survey	outdoor	pedestrian path	@	@	@	Literature
acoustic traffic lights	Pressl10-11	EU	low vision	survey	outdoor	pedestrian crossing	@	@	@	Literature
medical care	Pressl10-12	EU	low vision	survey	outdoor	wayfinding	@	@	@	Literature
tactile paving	Pressl10-13	EU	low vision	survey	outdoor	pedestrian crossing	@	@	@	Literature
shopping facilities	Pressl10-14	EU	low vision	survey	outdoor	wayfinding	@	@	@	Literature
barrier-free toilets	Pressl10-15	EU	low vision	survey	indoor	building-bathroom	@	@	@	Literature
disabled parking	Pressl10-16	EU	wheelchair-general	survey	indoor-outdoor	parking	@	@	@	Literature
wheelchair accessible toilets	Pressl10-17	EU	wheelchair-general	survey	indoor	building-bathroom	@	@	@	Literature
wheelchair accessible hotels	Pressl10-18	EU	wheelchair-general	survey	indoor	tourism	@	@	@	Literature
sights; museum	Pressl10-19	EU	wheelchair-general	survey	indoor	tourism	@	@	@	Literature
construction sites	Pressl10-2	EU	low vision	survey	outdoor	route-obstacles	@	@	@	Literature
pedestrian crossings without traffic lights	Pressl10-3	EU	low vision	survey	outdoor	pedestrian crossing	pedestrian crossing	@	@	Literature
material of path surface	Pressl10-4	EU	low vision	survey	outdoor	pedestrian path	@	@	@	Literature
squares and parks	Pressl10-5	EU	low vision	survey	outdoor	street layout	@	@	@	Literature
stairs and steps	Pressl10-6	EU	wheelchair-general	survey	outdoor	pedestrian path	@	@	@	Literature
material of path surface	Pressl10-7	EU	wheelchair-general	survey	outdoor	pedestrian path	@	@	@	Literature
missing sidewalk ramps	Pressl10-8	EU	wheelchair-general	survey	outdoor	pedestrian path	pedestrian path	@	@	Literature
cordons and gates	Pressl10-9	EU	wheelchair-general	survey	outdoor	pedestrian path	@	@	@	Literature
I work in a portable--	Pusch-1	NA-US	wheelchair-	member	transition	@	@	entrance	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
has a ramp.			general							
It would be nice to be able to reach the towels, to reach the faucet without banging your knees into something or having all the furniture, you know, the waste baskets, whatever they put in there, too close, or making it awkward.”	Pusch-10	NA-US	wheelchair-general	member	indoor	@	bathroom	@	bathroom	Literature
“[E]levators, doors that don't open right or too hard, too much pressure to open. Doors that shut too quick. Time you get it, it slams you in the side of the chair, about knocks you over. Or buttons that are too hard to press or not raised or too high in the elevator.”	Pusch-11	NA-US	wheelchair-general	member	indoor	@	elevator	@	elevator	Literature
there's a curb or step to get into the door of the restroom.	Pusch-12	NA-US	wheelchair-general	member	transition	@	bathroom	@	@	Literature
I've been places where, ‘Yeah, we have an elevator,’ and there’s three steps to get to the elevator.”	Pusch-13	NA-US	wheelchair-general	member	indoor	@	elevator	@	@	Literature
And I need to get to the bus stop earlier than I normally would, 6:30 in the morning, because by the time the bus gets to me, it's midpoint of its run, and it's	Pusch-14	NA-US	wheelchair-power	member	outdoor	@	transit-general	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
usually full. ...Also, if I need to do that, I need to make sure my chair is fully charged, that it's in good working order, because if it's not working, I'm up a creek.										
It has a bathroom with grab bars, and it's a single- use bathroom. So there aren't any narrow doors that I have to think about	Pusch-2	NA-US	wheelchair-general	member	indoor	@	bathroom	bathroom	@	Literature
there is a parking spot that is close, and so that works.	Pusch-3	NA-US	wheelchair-general	member	outdoor	@	@	building	@	Literature
[S]talls to get into and the ability to close the doors once you're in the stall ... your knees or the wheelchair is butted up against the toilet, and the door's not able to shut behind you. I mean, people can look in as they walk by, so that's real frustrating.”	Pusch-4	NA-US	wheelchair-general	member	indoor	@	bathroom	@	bathroom	Literature
I don't want to have to be the one that only uses the door that's locked, and therefore I'll call ahead to make sure that door is unlocked.	Pusch-5	NA-US	wheelchair-general	member	transition	entrance	interior doorway	@	@	Literature
The inside doors wide enough to get my chair through.	Pusch-6	NA-US	wheelchair-general	member	transition	@	@	interior doorway	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The bathroom doors wide enough to get in.	Pusch-7	NA-US	wheelchair-general	member	transition	@	@	bathroom	@	Literature
grab bars in the bathroom. In this unit, I currently have a drive-in shower.”	Pusch-8	NA-US	wheelchair-general	member	indoor	@	@	bathroom	@	Literature
I put in high toilets recently. That's such a cheap thing to do that I wonder why more people don't do it. I put them in both bathrooms.”	Pusch-9	NA-US	wheelchair-general	member	indoor	@	@	bathroom	@	Literature
had problems with the outside of the home. Uneven flagstones and cement were big problems because they caused participants to trip.	Reid-1	NA-CAN	target groups	observation	outdoor	@	pedestrian path	@	@	Literature
The ramp for the wheelchair was too steep in some cases.	Reid-2	NA-CAN	wheelchair-general	observation	transition	@	ramp	@	@	Literature
the entrance. Often the lighting was poor. Some lobby doors were too heavy and the keyholes were sometimes too high for people in wheelchairs.	Reid-3	NA-CAN	wheelchair-general	observation	transition	@	interior doorway	@	@	Literature
Qualitative analysis showed that dim lighting on signs was cited as a problem, and that the print on signs was often too small.	Reid-4	NA-CAN	target groups	observation	indoor	@	signage	@	@	Literature
the door was too narrow for the wheelchair to get	Reid-5	NA-CAN	wheelchair-general	observation	transition	@	interior doorway	@	interior doorway	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
through.										
Sharp angles and small rooms made it difficult to get around in a wheelchair.	Reid-6	NA-CAN	wheelchair-general	observation	indoor	@	indoor space	@	@	Literature
one person stated that having all the living space confined to one floor would be great.	Reid-7	NA-CAN	target groups	interview	indoor	@	@	indoor space	@	Literature
Outside the home, uneven ground was a problem, as was lighting in some cases.	Reid-8	NA-CAN	wheelchair-general	interview	outdoor	@	outdoor space	@	@	Literature
they say ‘oh we’ve got all our signs in Braille’ which is all very well [but] unless you know where to look for the sign how are you going to read the Braille?’’	Richards-1	EU-UK	low vision	member	indoor-outdoor	@	signage	@	signage	Literature
clear edging of steps	Richards-2	EU-UK	low vision	interview	indoor-outdoor	@	@	stairway	@	Literature
good colour contrast on materials	Richards-3	EU-UK	low vision	interview	indoor-outdoor	@	@	general mobility	@	Literature
suitable lighting	Richards-4	EU-UK	low vision	interview	indoor-outdoor	@	@	general mobility	@	Literature
contrasting handrails	Richards-5	EU-UK	low vision	interview	indoor-outdoor	@	@	handrail	@	Literature
clear signage	Richards-6	EU-UK	low vision	interview	indoor-outdoor	@	@	general mobility	@	Literature
every night we went into the restaurant they provided one table with a light and candle light, they were extremely good and they expected nothing in return	Richards-7	EU	low vision	member	indoor	@	@	service	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Robert: Every hotel we go into it's got a light by the bed as a reading light, it's got a standard light in the corner but never a light in the middle of the room. [All agree and talk at once] I mean it could be midday and it's like bloody midnight. You just can't get enough light in the room.	Richards-8	EU-UK	low vision	member	indoor	@	room	room	@	Literature
We'd love to go on coach trips but when we get off the coach we don't know where to go and I can't read the signs. If people give me vague directions like ''just go down there and turn right'' I can't follow them—I don't find it a lot of fun really.	Richards-9	EU-UK	low vision	member	outdoor	@	route	@	route	Literature
Is there an unobstructed turning radius of at least 60 inches in front of restroom doors? Is the sink counter 34 inches or less above the floor?	Rimmer-1	NA-US	target groups	interview	indoor	@	@	bathroom	@	Literature
Is there a visual signal on each floor indicating which elevator is approaching? Is the width of the elevator car at least 80 inches?	Rimmer-2	NA-US	target groups	interview	indoor	@	@	elevator	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Do parking spaces that are designated as accessible have an access aisle adjacent to the parking space?	Rimmer-3	NA-US	target groups	interview	outdoor	@	@	parking	@	Literature
Is there a clear path leading from the locker room entrance to the lockers that is at least 36 inches wide?	Rimmer-4	NA-US	target groups	interview	indoor	@	@	indoor space	@	Literature
"This is my apartment… which is universal design and level entry. This basically just shows how an apartment can be quite beautiful with also being accessible."	Ripat-1	NA-CAN	wheelchair-general	member	transition	@	@	entrance	@	Literature
barriers included washroom stalls that could not accommodate wheelchair users	Ripat-10	NA-CAN	wheelchair-general	observation	indoor	@	bathroom	@	@	Literature
narrow doorways, hallways, and aisles	Ripat-11	NA-CAN	wheelchair-general	observation	indoor	@	indoor space	@	@	Literature
"My son's school has three levels, and this is how everyone gets to the office, stairs. My son went to this school for seven years and I haven't seen his desk or classroom in the last four years."	Ripat-12	NA-CAN	wheelchair-general	member	indoor	@	building	@	@	Literature
Vern identified a building with an automatic button door opener, but with a two-inch ledge into the building, stating:	Ripat-13	NA-CAN	wheelchair-general	member	transition	@	entrance	entrance	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
"What good is the button, when you can't get into the building anyway?"										
Sub-zero temperatures, snow, and ice, were an ongoing challenge. Some participants avoided or minimized outdoor activities, whereas others utilized strategies to address winter barriers, such as driving their wheelchairs on the road to avoid impassable sidewalks: "In the summer I'm a pedestrian and in the winter I'm a car" (Wilson).	Ripat-14	NA-CAN	wheelchair-general	member	outdoor	@	pedestrian path	@	outdoor space	Literature
So I have this hand warmer that I can carry around with me…You know I used to be able to go out at ten [degrees] above, now I go out at zero [degrees] above because I know my, I know my hands are not going to get so cold they can't move.	Ripat-2	NA-CAN	wheelchair-general	member	outdoor	@	@	general mobility	@	Literature
"It's a world of difference having your own vehicle, just get up and go when you want to."	Ripat-3	NA-CAN	wheelchair-general	member	outdoor	@	@	general mobility	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Most described how friends “bumped” (lifted them up) stairs or curbs; such supports enabled access to inaccessible environments.	Ripat-4	NA-CAN	wheelchair-general	interview	outdoor	@	@	general mobility	stairway	Literature
temporary ramps were placed on stairs, or new ramps or widened doorways were installed during renovations. The importance of these modifications was stressed by Jayna, who described how lack of a ramp created more than just a physical barrier: “There was just no freedom ... I mean I can jump down the stairs myself if I wanted to but it’s the being able to come and go. To come and go as you wish.”	Ripat-5	NA-CAN	wheelchair-general	member	indoor	@	general mobility	stairway	stairway	Literature
“It puts a little bit of fear in me to say like if they're going to take [public disability transportation service] away from me, then what's going to happen to me? My independence goes down so much” (Olivia).	Ripat-6	NA-CAN	wheelchair-general	member	outdoor	@	@	general mobility	@	Literature
Accessibility was often limited by uneven sidewalks	Ripat-7	NA-CAN	wheelchair-general	observation	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
poor parking options and perceived misuse of assigned handicapped parking stalls	Ripat-8	NA-CAN	wheelchair-general	observation	outdoor	@	parking	@	@	Literature
features of building entrances such as high curbs, stairs, and absent automatic door opener buttons	Ripat-9	NA-CAN	wheelchair-general	observation	transition	@	entrance	@	@	Literature
All of the 17 buildings provided public parking to their visitors, but only five buildings had designated accessible parking spaces (handicap parking). These five buildings provided accessible parking spaces that were both clearly identifiable and closest to the entrance.	Rivano-Fischer-1	ASIA	wheelchair-general	observation	outdoor	@	@	parking	@	Literature
Three of the sites had accessible routes connecting the accessible spaces to the entrances. Only one of the buildings had the appropriate number of accessible spaces. None of the accessible parking spaces were wide enough.	Rivano-Fischer-2	ASIA	wheelchair-general	observation	outdoor	@	building	parking	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Thirteen of the 17 buildings (76%) required a ramp for wheelchair access and 11 of them provided one. Two of the sites had ramps that complied with the slope specification. Five of the buildings had ramps with a rise not higher than 76 cm. All the ramps provided had a compliant clear width of 91.5 cm or more and only one of the ramps did not have levelled landings. Ramps with handrails were present in two of the 11 sites that required them (table 3).	Rivano-Fischer-3	ASIA	wheelchair-general	observation	transition	@	ramp	ramp	@	Literature
The entrances of 11 buildings (65%) had a clear opening width of at least 81.5 cm. Sixteen of the sites complied with the entrances' threshold standard and all doors in all of the entrances had accessible hardware.	Rivano-Fischer-4	ASIA	wheelchair-general	observation	transition	@	@	entrance	@	Literature
None of the sites had call buttons in the hallways at a height compliant with the standards.	Rivano-Fischer-5	ASIA	wheelchair-general	observation	indoor	@	elevator	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Many participants noted that curb ramps were only on one side of the street or not continuous. Participants reported having to walk or wheel in the street when curb ramps were not available, which involved using driveways or the nearest curb ramp to access the street and travel in the street until the next curb ramp was reached.	Rosenberg-1	NA-US	wheelchair-general	interview	outdoor	@	pedestrian path	@	@	Literature
Facilitators for use included newly resurfaced smooth sidewalks, wide sidewalks with enough passing room, and the presence of a grass strip to separate participants from traffic.	Rosenberg-10	NA-US	wheelchair-general	interview	outdoor	@	@	pedestrian path	@	Literature
Having shelter from the weather (primarily rain in King County) available while waiting for buses or transportation while resting at parks or on local streets was noted to be important.	Rosenberg-11	NA-US	wheelchair-general	interview	outdoor	@	@	transit-stop	transit-stop	Literature
Participants reported difficulties such as overgrowth or parked cars blocking drivers from seeing pedestrians.	Rosenberg-12	NA-US	wheelchair-general	interview	outdoor	@	pedestrian crossing	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Other important outdoor built environment facilitators were presence of ramps	Rosenberg-13	NA-US	wheelchair-general	interview	outdoor	@	@	pedestrian path	@	Literature
outdoor built environment barriers included hills, outdoor stairs, and walking paths and trails in poor condition.	Rosenberg-14	NA-US	wheelchair-general	interview	outdoor	@	pedestrian path	@	@	Literature
problems using ramps included them being blocked, poorly situated (e.g., making you hold a door open while trying not to slide down the ramp), slippery, and inconvenient to access, forcing one to go out of the way to use it.	Rosenberg-15	NA-US	wheelchair-general	interview	transition	@	ramp	@	entrance	Literature
Although people recognized the truncated domes (raised bumps) at curb ramps being helpful for some, others reported these became slippery in the rain. Curb ramps were an often cited facilitator for accessing destinations.	Rosenberg-2	NA-US	wheelchair-general	interview	outdoor	@	pedestrian crossing	building	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
A main facilitator was having disabled parking available, particularly when it was close to the destination. One participant noted some destinations (e.g., stores) were located above parking areas, but only accessible via stairway, which prevented the use of such destinations (P10). Navigating parking lots due to parking being far from destinations was noted to cause problems because it was expressed that drivers operating vehicles seemed to lack awareness toward pedestrians.	Rosenberg-3	NA-US	wheelchair-general	interview	outdoor	@	parking	building	parking	Literature
Adequate sources of lighting were important for participants, as nearly half of the sample reported visual impairment. Several participants noted that when street lighting was inadequate and poor visibility was a concern, they coped by carrying a flashlight or using a headlamp when they went out at night.	Rosenberg-4	NA-US	low vision	interview	outdoor	@	pedestrian path	nighttime mobility	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Other participants reported depth perception problems with poor lighting and not going out after dark in part because of this problem.										
The lack of pedestrian crossings at convenient spots was a barrier to walking or wheeling in the neighborhood.	Rosenberg-5	NA-US	wheelchair-general	interview	outdoor	@	pedestrian path	@	pedestrian path	Literature
pedestrian crossing signal times were often reported as too short for those using assistive devices.	Rosenberg-6	NA-US	wheelchair-general	interview	outdoor	@	pedestrian crossing	@	@	Literature
One participant suggested that it would be nice to have two signal buttons—one button for those who need more time to cross and a button for those who can cross easily (P23).	Rosenberg-7	NA-US	wheelchair-general	interview	outdoor	@	@	pedestrian crossing	@	Literature
Participants reported having to walk or wheel in the street where there were no sidewalks and felt unsafe doing so.	Rosenberg-8	NA-US	wheelchair-general	interview	outdoor	@	@	outdoor space	outdoor space	Literature
Participants also reported many types of obstructions were barriers to getting around with an assistive device, such	Rosenberg-9	NA-US	wheelchair-general	interview	outdoor	@	pedestrian path	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
as sandwich boards that narrow available sidewalk space, making it difficult to pass.										
VIPs need to use their other senses to determine the locations of toilets and facilities, such as using their feet to feel the texture of tactile guide paths	Siu-1	ASIA	low vision	interview	indoor	@	@	indoor space	indoor space	Literature
Thus, an audible warning signal is one of the possible solutions. For example, attaching an audible warning device to a temporary barrier or other obstacle is a good suggestion.	Siu-10	ASIA	low vision	interview	indoor	@	@	indoor space	@	Literature
their fingers to read the Braille words giving directions to toilets and the locations of other facilities.	Siu-2	ASIA	low vision	interview	indoor	@	@	general mobility	signage	Literature
while searching, VIPs are sometimes easily hurt by the sharp edges of facilities, and the gaps between moveable parts such as door jambs and hinges.	Siu-3	ASIA	low vision	interview	indoor	@	general mobility	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Thus, people (not only VIPs) are less willing to touch the facilities of public toilets. Therefore, one of the possible solutions for a user-friendly design is to tackle the problem directly: to minimize contact. Therefore, automatic facilities are suggested.	Siu-4	ASIA	low vision	interview	indoor	@	@	bathroom	@	Literature
those including flushing mechanisms, water taps, and facility position systems, are a good start. In fact, as indicated in the Beijing and Belfast World Toilet Summits 2004 and 2005 respectively, with sufficient resources, public toilets should be moving towards the provision of automatic facilities which give convenience to all users.	Siu-5	ASIA	low vision	interview	indoor	@	@	bathroom	@	Literature
many VIPs do not want to use the existing disabled toilets. Besides the psychological reasons mentioned above, VIPs are easily trapped and hurt by the handrails, particularly folding	Siu-6	ASIA	low vision	interview	indoor	@	bathroom	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
handrails, provided for physically disabled persons in such toilets.										
Reading Braille located on the entrance door can also be a problem when people are constantly passing the entrance.	Siu-7	ASIA	low vision	interview	indoor	@	signage	@	@	Literature
Additional and modified systems, such as audio systems and easy-to-read and modified symbols, are good alternatives for these VIPs.	Siu-8	ASIA	low vision	interview	indoor	@	@	signage	@	Literature
For example, according to the observations, movable devices are often added to the public toilet environment, such as a folding stand for alerting users to the wet floor, or a folding-down retractable handrail. These kind of unpredictable and "invisible" devices are very dangerous for VIPs.	Siu-9	ASIA	low vision	interview	indoor	@	indoor space	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The single greatest obstacle that forces wheelchair users to travel much farther than walking pedestrians or aided mobility pedestrians is a curb at location three in Fig. 6. This small curb forces wheelchair users to travel an additional 400 m around the block in order to gain access to the Madsen Health Clinic.	Sobek-1	NA-US	wheelchair-general	wayfinding professional	outdoor	@	pedestrian path	@	@	Literature
Alternatively, the wheelchair users can use roads to avoid the additional travel, but this poses a greater risk of physical harm due to vehicular traffic.	Sobek-2	NA-US	wheelchair-general	wayfinding professional	outdoor	@	outdoor space	@	@	Literature
An adequate number of designated parking spaces that are located close to the desired destination and are large enough for the person to enter and leave his/her automobile with personal equipment (e.g., wheelchair).	Stark07-1	NA-US	wheelchair-general	interview	indoor-outdoor	@	@	parking	@	Literature
Floor surfaces have no inclines, bumps or hills and are made of a non-slip material.	Stark07-10	NA-US	wheelchair-general	access professional	indoor	@	@	indoor space	@	Literature
Counters and merchandise are within reach for persons who use	Stark07-11	NA-US	wheelchair-general	interview	indoor	@	@	service	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
wheelchairs or other mobility devices.										
Users are able to get close to and operate a drinking fountain easily, even from a seated position. Phones are labeled and phone receivers/buttons are able to be reached from a seated position.	Stark07-12	NA-US	wheelchair-general	interview	indoor	@	@	public object	@	Literature
There is enough lighting for users to see where they are going and what they are doing.	Stark07-13	NA-US	wheelchair-general	interview	indoor	@	@	indoor space	indoor space	Literature
The outdoor areas have signage located at the accessible entrances and directing users along the accessible route. The areas inside buildings and facilities have signage directing users towards accessible features.	Stark07-14	NA-US	wheelchair-general	interview	transition	@	@	entrance	@	Literature
Short distances to travel from a parking lot or street to the building, and short distances from the entrance of a building to the final destination within that building.	Stark07-2	NA-US	wheelchair-general	interview	indoor-outdoor	@	@	general mobility	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The entrance of a building and its immediate surroundings do not contain stairs (if stairs are present at the entrance, a ramp is available). There are be very low thresholds as well as negligible grades and cross slopes on any pathway.	Stark07-3	NA-US	wheelchair-general	interview	transition	@	entrance	entrance	@	Literature
Curb cuts are located on all pathways and are not blocked by built structures, snow, or other debris.	Stark07-4	NA-US	wheelchair-general	interview	outdoor	@	ramp	pedestrian path	@	Literature
A drive-through window which enables users to access services from outside the building, without making a transfer.	Stark07-5	NA-US	wheelchair-general	interview	outdoor	@	@	service	general mobility	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Doors that are easily operated with the push of a button at a height which can be reached while seated in a wheelchair. The door is wide enough and remains open long enough for users to pass through it while using a mobility device (e.g., wheelchair or crutches). Very lightweight doors Loaner scooters/Wheelchairs available Facility is located on a single level or has an elevator Accessible bathroom Wide spaces to move through easily Spaces are not crowded with merchandise or people Floor surface is flat, slip resistant Counters or merchandise are accessible Accessible drinking fountain Accessible phone Adequate lighting. There is an area of rescue assistance in case of emergency. All accessible features are in good working order There are accessible places to sit The accessible path of	Stark07-6	NA-US	wheelchair-general	interview	transition	@	@	interior doorway	interior doorway	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
travel/Entrance is well marked. There are signs in the building to indicate where accessible features are located. Doors are light enough to push/pull open with ease, one-handed if necessary, and stay open long enough for users to pass through it.										
All services of a facility are located on a single accessible level. If facilities are located on more than one floor, an accessible elevator is available to take users to all floors.	Stark07-7	NA-US	wheelchair-general	interview	indoor	@	@	service	@	Literature
All bathrooms and stalls are large enough to move around in while using personal equipment. All handles, locks, sinks, soap dispensers, and paper	Stark07-8	NA-US	wheelchair-general	interview	indoor	@	@	bathroom	bathroom	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
towel racks are easy to reach and manipulate while seated in a wheelchair.										
There is room to move around with necessary personal equipment (includes walkers, wheelchairs, and scooters) and ample room to turn around and change one's path of travel. Spaces do not contain large crowds and merchandise is not located within the path of travel.	Stark07-9	NA-US	wheelchair-general	interview	indoor	@	@	indoor space	indoor space	Literature
The most significant environmental element for all groups was a change in the level height of a surface (i.e., the need for a ramp).	Stark98-1	NA-US	target groups	interview	indoor	@	indoor space	indoor space	@	Literature
The moderate and severe clusters demonstrated similar patterns of need in terms of wide spaces that are easily maneuverable,	Stark98-2	NA-US	target groups	interview	indoor	@	@	indoor space	@	Literature
level changes that include ramps	Stark98-3	NA-US	target groups	interview	indoor	@	@	indoor space	@	Literature
items placed at an accessible height from a seated or wheel chair height.	Stark98-4	NA-US	target groups	interview	indoor	@	@	public object	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The additional needs of items that are easily manipulated with hands and fingers would include the need for large buttons and controls. Knobs or controls should be large and easy to grasp to accommodate a limited ability to perform gross motor tasks.	Stark98-5	NA-US	target groups	interview	indoor	@	@	public object	@	Literature
The users encountered difficulties when using the channel ramps; however, these occurred because each user could not align his or her wheelchair easily with the channel ramps before ascending and descending.	Storr-1	EU-UK	wheelchair-power	observation	transition	@	ramp	@	ramp	Literature
Participants in both groups (potential users and mobility trainers) were enthusiastic about the possibility to plan a route at home before embarking on a journey and being able to explore a new area before actually visiting it.	Strothotte-1	EU-UK	blind	interview	outdoor	street layout	@	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Information to be provided by the MoTA should contain all possible route details but such information should be accessible at different levels of detail.	Strothotte-2	EU-UK	blind	interview	outdoor	route-general	@	@	@	Literature
Level 1. - Basic information (to check you are still on course) - Direction of travel, grade of road and nearest pedestrian crossing, any known obstacles.	Strothotte-3	EU-UK	blind	interview	outdoor	route-general	@	@	@	Literature
Level 2 - Detailed information - To include the type of detail selected for inclusion in the pre journey plan e.g. shops, public buildings etc.	Strothotte-4	EU-UK	blind	interview	outdoor	route-destination	@	@	@	Literature
Level 3 - Transport information - Nearest bus stop, rail or tube station taxi rank and telephone.	Strothotte-5	EU-UK	blind	interview	outdoor	transit-stop	@	@	@	Literature
The room contains one hazard, the fire extinguisher. It is classified as such because it is fixed upon the wall at a height that for a typical person would lay above the waist. This creates a threat to the safety of the blind person, because she might not be able to perceive the fire	Swobodzinski-1	NA-US	blind	wayfinding professional	indoor	@	indoor space	@	route	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
extinguisher through normal cane use.										
The route calculation for the blind relies on buffers created around the walls and doors towards the inside of the room. The buffer is set to 90 cm, which is in general a suitable value for the shoulder width of an adult male. If the buffer is free of obstacles then the blind person can maintain the full cane sweep while proceeding towards the destination.	Swobodzinski-2	NA-US	blind	wayfinding professional	indoor	@	route	route	route	Literature
WC primarily reported barriers such as narrow doors, narrow passages	Thapar-1	NA-US	wheelchair-manual	observation	transition	@	indoor space	@	@	Literature
high telephones and drinking fountains	Thapar-2	NA-US	wheelchair-manual	observation	indoor	@	public object	@	@	Literature
for V-I, lack of hand railings was a big concern.	Thapar-3	NA-US	low vision	observation	indoor	@	building	@	@	Literature
Wayfinding concerns included poor signage, lighting and confusing layouts.	Thapar-4	NA-US	target groups	observation	indoor	@	building	@	@	Literature
lack of signage and building directories or illegible signage were frequently	Thapar-5	NA-US	target groups	observation	indoor	@	signage	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
reported barriers.										
Poor lighting and poor design, or layout of the buildings, made it difficult to locate destinations that further aggravated these problems.	Thapar-6	NA-US	target groups	observation	indoor	@	general mobility	@	general mobility	Literature
For example, alternative accessible entrances at seven buildings facilitated access for the wheelchair user.	Thapar-7	NA-US	wheelchair-manual	observation	transition	@	@	building	@	Literature
The facilitators most often reported by the WC were automatic doors, lack of stairs at building entrances	Thapar-8	NA-US	wheelchair-manual	observation	transition	@	@	entrance	@	Literature
For V-I, the major facilitator was good signage.	Thapar-9	NA-US	low vision	observation	indoor	@	@	building	@	Literature
For example, showers with handrails accommodated some people, but for many in wheelchairs, bathtubs presented a major barrier.	Turco-1	NA-US	wheelchair-general	interview	indoor	@	bathroom	bathroom	@	Literature
Some hotels also offered rooms that were too cluttered, thereby restricting wheelchair movement.	Turco-2	NA-US	wheelchair-general	interview	indoor	@	indoor space	@	@	Literature
frontdesk counters that were too high	Turco-3	NA-US	wheelchair-general	interview	indoor	@	service	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
the 3 most important barriers (largest product of prevalence and impact) were problems with the accessibility of stores and buildings	Vissers-1	EU	wheelchair-general	interview	indoor-outdoor	@	general mobility	@	@	Literature
Three-fourths of the respondents would use functions to store and use additional personal geographic data such as points-of-interest or other specific annotations such as small audio snippets.	Volkel-1	EU	low vision	survey	indoor-outdoor	wayfinding	@	@	@	Literature
This conclusion is supported by the great amount of environmental features for orientation named by respondents of the survey. Examples include tactilely sensible features such as curbs, stairs, fences, balustrades, ground composition, and changes of ground composition. Additionally, acoustically sensible features included traffic noise, the sound of stores and restaurants, and the echo from building fronts aroused by panning the white cane. Moreover, respondents reported	Volkel-2	EU	low vision	survey	outdoor	@	@	general mobility	general mobility	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
the use of smells from restaurants, bakeries, and snack bars as an orientation aid.										
Regarding wheelchair users, important information include the location of lowered curbs, stairs, missing ramps, condition of pavements, or too small traffic islands.	Volkel-3	EU	wheelchair-general	wayfinding professional	outdoor	pedestrian path	@	@	@	Literature
lowered curbs may impose additional risks for blind pedestrians as the transition between pavement and street cannot be detected using the haptic sense.	Volkel-4	EU	low vision	survey	outdoor	@	pedestrian crossing	@	@	Literature
Not surprisingly, 43 (48.9%) of the respondents reported to explicitly avoid large cross-ways or big plazas.	Volkel-5	EU	low vision	survey	outdoor	@	outdoor space	@	@	Literature
For pedestrians with sight, pedestrian crossing this parking lot is an easy task. However, for the	Yaagoubi12-1	NA-CAN	blind	wayfinding professional	outdoor	@	pedestrian crossing	@	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
blind, the pedestrian crossing can be very dangerous as there are no traffic signals.										
In addition, as we see in Fig. 11, the intersection I2 does not contain a crosswalk for pedestrians. As a result, the risk of pedestrian crossing the intersection I2 is very high.	Yaagoubi12-2	NA-CAN	blind	wayfinding professional	outdoor	@	pedestrian crossing	@	@	Literature
obstacles have a strong influence on the success of navigational activities, especially for blind pedestrians. The effects of these barriers can be either to block the blind pedestrian, so he or she has to change the current path, or it is possible for him or her to encounter such an obstacle while continuing in the same path.	Yaagoubi13-1	NA-CAN	blind	wayfinding professional	outdoor	@	route	@	route	Literature
They need to identify information on accessibility to scenic spots, toilets	Yau-1	ASIA	low vision	interview	indoor	building-bathroom	@	@	@	Literature
transportation	Yau-2	ASIA	low vision	interview	outdoor	transit-general	@	@	@	Literature
availability of assistance and presence of travel partners	Yau-3	ASIA	target groups	interview	indoor-outdoor	assistance	@	general mobility	@	Literature

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
routes and connections between them must also be investigated and found to be accessible.	Yau-4	ASIA	low vision	interview	indoor-outdoor	route-general	@	@	@	Literature
A combination of outdoor lighting fixtures such as floodlights, spotlights and landscape lighting and the use of full spectrum bulbs will enhance nighttime visibility and safety.	York-1	NA-US	target groups	access professional	outdoor	@	@	nighttime mobility	@	Literature
Good lighting can help to prevent falls and assist those who are visually impaired detect boundaries.	York-2	NA-US	low vision	access professional	outdoor	@	@	outdoor space	outdoor space	Literature
The interior is tightly packed	OSM-1	OA-AU	wheelchair-general	public comment	indoor	@	indoor space	@	@	OpenStreetMap
depending on the tide the ramp can be very steep	OSM-10	OA-AU	wheelchair-general	public comment	outdoor	@	ramp	@	@	OpenStreetMap
Bathroom was accessible however the door is not automatic.	OSM-100	NA-CAN	wheelchair-general	public comment	transition	@	interior doorway	@	@	OpenStreetMap
Side entrance inaccessible (stairs).	OSM-101	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Tables close together; ~1/2 of the tables are bar height.	OSM-102	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Doors are propped open.	OSM-103	NA-CAN	wheelchair-general	public comment	transition	@	@	interior doorway	interior doorway	OpenStreetMap
Lots of floor space for maneuvering a wheelchair. Consultation desks are at an optimal	OSM-104	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
height.										
Displays containing jewelry were a good height for visibility. Lots of floor space to maneuver a wheelchair.	OSM-105	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	indoor space	OpenStreetMap
Large fitting rooms with wide enough doorways.	OSM-106	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Lots of floor space.	OSM-107	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Manual door at entrance; Small ramp in front of entrance	OSM-108	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Spacious interior	OSM-109	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Most buses that pass this stop are accessible or a accessible one following within a few min, the ram onto the bus from this stop isn't too steep when the bus is lowered	OSM-11	OA-AU	wheelchair-general	public comment	outdoor	@	@	transit vehicle	@	OpenStreetMap
Automatic door opener button for main entrance. Small incline to the door.	OSM-110	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
No automatic door opener to the washroom but it is a push door.	OSM-111	NA-CAN	wheelchair-general	public comment	transition	@	interior doorway	@	interior doorway	OpenStreetMap
Tables good height for wheelchair users. Tables a little close together but staff seem very	OSM-112	NA-CAN	wheelchair-general	public comment	indoor	@	indoor space	indoor space	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
accommodating.										
Manual door at entrance; Small ramp in front of entrance	OSM-113	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Fitting room doors are too narrow for a wheelchair to pass. Lots of floor space between displays.	OSM-115	NA-CAN	wheelchair-general	public comment	indoor	@	service	service	interior doorway	OpenStreetMap
Manual doors at entrance; Two doors at entrance may cause difficulty - first door push, second door pull	OSM-116	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	entrance	OpenStreetMap
Manual door at entrance; Small ramp in front of entrance	OSM-117	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Narrow aisles	OSM-118	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Manual door at entrance	OSM-119	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Cannot access the upstairs part of the pub, but the lower level is very accessible with toilet neer the pokies	OSM-12	OA-AU	wheelchair-general	public comment	indoor	@	service	building	@	OpenStreetMap
Automatic door opener at entrance	OSM-120	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Only one patio table is accessible - chairs are stationary around tables	OSM-121	NA-CAN	wheelchair-general	public comment	indoor	@	seating	@	@	OpenStreetMap
Bathroom doorway inner width: 34in (86.36 cm)	OSM-122	NA-CAN	wheelchair-general	public comment	transition	@	interior doorway	@	@	OpenStreetMap
Automatic door opener at entrance	OSM-123	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
elevator in lobby to	OSM-124	NA-	wheelchair-	public	indoor	@	@	building	elevator	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
access businesses on other floors		CAN	general	comment						
Automatic door opener at entrance	OSM-125	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Some products on high shelves - could be difficult to reach without assistance	OSM-126	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	indoor space	OpenStreetMap
Sports bar is located downstairs - only accessible via stairs	OSM-127	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Manual door at entrance	OSM-128	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Must enter from Dresden Row entrance and get elevator up the second floor. The toilet is accessible but is down on the bottom floor (must use elevator).	OSM-129	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	building	@	OpenStreetMap
the toilet is up stairs and have to catch the lift up that is located outside on the corner next to nandos	OSM-13	OA-AU	wheelchair-general	public comment	indoor	@	bathroom	building	building	OpenStreetMap
Ramp leading to door. No automatic door opener button.	OSM-130	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Dressing rooms are narrow (doorways ~61 cm).	OSM-131	NA-CAN	wheelchair-general	public comment	transition	@	interior doorway	@	@	OpenStreetMap
Stairs to the second floor.	OSM-132	NA-CAN	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
Entrance is not wheelchair accessible - 14 cm step at main entrance and 6 cm lip to the door.	OSM-133	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Stairs within the store. Too narrow to manoeuvre within the store.	OSM-134	NA-CAN	wheelchair-general	public comment	indoor	@	indoor space	@	indoor space	OpenStreetMap
Low ramp and wheelchair accessible but no automatic door opener.	OSM-135	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Ramp inside store to go to 2nd floor.	OSM-136	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Wide aisles. Have 1 change room for wheelchair use.	OSM-137	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Accessible toilet on bottom floor. (Must use elevator).	OSM-138	NA-CAN	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap
Entrance very wide, no threshold, smooth tile, wide aisles.	OSM-139	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
No toilet facilities	OSM-14	OA-AU	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
Most products reachable for wheelchair user at low level. Counter is too high for a wheelchair user to interact with cashier.	OSM-140	NA-CAN	wheelchair-general	public comment	indoor	@	service	service	service	OpenStreetMap
Accessible ramp (steep and short) with automatic door.	OSM-141	NA-CAN	wheelchair-general	public comment	transition	@	ramp	entrance	@	OpenStreetMap
Have ramp inside to get to elevator to get to washroom on 2nd floor.	OSM-142	NA-CAN	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap
elevator and washroom are big.	OSM-143	NA-CAN	wheelchair-general	public comment	indoor	@	@	elevator	@	OpenStreetMap
Seating is movable but does obstruct the counters.	OSM-144	NA-CAN	wheelchair-general	public comment	indoor	@	service	seating	seating	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Not wheelchair accessible. Has steps that need to go down to enter the store.	OSM-145	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Has automatic door and small ramp for accessibility.	OSM-146	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Washroom and elevator large space.	OSM-147	NA-CAN	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
the entrance to the store has around 4 or 5 steps down.	OSM-148	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
You have to access through a side door which has some rough terrain. The accessible door requires unlocking - must call business before.	OSM-149	NA-CAN	wheelchair-general	public comment	transition	@	entrance	building	@	OpenStreetMap
Excellent ramp, low incline	OSM-15	OA-AU	wheelchair-general	public comment	transition	@	@	ramp	@	OpenStreetMap
Ramp to enter. No automatic door but will stay open until close it.	OSM-150	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	entrance	OpenStreetMap
Aisles wide. No accessible washroom but accessible table for wheelchair use.	OSM-151	NA-CAN	wheelchair-general	public comment	indoor	@	service	service	@	OpenStreetMap
Has ramp to enter but no automatic door button.	OSM-152	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Wide area inside.	OSM-153	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Has a lower floor and tailors on the second floor but no elevator to access either.	OSM-154	NA-CAN	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
Change room and washrooms small and not wheelchair	OSM-155	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
accessible.										
Tiny ramp at entrance	OSM-156	NA-CAN	wheelchair-general	public comment	transition	@	ramp	entrance	@	OpenStreetMap
Does not have elevator for easy access so not wheel chair accessible.	OSM-157	NA-CAN	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
Short ramp to get inside with automatic door opener.	OSM-158	NA-CAN	wheelchair-general	public comment	transition	@	ramp	entrance	@	OpenStreetMap
Wide area and height of ATM machines accessible.	OSM-159	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
High counter but helpful staff.	OSM-16	OA-AU	wheelchair-general	public comment	indoor	@	service	service	@	OpenStreetMap
This restaurant has 7 steep steps that lead up to the door. They have no alternative entrance.	OSM-160	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Washroom in building labeled accessible, however, entry door is not wide enough, only 88cm. Smaller wheelchairs/walkers would be able to gain access. Accessible stall with grab bar.	OSM-161	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	bathroom	@	OpenStreetMap
No automatic door opener. No stairs but heavy door.	OSM-162	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Wide area inside.	OSM-163	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
There are 2 accessible parking spaces on each floor of the parkade which are located close to the door and have ample room for van off-loading. The parking-payment machine (on the 2nd floor) is quite high and not totally accessible.	OSM-164	NA-CAN	wheelchair-general	public comment	indoor	@	parking	parking	@	OpenStreetMap
No automatic door to enter.	OSM-165	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Small and narrow aisles. 1 accessible wheelchair change room. High counters, ATM very high and not moveable.	OSM-166	NA-CAN	wheelchair-general	public comment	indoor	@	service	service	public object	OpenStreetMap
Access through a ramp on right side of plaza. No automatic door into the restaurant.	OSM-167	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Bathroom for customers is key access in main building, but the door is too narrow and therefore not accessible.	OSM-168	NA-CAN	wheelchair-general	public comment	transition	@	interior doorway	@	@	OpenStreetMap
Entrance is wide, but obstructed by table, products on floor.	OSM-169	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Poor path of travel to buildings.	OSM-17	OA-AU	wheelchair-general	public comment	indoor	@	parking	@	@	OpenStreetMap
Aisles very narrow throughout due to cluttered floor. Most products at low level. Counter is too high	OSM-170	NA-CAN	wheelchair-general	public comment	indoor	@	service	service	service	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
for a wheelchair user to interact with cashier.										
Entrance obstructed by large table	OSM-171	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
aisles are not wide enough to travel through due to many breakables along shelving and clutter on floor	OSM-172	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	indoor space	OpenStreetMap
counter is too high.	OSM-173	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Washroom located within restaurant and is accessible with grab bar included. Sink/soap dispenser may be a big high, but room provided for wheelchair to slide underneath.	OSM-174	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	bathroom	public object	OpenStreetMap
Very small store for maneuvering but very helpful and friendly staff.	OSM-175	NA-CAN	wheelchair-general	public comment	indoor	@	indoor space	service	indoor space	OpenStreetMap
Entrance is wide enough to enter with a wheelchair.	OSM-176	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Aisles are wide enough to get through and a good turning radius. Most products are low. Counter is slightly too high for a wheelchair user to interact with cashier.	OSM-177	NA-CAN	wheelchair-general	public comment	indoor	@	service	indoor space	indoor space	OpenStreetMap
Entrance very wide and open, no threshold	OSM-178	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
smooth tile, wide aisles. Most products reachable at low level. Counter is low enough to interact with cashiers. Changing rooms all wide and accessible.	OSM-179	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	service	OpenStreetMap
High counters but helpful staff. Good seating inside.	OSM-18	OA-AU	wheelchair-general	public comment	indoor	@	service	service	@	OpenStreetMap
Accessible entrance off of Artillery Place, with automatic doors	OSM-180	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Must access the business through entrance on the right side of Martello private residences with automatic door. One section of the store can only be accessed by stairs.	OSM-181	NA-CAN	wheelchair-general	public comment	indoor	@	service	building	@	OpenStreetMap
Wide entrance, small threshold < 1/2 inch where smooth tile turns into carpet.	OSM-182	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Wide aisles,brochures and information reachable at low level. Counter is low for wheelchair user to comfortably interact with agent.	OSM-183	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	service	OpenStreetMap
There are stairs as soon as you walk in the front door.	OSM-184	NA-CAN	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
Automatic doors inside the building and business.	OSM-185	NA-CAN	wheelchair-general	public comment	transition	@	@	building	@	OpenStreetMap
Accessible bathroom with grab bar and	OSM-186	NA-CAN	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
lowered toilet.										
As soon as you enter there are 8 steps to get up.	OSM-187	NA-CAN	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
No automatic doors.	OSM-188	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
The counter space was sitting height so it is very easy to approach the desk and reception.	OSM-189	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	service	OpenStreetMap
Some on slope, gravel surface. Poor path of travel to buildings.	OSM-19	OA-AU	wheelchair-general	public comment	outdoor	@	parking	@	@	OpenStreetMap
Counter is low, able to order food and reach it. Menu is high and visible by all with clear lettering. Tables out front are small, but can be pulled up to.	OSM-190	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	service	OpenStreetMap
Garbage cans out front are low.	OSM-191	NA-CAN	wheelchair-general	public comment	outdoor	@	@	public object	@	OpenStreetMap
Has 2 steps to go up, with a slight incline before reaching the entrance.	OSM-192	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Aisles are narrow and crowded with items on the floor.	OSM-193	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Entrance has some obstructions, but wide enough to go in, no threshold, smooth tile.	OSM-194	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Counter is low enough but stand for debit transaction is too high. Most products reaching	OSM-195	NA-CAN	wheelchair-general	public comment	indoor	@	service	service	service	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
level for wheelchair users.										
Entrance has wide door, no threshold.	OSM-196	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Counter and tables are too high.	OSM-197	NA-CAN	wheelchair-general	public comment	indoor	@	seating	@	@	OpenStreetMap
Easy access to entrance. Ramp also located out back for easier access.	OSM-198	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Bathroom is large and easy to get around in.	OSM-199	NA-CAN	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
the front door is difficult to open independently	OSM-2	OA-AU	wheelchair-general	public comment	transition	@	entrance	@	entrance	OpenStreetMap
Ramp into hall.	OSM-20	OA-AU	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Business on second floor. Stair access only.	OSM-200	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Counter is lower to make it easier to pay and hair stylist chairs are moveable to allow people with wheelchairs to remain seated in their chair.	OSM-201	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	service	OpenStreetMap
Entrance will not fit wider wheelchairs.	OSM-202	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Ramp to outdoor dining area but only way to access inside of restaurant is through stairs.	OSM-203	NA-CAN	wheelchair-general	public comment	indoor	@	service	indoor space	@	OpenStreetMap
Ramp leading into restaurant and a wide enough door to get in. However, you cannot access dining area due to physical	OSM-204	NA-CAN	wheelchair-general	public comment	transition	@	service	entrance	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
barriers.										
Washroom was accessible however large dehumidifier was stored in room making it unaccessible.	OSM-205	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
Main entrance not accessible, but have a ramp available for back entrance.	OSM-206	NA-CAN	wheelchair-general	public comment	transition	@	building	entrance	@	OpenStreetMap
Bathroom had low sinks & individual stalls. The hall leading to stall was103cm wide but door to bathroom was 77cm wide.	OSM-207	NA-CAN	wheelchair-general	public comment	indoor	@	interior doorway	bathroom	@	OpenStreetMap
One step to get into business, but it is 8cm high. As you enter the front door, you are led to more steps to get into main business.	OSM-208	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
7 Steps up to entrance.	OSM-209	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Accessible car park. But no accessible toilet facilities	OSM-21	OA-AU	wheelchair-general	public comment	indoor	@	service	service	@	OpenStreetMap
Entrance to business has small, uneven steps with small doorway.	OSM-210	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Accessible entrance with functional automatic doors.	OSM-211	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
The hallway to get to the bathroom was 90cm wide. The door	OSM-212	NA-CAN	wheelchair-general	public comment	indoor	@	interior doorway	hallway	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
to the accessible bathroom stall was less than 90cm (80cm).										
Entrance to building is accessible but, aisles are very narrow.	OSM-213	NA-CAN	wheelchair-general	public comment	indoor	@	indoor space	building	@	OpenStreetMap
Entrance is accessible but no automatic door and moderate ramp.	OSM-214	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Table are booths.	OSM-215	NA-CAN	wheelchair-general	public comment	indoor	@	seating	@	@	OpenStreetMap
Main entrance is accessible but slight ramp and no automatic door.	OSM-216	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Bathroom is a single room on main level, however, multiple doors to get there (<90cm) and not properly equipped to be accessible (sink is high and no grab bars).	OSM-217	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	bathroom	@	OpenStreetMap
Entrance is accessible but no automatic doors.	OSM-218	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Accessible entrance, however, no automatic door.	OSM-219	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
No steps	OSM-22	OA-AU	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Bathroom was a large single stall. sink, mirror and light switch were all low. Hallway was 103cm wide but door to bathroom was only 80cm.	OSM-220	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	bathroom	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Not wheelchair accessible. There were 4 steps to get to main entrance.	OSM-221	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Accessible entrance, however, no automatic doors and a very short, steep ramp.	OSM-222	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Bathroom was accessible, but it is an odd space (slightly L shaped) so it may not be possible to turn around. Door to the bathroom was 90cm.	OSM-223	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	indoor space	OpenStreetMap
Tight walkways between tables, can't get in bathroom, limited parking on street, cannot sit at the front of the restaurant (steps).	OSM-224	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Turn wheel to get in	OSM-225	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Railing, wide doorway, low sink and light switches in bathroom.	OSM-226	NA-CAN	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
Stairs to enter, ledge to get over at door.	OSM-227	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Two sets of stairs to enter the building.	OSM-228	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
No clutter in hallway.	OSM-229	NA-CAN	wheelchair-general	public comment	indoor	@	@	hallway	@	OpenStreetMap
Can park directly in front.	OSM-23	OA-AU	wheelchair-general	public comment	outdoor	@	service	@	@	OpenStreetMap
Very small bathroom doorway not wide enough to enter.	OSM-230	NA-CAN	wheelchair-general	public comment	transition	@	bathroom	@	interior doorway	OpenStreetMap
bathroom has wide entrance however no	OSM-231	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	bathroom	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
rail and a high sink.										
Automatic doors to enter building and yogurt bar.	OSM-232	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Narrow entrance to ramp between two poles after an incline.	OSM-233	NA-CAN	wheelchair-general	public comment	outdoor	@	ramp	@	@	OpenStreetMap
The restaurant had low tables and there was lots of space between tables.	OSM-234	NA-CAN	wheelchair-general	public comment	indoor	@	@	seating	@	OpenStreetMap
Bathroom did not have a larger stall with a railing. It did have an open hallway to enter, low sinks, paper towel dispenser and soap dispenser.	OSM-235	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	bathroom	@	OpenStreetMap
The front door was accessible, but then there was a large step to get down to the front desk.	OSM-236	NA-CAN	wheelchair-general	public comment	transition	@	service	building	@	OpenStreetMap
Automatic doors and elevator to access each floor.	OSM-237	NA-CAN	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap
There is a small lip at the entrance (less than 7cm). Door does not have automatic door-opening mechanism.	OSM-238	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Clients should call/book ahead to inform the business before arriving. Staff are very willing to accommodate clients using a wheelchair.	OSM-239	NA-CAN	wheelchair-general	public comment	indoor-outdoor	@	service	service	@	OpenStreetMap
Outdoors: different table types and heights.	OSM-24	OA-AU	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
There is a ramp leading to the entrance that is 91cm wide. Ramp has a sharp turn which may be difficult to maneuver via wheelchair (depending on the size of the chair).	OSM-240	NA-CAN	wheelchair-general	public comment	transition	@	ramp	@	ramp	OpenStreetMap
Front entrance is flat wide enough for wheelchair use. There is no automatic door-opening mechanism.	OSM-241	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Low grade ramp, very wide. Bathroom is narrow and has no grab bars	OSM-242	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	ramp	@	OpenStreetMap
Washrooms located at the bottom of a staircase.	OSM-243	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
Entrance accessible, no automatic doors	OSM-244	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Automatic doors, wide entry way, low grade ramp	OSM-245	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Automatic door, controlled with button.	OSM-246	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Bathroom has grab rails and plenty of space	OSM-247	NA-CAN	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
Entrance has accessible ramp but it is quite high grade	OSM-248	NA-CAN	wheelchair-general	public comment	transition	@	ramp	entrance	@	OpenStreetMap
Step >7cm at entrance of building	OSM-249	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
nice spacious shop to wheel around in. Checkout counters appr. 90cm high.	OSM-25	OA-AU	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Crowded floor layout	OSM-250	NA-CAN	wheelchair-general	public comment	indoor	@	indoor space	@	@	OpenStreetMap
Push button outside for entryway doors	OSM-251	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	entrance	OpenStreetMap
Bathroom does not have grab bars	OSM-252	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
Washroom was narrow, no grab bars, no space under sink for wheelchair to fit.	OSM-253	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
Floor plan is relatively open, a few booths with a step up that are not accessible as well as stool seating at a high bar. High counter for mixing coffee	OSM-254	NA-CAN	wheelchair-general	public comment	indoor	@	service	indoor space	@	OpenStreetMap
Washroom is small, no grab bars around toilet, cupboard beneath sink.	OSM-255	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
Bathroom is narrow, no hand rails, can't wheel underneath sink.	OSM-256	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	bathroom	OpenStreetMap
Entrance with a low grade ramp, push buttons for opening main doors	OSM-257	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	entrance	OpenStreetMap
Power door entry with 34 inch wide door.	OSM-258	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
The bathroom doorway is a little bit too narrow (approx. 30 inches) and there are no wall bars beside the toilet.	OSM-259	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
Disabled parking directly in front of main door	OSM-26	OA-AU	wheelchair-general	public comment	outdoor	@	@	building	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Bathroom is completely accessible with wall bars.	OSM-260	NA-CAN	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
Fitting rooms, however, are not wide enough for an individual in a wheelchair to gain entry to. High shelving as well	OSM-261	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Bathroom is spacious and accessible	OSM-262	NA-CAN	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
The outside deck is not accessible as it as a 5 inch step.	OSM-263	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Employee(s) of store will provide a ramp, when asked, for the step leading into the store.	OSM-264	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	service	OpenStreetMap
No power doors on site	OSM-265	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Fully wheelchair accessibly with three spacious bathrooms with power doors and wall bars.	OSM-266	NA-CAN	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
Fairly low shelving that is reachable while sitting.	OSM-267	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	service	OpenStreetMap
Accessible entrance with a ramp at 5781 Charles St. is unmarked. Two stairs lead to main dining room, making main dining area inaccessible.	OSM-268	NA-CAN	wheelchair-general	public comment	transition	@	building	entrance	@	OpenStreetMap
Intercom system to gain access to the building is too high at 66Ó and obstructed	OSM-269	NA-CAN	wheelchair-general	public comment	transition	@	building	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
by a planter placed too close to the first stair.										
Low counter in middle/checkout section	OSM-27	OA-AU	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Bathroom is technically accessible, but doubles as a storage closet and on this particular day had a broken bar stool obstructing toilet.	OSM-270	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
door clearance into the the building clearly wide enough for a wheelchair, with no threshold or step up. Button visible to activate automatic door.	OSM-271	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
2 parking spaces for disabled customers, wide automatic doors for entrance and exit into building.Wide aisles ample for a wheelchair. No stairs anywhere.	OSM-272	NA-CAN	wheelchair-general	public comment	indoor-outdoor	@	@	building	@	OpenStreetMap
Bathroom accessible, rug may be problematic.	OSM-273	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
Hallway to get to the bathroom is 80 cm wide (inaccessible). The bathroom itself meets accessibility requirements	OSM-274	NA-CAN	wheelchair-general	public comment	indoor	@	hallway	building	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Completely wheelchair accessible. No steps or threshold issues to enter. Two sets of double doors to the entrance, ample space between tables, fully accessible bathroom.	OSM-275	NA-CAN	wheelchair-general	public comment	indoor-outdoor	@	@	service	@	OpenStreetMap
Step up to get to bathroom is prohibitive for a wheelchair. Doorways to bathroom too narrow at 71 cm, and only 121 cm depth of clear space inside the actual bathroom.	OSM-276	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
Wheelchair ramp with handrails on either side.	OSM-277	NA-CAN	wheelchair-general	public comment	transition	@	@	ramp	@	OpenStreetMap
The bathroom is down a steep set of stairs.	OSM-278	NA-CAN	wheelchair-general	public comment	transition	@	bathroom	@	@	OpenStreetMap
The store is cluttered at entrance.	OSM-280	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Very open inside, a lot of room to manoeuver.	OSM-281	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	indoor space	OpenStreetMap
There is one tall step in-which is bumpable in a manual wheelchair.	OSM-282	NA-CAN	**wheelchair-manual**	public comment	transition	@	entrance	@	entrance	OpenStreetMap
ask for keys to washroom. owner uses washroom as storage for supplies and garbage, such as rat traps, chemical solvents, food waste, etc. washroom is highly unsanitary.	OSM-283	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
No accessible washroom and no barrier-free entry. There is one step at door. Inside is very cramped.	OSM-284	NA-CAN	wheelchair-general	public comment	indoor-outdoor	@	building	@	@	OpenStreetMap
restaurant is accessible, but you have to enter through a back door, which is locked. if you are alone it may be difficult to get the attention of staff from outside the restaurant in order to get the door unlocked.	OSM-285	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	entrance	OpenStreetMap
exterior door is powered.	OSM-286	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
washrooms are down a flight of stairs.	OSM-287	NA-CAN	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
back room (rented out for parties etc., not in regular use) is up 3 average-sized steps. owner has a homemade "ramp" that is quite steep and won't hold a power chair.	OSM-288	NA-CAN	**wheelchair-power**	public comment	transition	@	ramp	interior doorway	@	OpenStreetMap
Annoying poles blocking entrance and exit on outside	OSM-289	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Ramp to railway platform and ticket office. Accessible toilets also at top of ramp.	OSM-29	OA-AU	wheelchair-general	public comment	indoor	@	@	transit-stop	@	OpenStreetMap
ramp can only be access from the parking lot in the rear.	OSM-290	NA-CAN	wheelchair-general	public comment	transition	@	entrance	building	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Accesible from the back	OSM-291	NA-CAN	wheelchair-general	public comment	transition	@	entrance	building	@	OpenStreetMap
Upstairs section not wheelchair accessible but accessible toilets downstairs	OSM-292	OA	wheelchair-general	public comment	indoor	@	service	building	@	OpenStreetMap
Steps at the entrance	OSM-293	OA	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Steep ramp	OSM-294	OA	wheelchair-general	public comment	transition	@	ramp	@	@	OpenStreetMap
level courtyard and interior	OSM-295	OA	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Need to use back entrance behind building	OSM-296	EU-UK	wheelchair-general	public comment	transition	@	service	@	@	OpenStreetMap
Step up into premises - ramp available on request	OSM-297	EU-UK	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Steep ramp up to door	OSM-298	EU-UK	wheelchair-general	public comment	transition	@	ramp	entrance	@	OpenStreetMap
When I visited they had chairs stacked in front of the disabled toilet. Call ahead so they can clear the way!	OSM-299	EU-UK	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
the staff are very helpful and gladly/proactively open the door & move tables as necessary.	OSM-3	OA-AU	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap
One wheelchair car park near entrance.	OSM-30	OA-AU	wheelchair-general	public comment	outdoor	@	@	entrance	@	OpenStreetMap
Level access to upper level	OSM-300	EU-UK	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap
accessible toilet via signposted side door	OSM-301	EU-UK	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
Lifts to first floor	OSM-302	EU-UK	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The only access to the building for the public is up a ramp that is 1:20 scale over 15 metres. Even the most upper bodied strengthened wheelchair user will struggle to get up to this ramp	OSM-303	EU-UK	**wheelchair-manual**	**member**	transition	@	ramp	entrance	@	OpenStreetMap
Small step up into shop, I was in a powerchair so a no go	OSM-304	EU-UK	**wheelchair-power**	**member**	transition	@	entrance	@	@	OpenStreetMap
This is wheelchair accessible but there is hardly enough space to move as the store is so full, with every inch of floor space being used. Some parts you just can't reach as items are stacked on the floor	OSM-305	EU-UK	wheelchair-general	public comment	indoor	@	service	@	service	OpenStreetMap
wheelchair access from car park	OSM-306	EU-UK	wheelchair-general	public comment	outdoor	@	@	building	@	OpenStreetMap
Very small area of curb in grassed area, so bus can not always line up with curb depending on how cars have parked.	OSM-307	EU-UK	wheelchair-general	public comment	outdoor	@	transit vehicle	transit vehicle	transit vehicle	OpenStreetMap
Bus stop is at a strange angle to the road and at the edge of a parking bay, so buses can't always line up properly with the stop due to the road shape or parked cars.	OSM-308	EU-UK	wheelchair-general	public comment	outdoor	@	transit vehicle	@	transit vehicle	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
No raised kerb and bin in stage place normally forces bus to stop we're a dropped kerb is making it impossible for the buses ramp to work.	OSM-309	EU-UK	wheelchair-general	public comment	outdoor	@	transit vehicle	transit vehicle	@	OpenStreetMap
One wheelchair accessible car park near entrance.	OSM-31	OA-AU	wheelchair-general	public comment	outdoor	@	@	entrance	@	OpenStreetMap
Flat, street level.	OSM-310	EU-UK	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Some of the seating can't be reached in a wheelchair due to gaps / walkways being too narrow.	OSM-311	EU-UK	wheelchair-general	public comment	indoor	@	seating	@	@	OpenStreetMap
no raised boarding point boarding from road level.	OSM-312	EU-UK	wheelchair-general	public comment	outdoor	@	transit vehicle	@	transit vehicle	OpenStreetMap
Technically accessible but a very cramped store, difficult to get around in even small self-propelled chair.	OSM-313	EU-UK	**wheelchair-manual**	public comment	indoor	@	service	@	@	OpenStreetMap
Lifts and plenty of disabled parking spaces.	OSM-314	EU-UK	wheelchair-general	public comment	indoor-outdoor	@	@	building	@	OpenStreetMap
The postion of the door to between the bus station and the bus is too close to the wall so busses may not be able to line up with the door sufficiently to allow them to deploy their ramp.	OSM-315	EU-UK	wheelchair-general	public comment	indoor	@	transit vehicle	transit vehicle	transit vehicle	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
all trains that call here carry a wheelchair boarding ramp as a matter of course. However, the platform for trains to Warrington and Manchester is only accessible via steps.	OSM-316	EU-UK	wheelchair-general	public comment	indoor	@	transit-stop	transit vehicle	@	OpenStreetMap
Step-free access throughout.	OSM-317	EU-UK	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Doors wide, however some require user to pull to open.	OSM-318	EU-UK	wheelchair-general	public comment	transition	@	interior doorway	interior doorway	interior doorway	OpenStreetMap
Only downfall is that the staff are unhelpful	OSM-319	EU-UK	wheelchair-general	public comment	outdoor	@	service	@	@	OpenStreetMap
There are two entrances. The one from Hotham St has electric self opening door. The one from Franklin St has heavy outward opening door. Both have flat entry.	OSM-32	OA-AU	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Stepped access and VERY heavy front door,	OSM-320	EU-UK	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Lower level not accessible	OSM-321	EU-UK	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
Lift to upstairs dining area	OSM-322	EU-UK	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Access fine but if driving and parking nearby is impossible if you dont get a space infront which are very very limited	OSM-323	EU-UK	wheelchair-general	public comment	indoor-outdoor	@	building	@	@	OpenStreetMap
Lifts to all platforms	OSM-324	EU-UK	wheelchair-general	public comment	indoor	@	@	transit-stop	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Small step into the chemist/post office but my electric wheelchair does not need a kerb climber to enter it is really very low. Automatic door. I have chosen partial as it may be a barrier to a self propelled chair.	OSM-325	EU-UK	**wheelchair-power**	**member**	transition	@	entrance	entrance	@	OpenStreetMap
Accessible buses do run but they can be swapped for inaccessible ones without warning	OSM-326	EU-UK	wheelchair-general	public comment	transit vehicle	@	transit-general	transit-general	@	OpenStreetMap
All boats are accessible however wheelchairs can on only get indoors on 2 out of 4 of the boats. The cafe is down stairs on the boats as are the toilets so not accessible.	OSM-327	EU-UK	wheelchair-general	public comment	transit vehicle	@	indoor space	@	@	OpenStreetMap
Doors too narrow for standard manual wheelchair.	OSM-328	EU-UK	**wheelchair-manual**	public comment	transition	@	interior doorway	@	@	OpenStreetMap
Lockers blocking accessible toilet.	OSM-329	EU-UK	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
The shop has a flat entry	OSM-33	OA-AU	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Single blue badge space ramped at front of car, not at pedestrian access.	OSM-330	EU-UK	wheelchair-general	public comment	outdoor	@	parking	parking	@	OpenStreetMap
Ramp downstairs might be narrow for electric wheelchairs.	OSM-331	EU-UK	**wheelchair-power**	public comment	indoor	@	ramp	building	@	OpenStreetMap
Lift to upstairs patio seating.	OSM-332	EU-UK	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
No lift to upstairs	OSM-333	EU-UK	wheelchair-	public	indoor	@	service	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
area.			general	comment						
There are steps going into the pub and different levels once you are inside.	OSM-334	EU-UK	wheelchair-general	public comment	transition	@	service	@	@	OpenStreetMap
6 inch plus step (down)	OSM-335	EU-UK	**wheelchair-manual**	public comment	transition	@	entrance	@	@	OpenStreetMap
they will move chairs and give you a cut in your wheelchair.	OSM-336	EU-UK	wheelchair-general	public comment	indoor	@	@	service	service	OpenStreetMap
Single step	OSM-337	EU-UK	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
low step (not measured)	OSM-338	EU-UK	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Ramp with railings	OSM-339	EU-UK	wheelchair-general	public comment	transition	@	@	ramp	@	OpenStreetMap
aisles are so congested it is not very accessible, especially for larger electric wheelchairs. At the checkout the aisle is not wide enough for wheelchair to pass others at next checkout.	OSM-34	OA-AU	**wheelchair-power**	public comment	indoor	@	indoor space	@	@	OpenStreetMap
Raised kerb	OSM-340	EU-UK	wheelchair-general	public comment	outdoor	@	pedestrian path	@	@	OpenStreetMap
kerb surround	OSM-341	EU-UK	wheelchair-general	public comment	outdoor	@	pedestrian path	@	@	OpenStreetMap
Automatic sliding door	OSM-342	EU-UK	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Low door sill from pavement	OSM-343	EU-UK	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Steep narrow path from road	OSM-344	EU-UK	wheelchair-general	public comment	outdoor	@	pedestrian path	@	@	OpenStreetMap
Low door sill	OSM-345	EU-UK	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Tactile pedestrian crossing from island to even numbers	OSM-346	EU-UK	wheelchair-general	public comment	outdoor	@	@	pedestrian crossing	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Narrow lift	OSM-347	EU-UK	wheelchair-general	public comment	indoor	@	elevator	building	@	OpenStreetMap
Powered door opens inward.	OSM-348	EU-UK	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Automatic powered entry and exit doors	OSM-349	EU-UK	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Staff friendly and helpful.	OSM-35	OA-AU	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Two Blue Badge bays with step-free route to court entrance	OSM-350	EU-UK	wheelchair-general	public comment	outdoor	@	@	entrance	@	OpenStreetMap
Some paths steep and narrow	OSM-351	EU-UK	wheelchair-general	public comment	outdoor	@	pedestrian path	@	@	OpenStreetMap
Single step and narrow right-angle turn to door	OSM-352	EU-UK	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Steep narrow ramp with door sill at top	OSM-353	EU-UK	wheelchair-general	public comment	transition	@	ramp	@	@	OpenStreetMap
Dedicated Blue Badge Bays on first level, Exit to shops and Shopmobility has powered door. Lifts to shops.	OSM-354	EU-UK	wheelchair-general	public comment	indoor	@	@	parking	@	OpenStreetMap
Single step	OSM-355	EU-UK	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Wooden ramp down, slippery when wet	OSM-356	EU-UK	wheelchair-general	public comment	transition	@	ramp	@	ramp	OpenStreetMap
narrow ramp	OSM-357	EU-UK	wheelchair-general	public comment	transition	@	ramp	@	@	OpenStreetMap
All weather smooth asphalt path from Visitor Centre and Blue Badge parking.	OSM-358	EU-UK	wheelchair-general	public comment	outdoor	@	@	pedestrian path	@	OpenStreetMap
Uneven path access from car park.	OSM-359	EU-UK	wheelchair-general	public comment	outdoor	@	parking	@	@	OpenStreetMap
Two accessible carparks	OSM-36	OA-AU	wheelchair-general	public comment	outdoor	@	@	service	@	OpenStreetMap
Narrow ramp from car park.	OSM-360	EU-UK	wheelchair-general	public comment	outdoor	@	ramp	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Route from station steep uphill with pedestrian crossing on blind bend.	OSM-361	EU-UK	wheelchair-general	public comment	outdoor	@	pedestrian path	@	@	OpenStreetMap
High Counter in shop.	OSM-362	EU-UK	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Several Blue Badge spaces near entrance	OSM-363	EU-UK	wheelchair-general	public comment	outdoor	@	@	building	@	OpenStreetMap
automatic doors, lift to upper floor	OSM-364	EU-UK	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap
Slope up from street	OSM-365	EU-UK	wheelchair-general	public comment	outdoor	@	pedestrian path	@	@	OpenStreetMap
Narrow footway and low step at wide doors	OSM-366	EU-UK	wheelchair-general	public comment	transition	@	pedestrian path	entrance	@	OpenStreetMap
Low step = 4cm	OSM-367	EU-UK	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Dedicated Blue Badge spaces.	OSM-368	EU-UK	wheelchair-general	public comment	outdoor	@	@	parking	@	OpenStreetMap
Ramped access to automatic doors.	OSM-369	EU-UK	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Inside the cinema complex, wheelchair parking available, no steps and disabled toilets available	OSM-37	OA-AU	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Wooden horizontal slats make it difficult to cross.	OSM-370	EU-UK	wheelchair-general	public comment	outdoor	@	pedestrian path	@	@	OpenStreetMap
There is a big step but they have got a ramp.	OSM-371	EU-UK	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
Entrance depends on which platform you need to access, only the London bound platform is accessible from the station building itself, the other platform is accessed via a separate entrance on	OSM-372	EU-UK	wheelchair-general	public comment	transition	@	transit-stop	transit-stop	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
the far side										
Lifts to all platforms	OSM-373	EU-UK	wheelchair-general	public comment	indoor	@	@	transit-stop	@	OpenStreetMap
disabled toilets up a steep ramp	OSM-374	EU-UK	wheelchair-general	public comment	indoor	@	bathroom	bathroom	@	OpenStreetMap
Wide pavement	OSM-375	EU-UK	wheelchair-general	public comment	outdoor	@	@	pedestrian path	@	OpenStreetMap
all London Buses have wheelchair ramps	OSM-376	EU-UK	wheelchair-general	public comment	transit vehicle	@	@	entrance	@	OpenStreetMap
the building need automatic door.	OSM-377	EU-UK	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
lift to gallery accessible but button for the lift need adjudtnebt	OSM-378	EU-UK	wheelchair-general	public comment	indoor	@	elevator	service	@	OpenStreetMap
toilet corridor is narrow' especially for electric wheelchairs. accessible toilet is a good size.	OSM-379	EU-UK	**wheelchair-power**	public comment	indoor	@	hallway	bathroom	@	OpenStreetMap
Designated "accessible" table indoor and outdoor seating is all accessible	OSM-38	NA-CAN	wheelchair-general	public comment	indoor-outdoor	@	@	service	@	OpenStreetMap
no drop curb	OSM-380	EU-UK	wheelchair-general	public comment	outdoor	@	pedestrian path	@	@	OpenStreetMap
easy for electric wheelchair but difficult to go up for manual wheelchairs. steep	OSM-381	EU-UK	**wheelchair-manual**	public comment	transition	@	ramp	entrance	@	OpenStreetMap
Four steps down from street, no lift available	OSM-382	EU-UK	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
signing is not clear.	OSM-383	EU-UK	wheelchair-	public	indoor-	@	signage	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
			general	comment	outdoor					
the lift to the toilet is broken.	OSM-384	EU-UK	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
There are two lifts behind the main entrance next to the Minories pub.	OSM-385	EU-UK	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap
DLR is step free from street to train	OSM-386	EU-UK	wheelchair-general	public comment	indoor-outdoor	@	@	transit-stop	@	OpenStreetMap
Ramp with railing to main door has tactile paving at foot and top and for steps. Rear door has straight ramp & railings.	OSM-387	EU-UK	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Dedicated disabled parking near entrance.	OSM-389	EU-UK	wheelchair-general	public comment	outdoor	@	@	entrance	@	OpenStreetMap
Only a select few tables will accommodate a person sitting in a wheelchair.	OSM-39	NA-CAN	wheelchair-general	public comment	indoor	@	service	service	seating	OpenStreetMap
Wide gates, lift down to all plaforms, Radar key operated wheelchair accessible toilet near lift at ticket hall level.	OSM-390	EU-UK	wheelchair-general	public comment	indoor	@	@	transit-stop	@	OpenStreetMap
Radar key operated, room to fit a wheelchair but transfers would be difficult. These toilets are frequently out of order.	OSM-391	EU-UK	wheelchair-general	public comment	indoor	@	bathroom	@	bathroom	OpenStreetMap
Level access to theatre blocked by tables and chairs on the pavement outside!	OSM-392	EU-UK	wheelchair-general	public comment	outdoor	@	entrance	entrance	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
level access to women's toilet but cubicle too small to maneuovre wheelchair in.	OSM-393	EU-UK	wheelchair-general	public comment	indoor	@	bathroom	bathroom	@	OpenStreetMap
The corridor, along with the wheelchair toilets are usually used for storage, so not great if you're in a rush.	OSM-394	EU-UK	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
I would say that this is not wheelchair accessible as the turning circle into the place is very tight, but small manual chair may have more success then my powered chair.	OSM-395	EU-UK	**wheelchair-power**	**member**	transition	@	entrance	@	@	OpenStreetMap
Although the restaurant claims to be wheelchair accessible, it is VERY small and would not be suitable for powered chairs.	OSM-396	EU-UK	**wheelchair-power**	public comment	indoor	@	indoor space	@	@	OpenStreetMap
Moving within the cafe is somewhat difficult because of lack of space	OSM-397	EU-UK	wheelchair-general	public comment	indoor	@	indoor space	@	indoor space	OpenStreetMap
Uneven entry, not all rooms at same level plus very narrow and steep staircase.	OSM-398	EU-UK	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
WC usually locked. Accessible but always locked.	OSM-399	NA-US	wheelchair-general	public comment	indoor	@	bathroom	@	bathroom	OpenStreetMap
Aisles are wide enough to go through (just), buttoo narrow to turn. Staff are very helpful.	OSM-4	OA-AU	wheelchair-general	public comment	indoor	@	indoor space	indoor space	indoor space	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
They keep trash and mops and vacuums in the elevator and the elevator is locked. Despite repeated complaints.	OSM-400	NA-US	wheelchair-general	public comment	indoor	@	elevator	@	elevator	OpenStreetMap
Many, many steps and no elevator.	OSM-401	NA-US	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
Cashier & order counter are high and the door could be difficult, but the inside is clear & there's no step.	OSM-402	NA-US	wheelchair-general	public comment	indoor	@	service	indoor space	@	OpenStreetMap
Front door too narrow, no handicap parking spaces	OSM-403	NA-US	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Steep handicap ramp on the left side of churh	OSM-404	NA-US	wheelchair-general	public comment	transition	@	ramp	entrance	@	OpenStreetMap
elevator upstairs to restrooms	OSM-405	NA-US	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
Handicap parking with ramp at the back right of the building.	OSM-406	NA-US	wheelchair-general	public comment	outdoor	@	@	parking	@	OpenStreetMap
Street parking	OSM-407	NA-US	wheelchair-general	public comment	outdoor	@	@	service	@	OpenStreetMap
curb cut at corner	OSM-408	NA-US	wheelchair-general	public comment	outdoor	@	@	pedestrian crossing	@	OpenStreetMap
Railing on entry ramp	OSM-409	NA-US	wheelchair-general	public comment	transition	@	@	ramp	@	OpenStreetMap
Washroom not accessible	OSM-41	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
large ladies room with grab bar.	OSM-410	NA-US	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
Ladies room door is narrow, room is small	OSM-411	NA-US	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
they have a ramp to get over the small entrance step	OSM-412	NA-US	wheelchair-general	public comment	transition	@	entrance	entrance	entrance	OpenStreetMap
There is a step up into the restraunt	OSM-413	NA-US	wheelchair-general	public comment	transition	@	entrance	@	entrance	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
a chord strung accross parking lot between the 1 handicapped parking spot and only door.	OSM-414	NA-US	wheelchair-general	public comment	outdoor	@	parking	@	@	OpenStreetMap
all entrances to indoors have steps	OSM-415	NA-US	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Bring your own table cause they are all pub tables inside and picnic tables outside!	OSM-416	NA-US	wheelchair-general	public comment	indoor-outdoor	@	seating	@	@	OpenStreetMap
For some crazy reason they got rid of accessible picnic tables which had swing away benches. New ones are fixed so no outdoor seating is accessible!	OSM-417	NA-US	wheelchair-general	public comment	outdoor	@	seating	seating	seating	OpenStreetMap
Several spots available on flat surface, general seating is on gravel	OSM-418	NA-US	wheelchair-general	public comment	outdoor	@	seating	seating	@	OpenStreetMap
The stall in the men's room has grab bars, but the stall door isn't wide enough for a wheelchair.	OSM-419	NA-US	wheelchair-general	public comment	indoor	@	bathroom	bathroom	@	OpenStreetMap
wheelchair accessible bathrooms	OSM-42	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Unlike other McDonald's locations in this county, this location has automatic doors. But, the employees who open in the morning don't always turn the doors on.	OSM-420	NA-US	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
All doors that do not have push buttons are way too heavy.	OSM-421	NA-US	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Bathrooms with working handicap door buttons are downstairs. To get there, take the elevator down and the bathrooms will be just outside the elevator doors.	OSM-422	NA-US	wheelchair-general	public comment	indoor	@	@	bathroom	@	OpenStreetMap
they lock the accessible door	OSM-423	NA-US	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Handicapped parking does not have a ramp to keep you out of traffic getting inside.	OSM-424	NA-US	wheelchair-general	public comment	outdoor	@	parking	parking	@	OpenStreetMap
Low display case makes it easy to see all cookies while seated.	OSM-425	NA-US	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
elevator access to theaters on the second floor is through a locked door.	OSM-426	NA-US	wheelchair-general	public comment	indoor	@	elevator	service	@	OpenStreetMap
They like to use the bathroom hallways as storage for clothing racks.	OSM-427	NA-US	wheelchair-general	public comment	indoor	@	hallway	@	@	OpenStreetMap
But, there is a HUGE step to get in. So easy to put a ramp- shame on you Hare Krishna!	OSM-428	NA-US	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
bathroom is upstairs but there is an elevator.	OSM-429	NA-US	wheelchair-general	public comment	indoor	@	bathroom	bathroom	@	OpenStreetMap
There is an out of the way ramp and the handicap buttons did not work	OSM-43	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	@	OpenStreetMap
large step at front entrance and no other entrance.	OSM-430	NA-US	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
fairgrounds has nice wide walkways and paths both indoors and out.	OSM-431	NA-US	wheelchair-general	public comment	indoor-outdoor	@	@	route	@	OpenStreetMap
Everything is flat including the outdoor patio.	OSM-432	NA-US	wheelchair-general	public comment	indoor-outdoor	@	@	route	@	OpenStreetMap
Restaurant is small with tables close together, so could be difficult to navigate with a larger wheelchair.	OSM-433	NA-US	wheelchair-general	public comment	indoor	@	indoor space	@	@	OpenStreetMap
Street level access to auditorium has ramp.	OSM-434	NA-US	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
unfortunately all seating in wheelchair accessible indoor area is high top tables.	OSM-435	NA-US	wheelchair-general	public comment	indoor	@	seating	@	@	OpenStreetMap
Seating area and accessible restroom reached via rear trash alley/kitchen entrance. No sign or info explaining this at front.	OSM-436	NA-US	wheelchair-general	public comment	transition	@	service	@	@	OpenStreetMap
One step at entrance	OSM-437	NA-US	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Their website says ramp at side wheelchair accessible but it's difficult to get attention of any staff from outside and there is trash/rubble on a very steep ramp.	OSM-438	NA-US	wheelchair-general	public comment	transition	@	ramp	entrance	@	OpenStreetMap
Fully accessible throughout including restroom with wide door, large interior and handrails.	OSM-439	NA-US	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
The exterior ramps	OSM-44	NA-	wheelchair-	public	transition	@	ramp	entrance	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
were small, but the automatic doors are nice,		CAN	general	comment						
Access to upstairs via elevators.	OSM-440	NA-US	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap
entrance to train is extra narrow so wider chairs won't fit	OSM-441	NA-US	wheelchair-general	public comment	transition	@	transit-stop	@	@	OpenStreetMap
button to work elevator to main galleries is placed relatively high	OSM-442	NA-US	wheelchair-general	public comment	indoor	@	elevator	service	@	OpenStreetMap
Door is too narrow, have to get both doors opened.	OSM-443	NA-US	wheelchair-general	public comment	transition	@	entrance	@	entrance	OpenStreetMap
Inside the building, there are many tables and chairs that will not allow for easy access around the store.	OSM-444	NA-US	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
The bathroom does not have grab bars and the sink is too high for a person in wheelchair to use.	OSM-445	NA-US	wheelchair-general	public comment	indoor	@	bathroom	@	@	OpenStreetMap
Main entrance has ramp; building has elevator with wheelchair accessible rooms	OSM-446	NA-US	wheelchair-general	public comment	indoor-outdoor	@	@	building	@	OpenStreetMap
This building is fully accessible. There is a ramp to enter the building and elevators to access the doors. Many classrooms also have automated doors for wheelchair users.	OSM-447	NA-US	wheelchair-general	public comment	indoor-outdoor	@	@	building	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Location has 3 steps greater than 7cm in height; the center is also very cramped and would be difficult for wheelchair users to maneuver	OSM-448	NA-US	wheelchair-general	public comment	indoor	@	indoor space	@	indoor space	OpenStreetMap
the interior shops have lips at the entrances.	OSM-45	NA-CAN	wheelchair-general	public comment	transition	@	interior doorway	@	@	OpenStreetMap
There were handicap buttons for the doors	OSM-46	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
a lift for interior of the building	OSM-47	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
the interior spacs were small	OSM-48	NA-CAN	wheelchair-general	public comment	indoor	@	indoor space	@	@	OpenStreetMap
the upstairs is not wheelchair accessable	OSM-49	NA-CAN	wheelchair-general	public comment	indoor	@	building	@	@	OpenStreetMap
The cinema theatre aisles are smooth ramps.	OSM-5	OA-AU	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Big Wide Doors	OSM-50	NA-CAN	wheelchair-general	public comment	transition	@	@	interior doorway	@	OpenStreetMap
There is a small lip and no handicap button	OSM-51	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
There is a sign on the door that says: "ask the front desk for access to the building," however there is no way to get inside to ask the clerk at the front desk for assistance, if one is alone.	OSM-52	NA-CAN	wheelchair-general	public comment	transition	@	entrance	entrance	entrance	OpenStreetMap
Only Stairs into the building	OSM-53	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Big doors would be helpful	OSM-54	NA-CAN	wheelchair-general	public comment	transition	@	@	interior doorway	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Ramp to get in	OSM-55	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	entrance	OpenStreetMap
tight isles	OSM-56	NA-CAN	wheelchair-general	public comment	indoor	@	indoor space	@	@	OpenStreetMap
Accessible entrance through Dentistry (left of stairs to Forrest bld.) or via College St. entrance (right of stairs to Forrest bld.), ramp & automatic door.	OSM-57	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Very friendly and accommodating staff :)	OSM-58	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Large stairs at entrance.	OSM-59	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Theatres have accessible seating but aisles have series of single steps rather than smooth ramp.	OSM-6	OA-AU	wheelchair-general	public comment	indoor	@	indoor space	service	@	OpenStreetMap
Would need assistance getting up 5 stairs at entrance.	OSM-60	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	entrance	OpenStreetMap
Parking lot across the street.	OSM-61	NA-CAN	wheelchair-general	public comment	outdoor	@	@	service	@	OpenStreetMap
Lots of stairs.	OSM-62	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Parking lot near.	OSM-63	NA-CAN	wheelchair-general	public comment	outdoor	@	@	service	@	OpenStreetMap
Many stairs at the entrance.	OSM-64	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Automatic door opener at entrance	OSM-65	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Spacious inside	OSM-66	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Doors propped open.	OSM-67	NA-CAN	wheelchair-general	public comment	transition	@	@	interior doorway	interior doorway	OpenStreetMap
Lots of floor space.	OSM-68	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Counters for	OSM-69	NA-	wheelchair-	public	indoor	@	service	@	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
customer service extremely high.		CAN	general	comment						
easy access via a ramp.	OSM-7	OA-AU	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Restaurant is located upstairs - only accessible via stairs	OSM-70	NA-CAN	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Manual door at entrance	OSM-71	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Lower level is accessible through side entrance, however, this doesn't grant access to main level.	OSM-72	NA-CAN	wheelchair-general	public comment	indoor	@	building	building	@	OpenStreetMap
Uneven pavement in parking lot nearby.	OSM-73	NA-CAN	wheelchair-general	public comment	outdoor	@	parking	@	@	OpenStreetMap
Manual door at entrance	OSM-74	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Restaurant is located downstairs; Only accessible via stairs	OSM-75	NA-CAN	wheelchair-general	public comment	transition	@	service	@	@	OpenStreetMap
Wheelchair ramp too steep for ADA standards; No railings on ramp - Railings for steps;	OSM-76	NA-CAN	wheelchair-general	public comment	transition	@	ramp	@	@	OpenStreetMap
Automatic door at entrance	OSM-77	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Business is located downstairs - only accessible via stairs	OSM-78	NA-CAN	wheelchair-general	public comment	transition	@	service	@	@	OpenStreetMap
Manual door at entrance	OSM-79	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
The only thing to note is that when it is busy the aisles can be very cramped.	OSM-8	OA-AU	wheelchair-general	public comment	indoor	@	service	@	@	OpenStreetMap
Manual door at entrance	OSM-80	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Chairs and tables can be moved if needed	OSM-81	NA-CAN	wheelchair-general	public comment	indoor	@	indoor space	@	indoor space	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Plenty of floor space. Very high counters at reception.	OSM-82	NA-CAN	wheelchair-general	public comment	indoor	@	service	indoor space	@	OpenStreetMap
Wide enough doorway to enter.	OSM-83	NA-CAN	wheelchair-general	public comment	transition	@	@	interior doorway	@	OpenStreetMap
Lots of floor space. Low consultation desks for easy accessibility in a wheelchair.	OSM-84	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Automatic door opener at entrance	OSM-85	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Inside is spacious with enough room to move wheelchair; Chairs can be moved at tables	OSM-86	NA-CAN	wheelchair-general	public comment	indoor	@	@	seating	indoor space	OpenStreetMap
Restaurant is located upstairs- only accessible via stairs	OSM-87	NA-CAN	wheelchair-general	public comment	transition	@	service	@	@	OpenStreetMap
Manual door at entrance	OSM-88	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
Bathroom doorway inner width: 34Ó (86.36 cm)	OSM-89	NA-CAN	wheelchair-general	public comment	transition	@	interior doorway	@	@	OpenStreetMap
You may have to ask for ramp to be put out	OSM-9	OA-AU	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
The displays were a good height. Lots of floor space to maneuver a wheelchair.	OSM-90	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	indoor space	OpenStreetMap
Small incline to doorway, but no lip. Doors are propped open.	OSM-91	NA-CAN	wheelchair-general	public comment	transition	@	interior doorway	interior doorway	interior doorway	OpenStreetMap
Lots of floor space.	OSM-92	NA-CAN	wheelchair-general	public comment	indoor	@	@	indoor space	@	OpenStreetMap
Tables are well spread out and are regular height as opposed to bar	OSM-93	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
height. There is a ramp between the two sections of the food court.										
Automatic door opener button for main entrance.	OSM-94	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Lots of floor room. Bank machines are a good height for wheelchair users and also have stability handles.	OSM-95	NA-CAN	wheelchair-general	public comment	indoor	@	@	service	@	OpenStreetMap
Mall entrance is also accessible do to the presence of a lift.	OSM-96	NA-CAN	wheelchair-general	public comment	transition	@	@	entrance	@	OpenStreetMap
Very tight space between displays. Fitting room too small for a wheelchair.	OSM-97	NA-CAN	wheelchair-general	public comment	indoor	@	indoor space	@	@	OpenStreetMap
entrance from Dresden Row is not at all accessible due to the amount of stairs.	OSM-98	NA-CAN	wheelchair-general	public comment	transition	@	entrance	@	@	OpenStreetMap
elevator in building as well as ramps and a parking garage.	OSM-99	NA-CAN	wheelchair-general	public comment	indoor	@	@	building	@	OpenStreetMap
[floor and ground surfaces] Advisory 302.1 General. A stable surface is one that remains unchanged by contaminants or applied force, so that when the contaminant or force is removed, the surface returns to its original condition. A firm surface resists	ADA.3-1	NA-US	target groups	standard	indoor-outdoor	@	@	building	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
deformation by either indentations or particles moving on its surface. A slip-resistant surface provides sufficient frictional counterforce to the forces exerted in walking to permit safe ambulation.										
[clear floor and ground space] 305.3 Size. The clear floor or ground space shall be 30 inches (760 mm) minimum by 48 inches (1220 mm) minimum.	ADA.3-10	NA-US	target groups	standard	indoor	@	@	indoor space	@	Standards
[clear floor and ground space] 305.5 Position. Unless otherwise specified, clear floor or ground space shall be positioned for either forward or parallel approach to an element.	ADA.3-11	NA-US	target groups	standard	indoor-outdoor	@	@	public object	@	Standards
[clear floor and ground space] 305.6 Approach. One full unobstructed side of the clear floor or ground space shall adjoin an accessible route or adjoin another clear floor or ground space.	ADA.3-12	NA-US	target groups	standard	indoor-outdoor	@	@	indoor space	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[clear floor and ground space] 305.7.1 Forward Approach. Alcoves shall be 36 inches (915 mm)wide minimum where the depth exceeds 24 inches (610 mm).	ADA.3-13	NA-US	target groups	standard	indoor	@	@	indoor space	@	Standards
[clear floor and ground space] 305.7.2 Parallel Approach. Alcoves shall be 60 inches (1525 mm) wide minimum where the depth exceeds 15 inches (380 mm).	ADA.3-14	NA-US	target groups	standard	indoor	@	@	indoor space	@	Standards
[knee and toe clearance] 306.2 Toe Clearance.: 306.2.1 General. Space under an element between the finish floor or ground and 9 inches (230 mm) above the finish floor or ground shall be considered toe clearance and shall comply with 306.2.; 306.2.2 Maximum Depth. Toe clearance shall extend 25 inches (635 mm) maximum under an element.; 306.2.3 Minimum Required Depth. Where toe clearance is required at an element as part of a clear floor space, the toe clearance shall extend 17	ADA.3-15	NA-US	target groups	standard	indoor-outdoor	@	@	public object	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
inches (430 mm) minimum under the element.; 306.2.4 Additional Clearance. Space extending greater than 6 inches (150 mm) beyond the available knee clearance at 9 inches (230 mm) above the finish floor or ground shall not be considered toe clearance.; 306.2.5 Width. Toe clearance shall be 30 inches (760 mm) wide minimum.										

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[knee and toe clearance] 306.3 Knee Clearance.: 306.3.1 General. Space under an element between 9 inches (230 mm) and 27 inches (685 mm) above the finish floor or ground shall be considered knee clearance and shall comply with 306.3.; 306.3.2 Maximum Depth. Knee clearance shall extend 25 inches (635 mm) maximum under an element at 9 inches (230 mm) above the finish floor or ground. 306.3.3 Minimum Required Depth. Where knee clearance is required under an element as part of a clear floor space, the knee clearance shall be 11 inches (280 mm) deep minimum at 9 inches (230 mm) above the finish floor or ground, and 8 inches (205 mm) deep minimum at 27 inches (685 mm) above the finish floor or ground.; 306.3.4 Clearance Reduction. Between 9 inches (230 mm) and 27 inches (685 mm)	ADA.3-16	NA-US	target groups	standard	indoor-outdoor	@	@	public object	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
above the finish floor or ground, the knee clearance shall be permitted to reduce at a rate of 1 inch (25 mm) in depth for each 6 inches (150 mm) in height.; 306.3.5 Width. Knee clearance shall be 30 inches (760 mm) wide minimum.										
[protruding objects] 307.2 Protrusion Limits. Objects with leading edges more than 27 inches (685 mm) and not more than 80 inches (2030 mm) above the finish floor or ground shall protrude 4 inches (100 mm) maximum horizontally into the circulation path.	ADA.3-18	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[protruding objects] Advisory 307.2 Protrusion Limits. When a cane is used and the element is in the detectable range, it gives a person sufficient time to detect the element with the cane before there is body contact. Elements located on circulation paths, including operable elements, must comply with requirements for protruding objects. For example, awnings and their supporting structures cannot reduce the minimum required vertical clearance. Similarly, casement windows, when open, cannot encroach more than 4 inches (100 mm) into circulation paths above 27 inches (685 mm).	ADA.3-19	NA-US	low vision	standard	indoor-outdoor	@	@	route	public object	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[floor and ground surfaces] 302.2 Carpet. Carpet or carpet tile shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. Carpet or carpet tile shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall be ½ inch (13 mm) maximum. Exposed edges of carpet shall be fastened to floor surfaces and shall have trim on the entire length of the exposed edge. Carpet edge trim shall comply with 303.	ADA.3-2	NA-US	target groups	standard	indoor	@	@	indoor space	@	Standards
[protruding objects] 307.3 Post-Mounted Objects. Free-standing objects mounted on posts or pylons shall overhang circulation paths 12 inches (305 mm) maximum when located 27 inches (685 mm) minimum and 80 inches (2030 mm) maximum above the finish floor or ground. Where a sign or other obstruction is mounted between posts or pylons and	ADA.3-20	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
the clear distance between the posts or pylons is greater than 12 inches (305 mm), the lowest edge of such sign or obstruction shall be 27 inches (685 mm) maximum or 80 inches (2030 mm) minimum above the finish floor or ground.										
[protruding objects] 307.4 Vertical Clearance. Vertical clearance shall be 80 inches (2030 mm) high minimum. Guardrails or other barriers shall be provided where the vertical clearance is less than 80 inches (2030 mm) high. The leading edge of such guardrail or barrier shall be located 27 inches (685 mm) maximum above the finish floor or ground.	ADA.3-21	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards
[protruding objects] 307.5 Required Clear Width. Protruding objects shall not reduce the clear width required for accessible routes.	ADA.3-22	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[reach ranges] 308.2.1 Unobstructed. Where a forward reach is unobstructed, the high forward reach shall be 48 inches (1220 mm) maximum and the low forward reach shall be 15 inches (380 mm) minimum above the finish floor or ground.	ADA.3-23	NA-US	target groups	standard	indoor-outdoor	@	@	public object	@	Standards
[reach ranges] 308.2.2 Obstructed High Reach. Where a high forward reach is over an obstruction, the clear floor space shall extend beneath the element for a distance not less than the required reach depth over the obstruction. The high forward reach shall be 48 inches (1220 mm) maximum where the reach depth is 20 inches (510 mm) maximum. Where the reach depth exceeds 20 inches (510 mm), the high forward reach shall be 44 inches (1120 mm) maximum and the reach depth shall be 25 inches (635 mm) maximum.	ADA.3-24	NA-US	target groups	standard	indoor-outdoor	@	@	public object	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[reach ranges-side] 308.3.1 Unobstructed. Where a clear floor or ground space allows a parallel approach to an element and the side reach is unobstructed, the high side reach shall be 48 inches (1220 mm) maximum and the low side reach shall be 15 inches (380 mm) minimum above the finish floor or ground.	ADA.3-25	NA-US	wheelchair-general	standard	indoor-outdoor	@	@	public object	@	Standards
[reach ranges] 308.3.2 Obstructed High Reach. Where a clear floor or ground space allows a parallel approach to an element and the high side reach is over an obstruction, the height of the obstruction shall be 34 inches (865 mm) maximum and the depth of the obstruction shall be 24 inches (610 mm) maximum. The high side reach shall be 48 inches (1220 mm) maximum for a reach depth of 10 inches (255 mm) maximum. Where the reach depth exceeds 10 inches (255 mm), the high side reach shall	ADA.3-26	NA-US	wheelchair-general	standard	indoor-outdoor	@	@	public object	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
be 46 inches (1170 mm) maximum for a reach depth of 24 inches (610 mm) maximum.										
[operable parts] 309.4 Operation. Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be 5 pounds (22.2 N) maximum.	ADA.3-27	NA-US	target groups	standard	indoor-outdoor	@	public object	public object	@	Standards
[floor and ground surfaces] Advisory 302.2 Carpet. Carpets and permanently affixed mats can significantly increase the amount of force (roll resistance) needed to propel a wheelchair over a surface. The firmer the carpeting and backing, the lower the roll resistance. A	ADA.3-3	NA-US	wheelchair-general	standard	indoor	@	indoor space	indoor space	indoor space	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
pile thickness up to ½ inch (13 mm) (measured to the backing, cushion, or pad) is allowed, although a lower pile provides easier wheelchair maneuvering. If a backing, cushion or pad is used, it must be firm. Preferably, carpet pad should not be used because the soft padding increases roll resistance.										
[floor and ground surfaces] 302.3 Openings. Openings in floor or ground surfaces shall not allow passage of a sphere more than ½ inch (13 mm) diameter except as allowed in 407.4.3, 409.4.3, 410.4, 810.5.3 and 810.10. Elongated openings shall be placed so that the long dimension is perpendicular to the dominant direction of travel.	ADA.3-4	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards
[changes in level] 303.2 Vertical. Changes in level of ¼ inch (6.4 mm) high maximum shall be permitted to be vertical.	ADA.3-5	NA-US	target groups	standard	transition	@	entrance	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[changes in level] 303.3 Beveled. Changes in level between ¼ inch (6.4 mm) high minimum and ½ inch (13 mm) high maximum shall be beveled with a slope not steeper than 1:2.	ADA.3-6	NA-US	target groups	standard	transition	@	@	entrance	@	Standards
[changes in level] 303.4 Ramps. Changes in level greater than ½ inch (13 mm) high shall be ramped, and shall comply with 405 or 406.	ADA.3-7	NA-US	target groups	standard	transition	@	@	entrance	@	Standards
[turning space] 304.3.1 Circular Space. The turning space shall be a space of 60 inches (1525 mm) diameter minimum. The space shall be permitted to include knee and toe clearance complying with 306.; 304.3.2 T-Shaped Space. The turning space shall be a T-shaped space within a 60 inch (1525 mm) square minimum with arms and base 36 inches (915 mm) wide minimum. Each arm of the T shall be clear of obstructions 12 inches (305 mm) minimum in each direction and the base	ADA.3-8	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
shall be clear of obstructions 24 inches (610 mm) minimum. The space shall be permitted to include knee and toe clearance complying with 306 only at the end of either the base or one arm.										
[turning space] 304.4 Door Swing. Doors shall be permitted to swing into turning spaces.	ADA.3-9	NA-US	target groups	standard	transition	@	@	entrance	@	Standards
[accessible routes] 402.2 Components. Accessible routes shall consist of one or more of the following components: walking surfaces with a running slope not steeper than 1:20, doorways, ramps, curb ramps excluding the flared sides, elevators, and platform lifts. All components of an accessible route shall comply with the applicable requirements of Chapter 4.	ADA.4-1	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[doors, doorways, and gates] 404.2.7 Door and Gate Hardware. Handles, pulls, latches, locks, and other operable parts on doors and gates shall comply with 309.4. Operable parts of such hardware shall be 34 inches (865 mm) minimum and 48 inches (1220 mm) maximum above the finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides.	ADA.4-10	NA-US	target groups	standard	transition	@	@	entrance	@	Standards
[doors, doorways, and gates] Advisory 404.2.7 Door and Gate Hardware. Door hardware that can be operated with a closed fist or a loose grip accommodates the greatest range of users. Hardware that requires simultaneous hand and finger movements require greater dexterity and coordination, and is not recommended.	ADA.4-11	NA-US	target groups	standard	transition	@	entrance	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[doors, doorways, and gates] 404.2.8.1 Door Closers and Gate Closers. Door closers and gate closers shall be adjusted so that from an open position of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum. 404.2.8.2 Spring Hinges. Door and gate spring hinges shall be adjusted so that from the open position of 70 degrees, the door or gate shall move to the closed position in 1.5 seconds minimum.	ADA.4-12	NA-US	target groups	standard	transition	@	@	entrance	@	Standards
[doors, doorways, and gates] 404.2.9 Door and Gate Opening Force. Fire doors shall have a minimum opening force allowable by the appropriate administrative authority. The force for pushing or pulling open a door or gate other than fire doors shall be as follows: 1. Interior hinged doors and gates: 5 pounds (22.2 N) maximum. 2. Sliding or folding doors: 5 pounds (22.2	ADA.4-13	NA-US	target groups	standard	transition	@	@	entrance	entrance	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
N) maximum. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door or gate in a closed position.										
[doors, doorways, and gates] 404.2.10 Door and Gate Surfaces. Swinging door and gate surfaces within 10 inches (255 mm) of the finish floor or ground measured vertically shall have a smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16 inch (1.6 mm) of the same plane as the other. Cavities created by added kick plates shall be capped.	ADA.4-14	NA-US	target groups	standard	transition	@	@	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[doors, doorways, and gates] 404.2.11 Vision Lights. Doors, gates, and side lights adjacent to doors or gates, containing one or more glazing panels that permit viewing through the panels shall have the bottom of at least one glazed panel located 43 inches (1090 mm) maximum above the finish floor.	ADA.4-15	NA-US	target groups	standard	transition	@	@	entrance	@	Standards
[doors, doorways, and gates] 404.3.1 Clear Width. Doorways shall provide a clear opening of 32 inches (815 mm) minimum in power-on and power-off mode. The minimum clear width for automatic door systems in a doorway shall be based on the clear opening provided by all leaves in the open position.	ADA.4-16	NA-US	target groups	standard	transition	@	@	entrance	@	Standards
[doors, doorways, and gates] 404.3.5 Controls. Manually operated controls shall comply with 309. The clear floor space adjacent to the control shall be located beyond the arc of the door swing.	ADA.4-17	NA-US	target groups	standard	transition	@	@	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[doors, doorways, and gates] 404.3.6 Break Out Opening. Where doors and gates without standby power are a part of a means of egress, the clear break out opening at swinging or sliding doors and gates shall be 32 inches (815 mm) minimum when operated in emergency mode.	ADA.4-18	NA-US	target groups	standard	transition	@	@	entrance	@	Standards
[ramps] 405.2 Slope. Ramp runs shall have a running slope not steeper than 1:12.	ADA.4-19	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards
[walking surfaces] 403.3 Slope. The running slope of walking surfaces shall not be steeper than 1:20. The cross slope of walking surfaces shall not be steeper than 1:48.	ADA.4-2	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards
[ramps] 405.3 Cross Slope. Cross slope of ramp runs shall not be steeper than 1:48.	ADA.4-20	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards
[ramps] 405.5 Clear Width. The clear width of a ramp run and, where handrails are provided, the clear width between handrails shall be 36 inches (915 mm) minimum.	ADA.4-21	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[ramps] 405.6 Rise. The rise for any ramp run shall be 30 inches (760 mm) maximum.; 405.7 Landings. Ramps shall have landings at the top and the bottom of each ramp run. Landings shall comply with 405.7.	ADA.4-22	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards
[ramps] 405.7.2 Width. The landing clear width shall be at least as wide as the widest ramp run leading to the landing.; 405.7.3 Length. The landing clear length shall be 60 inches (1525 mm) long minimum.; 405.7.4 Change in Direction. Ramps that change direction between runs at landings shall have a clear landing 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum. 405.7.5 Doorways. Where doorways are located adjacent to a ramp landing, maneuvering clearances required by 404.2.4 and 404.3.2 shall be permitted to overlap the required landing area.	ADA.4-23	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[ramps] 405.8 Handrails. Ramp runs with a rise greater than 6 inches (150 mm) shall have handrails complying with 505.	ADA.4-24	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards
[ramps] 405.9.1 Extended Floor or Ground Surface. The floor or ground surface of the ramp run or landing shall extend 12 inches (305 mm) minimum beyond the inside face of a handrail complying with 505.	ADA.4-25	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards
[ramps] 405.9.2 Curb or Barrier. A curb or barrier shall be provided that prevents the passage of a 4 inch (100 mm) diameter sphere, where any portion of the sphere is within 4 inches (100 mm) of the finish floor or ground surface.	ADA.4-26	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards
[ramps] 405.10 Wet Conditions. Landings subject to wet conditions shall be designed to prevent the accumulation of water.	ADA.4-27	NA-US	target groups	standard	indoor-outdoor	@	ramp	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[curb ramps] 406.2 Counter Slope. Counter slopes of adjoining gutters and road surfaces immediately adjacent to the curb ramp shall not be steeper than 1:20. The adjacent surfaces at transitions at curb ramps to walks, gutters, and streets shall be at the same level.	ADA.4-28	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards
[curb ramps] 406.3 Sides of Curb Ramps. Where provided, curb ramp flares shall not be steeper than 1:10.	ADA.4-29	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards
[walking surfaces] 403.5.1 Clear Width. Except as provided in 403.5.2 and 403.5.3, the clear width of walking surfaces shall be 36 inches (915 mm) minimum.	ADA.4-3	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards
[curb ramps] 406.4 Landings. Landings shall be provided at the tops of curb ramps. The landing clear length shall be 36 inches (915 mm) minimum. The landing clear width shall be at least as wide as the curb ramp, excluding flared sides, leading to the landing.	ADA.4-30	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[curb ramps] 406.5 Location. Curb ramps and the flared sides of curb ramps shall be located so that they do not project into vehicular traffic lanes, parking spaces, or parking access aisles. Curb ramps at marked pedestrian crossings shall be wholly contained within the markings, excluding any flared sides.	ADA.4-31	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards
[curb ramps] 406.6 Diagonal Curb Ramps. Diagonal or corner type curb ramps with returned curbs or other well-defined edges shall have the edges parallel to the direction of pedestrian flow. The bottom of diagonal curb ramps shall have a clear space 48 inches (1220 mm) minimum outside active traffic lanes of the roadway. Diagonal curb ramps provided at marked pedestrian crossings shall provide the 48 inches (1220 mm) minimum clear space within the markings. Diagonal curb ramps with flared sides shall	ADA.4-32	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
have a segment of curb 24 inches (610 mm) long minimum located on each side of the curb ramp and within the marked pedestrian crossing.										
[curb ramps] 406.7 Islands. Raised islands in pedestrian crossings shall be cut through level with the street or have curb ramps at both sides. Each curb ramp shall have a level area 48 inches (1220 mm) long minimum by 36 inches (915 mm) wide minimum at the top of the curb ramp in the part of the island intersected by the pedestrian crossings. Each 48 inch (1220 mm) minimum by 36 inch (915 mm) minimum area shall be oriented so that the 48 inch (1220 mm) minimum length is in the direction of the	ADA.4-33	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
running slope of the curb ramp it serves. The 48 inch (1220 mm) minimum by 36 inch (915 mm) minimum areas and the accessible route shall be permitted to overlap.										
[elevators] 407.2.1 Call Controls. Where elevator call buttons or keypads are provided, they shall comply with 407.2.1 and 309.4. Call buttons shall be raised or flush.	ADA.4-34	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.2.1.2 Size. Call buttons shall be ¾ inch (19 mm) minimum in the smallest dimension.	ADA.4-35	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] Advisory 407.2.1.3 Clear Floor or Ground Space. The clear floor or ground space required at elevator call buttons must remain free of obstructions including ashtrays, plants, and other decorative elements that prevent	ADA.4-36	NA-US	wheelchair-general	standard	indoor	@	elevator	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
wheelchair users and others from reaching the call buttons.										
[elevators, Advisory 407.2.1.3 Clear Floor or Ground Space.] Recessed ashtrays should not be placed near elevator call buttons so that persons who are blind or visually impaired do not inadvertently contact them or their contents as they reach for the call buttons.	ADA.4-37	NA-US	low vision	standard	indoor	@	elevator	elevator	@	Standards
[elevators] 407.2.1.4 Location. The call button that designates the up direction shall be located above the call button that designates the down direction.	ADA.4-38	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.2.1.5 Signals. Call buttons shall have visible signals to indicate when each call is registered and when each call is answered.	ADA.4-39	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[walking surfaces] 403.5.2 Clear Width at Turn. Where the accessible route makes a 180 degree turn around an element which is less than 48 inches (1220 mm) wide, clear width shall be 42 inches (1065 mm) minimum approaching the turn, 48 inches (1220 mm) minimum at the turn and 42 inches (1065 mm) minimum leaving the turn.	ADA.4-4	NA-US	wheelchair-general	standard	indoor-outdoor	@	@	route	@	Standards
[elevators] 407.2.1.6 Keypads. Where keypads are provided, keypads shall be in a standard telephone keypad arrangement and shall comply with 407.4.7.2.	ADA.4-40	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.2.2.1 Visible and Audible Signals. A visible and audible signal shall be provided at each hoistway entrance to indicate which car is answering a call and the car’s direction of travel. Where in-car signals are provided, they shall be visible from the floor area adjacent to the hall call buttons.	ADA.4-41	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[elevators] 407.2.2.2 Visible Signals. Visible signal fixtures shall be centered at 72 inches (1830 mm) minimum above the finish floor or ground. The visible signal elements shall be 2-½ inches (64 mm) minimum measured along the vertical centerline of the element. Signals shall be visible from the floor area adjacent to the hall call button.	ADA.4-42	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.2.2.3 Audible Signals. Audible signals shall sound once for the up direction and twice for the down direction, or shall have verbal annunciators that indicate the direction of elevator car travel.	ADA.4-43	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.2.2.4 Differentiation. Each destination-oriented elevator in a bank of elevators shall have audible and visible means for differentiation.	ADA.4-44	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[elevators] 407.2.3.1 Floor Designation. Floor designations complying with 703.2 and 703.4.1 shall be provided on both jambs of elevator hoistway entrances. Floor designations shall be provided in both tactile characters and braille. Tactile characters shall be 2 inches (51 mm) high minimum. A tactile star shall be provided on both jambs at the main entry level.	ADA.4-45	NA-US	low vision	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.2.3.2 Car Designations. Destination-oriented elevators shall provide tactile car identification complying with 703.2 on both jambs of the hoistway immediately below the floor designation. Car designations shall be provided in both tactile characters and braille. Tactile characters shall be 2 inches (51 mm) high minimum.	ADA.4-46	NA-US	low vision	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.3.1 Type. elevator doors shall be the horizontal sliding type. Car gates shall be prohibited.	ADA.4-47	NA-US	target groups	standard	indoor	@	elevator	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[elevators] 407.3.2 Operation. elevator hoistway and car doors shall open and close automatically.	ADA.4-48	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.3.3 Reopening Device. elevator doors shall be provided with a reopening device	ADA.4-49	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[walking surfaces] 403.5.3 Passing Spaces. An accessible route with a clear width less than 60 inches (1525 mm) shall provide passing spaces at intervals of 200 feet (61 m) maximum. Passing spaces shall be either: a space 60 inches (1525 mm) minimum by 60 inches (1525 mm) minimum; or, an intersection of two walking surfaces providing a T-shaped space complying with 304.3.2 where the base and arms of the T-shaped space extend 48 inches (1220 mm) minimum beyond the intersection.	ADA.4-5	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards
[elevators] 407.3.5 Door Delay. elevator doors shall remain fully open in response to a car call for 3 seconds minimum.	ADA.4-50	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[elevators] 407.4.1 Car Dimensions. Inside dimensions of elevator cars and clear width of elevator doors shall comply with Table 407.4.1.	ADA.4-51	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.4.3 Platform to Hoistway Clearance. The clearance between the car platform sill and the edge of any hoistway landing shall be 1¼ inch (32 mm) maximum.	ADA.4-52	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.4.4 Leveling. Each car shall be equipped with a self-leveling feature that will automatically bring and maintain the car at floor landings within a tolerance of ½ inch (13 mm) under rated loading to zero loading conditions.	ADA.4-53	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.4.5 Illumination. The level of illumination at the car controls, platform, car threshold and car landing sill shall be 5 foot candles (54 lux) minimum.	ADA.4-54	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.4.6.2.1 Size. Buttons shall be 3/4 inch (19 mm)	ADA.4-55	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
minimum in their smallest dimension.										
[elevators] 407.4.6.2.2 Arrangement. Buttons shall be arranged with numbers in ascending order. When two or more columns of buttons are provided they shall read from left to right.	ADA.4-56	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.4.6.4.1 Height. Emergency control buttons shall have their centerlines 35 inches (890 mm) minimum above the finish floor.	ADA.4-57	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.4.6.4.2 Location. Emergency controls, including the emergency alarm, shall be grouped at the bottom of the panel.	ADA.4-58	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.4.7.1.2 Location. Raised character and braille designations shall be placed immediately to the left of the control button to which the designations apply.	ADA.4-59	NA-US	low vision	standard	indoor	@	@	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[doors, doorways, and gates] 404.2.1 Revolving Doors, Gates, and Turnstiles. Revolving doors, revolving gates, and turnstiles shall not be part of an accessible route.	ADA.4-6	NA-US	target groups	standard	transition	@	entrance	@	@	Standards
[elevators] 407.4.7.1.3 Symbols. The control button for the emergency stop, alarm, door open, door close, main entry floor, and phone, shall be identified with tactile symbols as shown in Table 407.4.7.1.3.	ADA.4-60	NA-US	low vision	standard	indoor	@	@	elevator	@	Standards
[elevators] 407.4.7.2 Keypads. Keypads shall be identified by characters complying with 703.5 and shall be centered on the corresponding keypad button. The number five key shall have a single raised dot.	ADA.4-61	NA-US	low vision	standard	indoor	@	@	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[elevators] 407.4.8.1.1 Size. Characters shall be ½ inch (13 mm) high minimum.; 407.4.8.1.2 Location. Indicators shall be located above the car control panel or above the door.; 407.4.8.1.3 Floor Arrival. As the car passes a floor and when a car stops at a floor served by the elevator, the corresponding character shall illuminate. EXCEPTION: Destination-oriented elevators shall not be required to comply with 407.4.8.1.3 provided that the visible indicators extinguish when the call has been answered.; 407.4.8.1.4 Destination Indicator. In destination-oriented elevators, a display shall be provided in the car with visible indicators to show car destinations.	ADA.4-62	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[elevators] 407.4.8.2.1 Signal Type. The signal shall be an automatic verbal annunciator which announces the floor at which the car is about to stop. EXCEPTION: For elevators other than destination-oriented elevators that have a rated speed of 200 feet per minute (1 m/s) or less, a non-verbal audible signal with a frequency of 1500 Hz maximum which sounds as the car passes or is about to stop at a floor served by the elevator shall be permitted.; 407.4.8.2.2 Signal Level. The verbal annunciator shall be 10 dB minimum above ambient, but shall not exceed 80 dB, measured at the annunciator.; 407.4.8.2.3 Frequency. The verbal annunciator shall have a frequency of 300 Hz minimum to 3000 Hz maximum.	ADA.4-63	NA-US	target groups	standard	indoor	@	@	elevator	@	Standards
[platform lifts] 410.4 Platform to Runway Clearance. The clearance between the platform sill and the	ADA.4-64	NA-US	target groups	standard	indoor-outdoor	@	@	elevator	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
edge of any runway landing shall be 1¼ inch (32 mm) maximum.										
[platform lifts] 410.6 Doors and Gates. Platform lifts shall have low-energy power-operated doors or gates complying with 404.3. Doors shall remain open for 20 seconds minimum. End doors and gates shall provide a clear width 32 inches (815 mm) minimum. Side doors and gates shall provide a clear width 42 inches (1065 mm) minimum.	ADA.4-65	NA-US	target groups	standard	indoor-outdoor	@	@	elevator	@	Standards
[doors, doorways, and gates] 404.2.3 Clear Width. Door openings shall provide a clear width of 32 inches (815 mm) minimum. Clear openings of doorways with swinging doors shall be measured between the face of the door and the stop, with the door open 90 degrees. Openings more than 24 inches (610 mm) deep shall provide a clear opening of 36 inches (915 mm) minimum. There shall be no projections into the	ADA.4-7	NA-US	target groups	standard	transition	@	@	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
required clear opening width lower than 34 inches (865 mm) above the finish floor or ground. Projections into the clear opening width between 34 inches (865 mm) and 80 inches (2030 mm) above the finish floor or ground shall not exceed 4 inches (100 mm).										
[doors, doorways, and gates] 404.2.5 Thresholds. Thresholds, if provided at doorways, shall be ½ inch (13 mm) high maximum. Raised thresholds and changes in level at doorways shall comply with 302 and 303.	ADA.4-8	NA-US	target groups	standard	transition	@	@	entrance	@	Standards
[doors, doorways, and gates] 404.2.6 Doors in Series and Gates in Series. The distance between two hinged or pivoted doors in series and gates in series shall be 48 inches (1220 mm) minimum plus the width of doors or gates swinging into the space.	ADA.4-9	NA-US	target groups	standard	transition	@	@	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[parking spaces] 502.2 Vehicle Spaces. Car parking spaces shall be 96 inches (2440 mm) wide minimum and van parking spaces shall be 132 inches (3350 mm) wide minimum, shall be marked to define the width, and shall have an adjacent access aisle complying with 502.3.	ADA.5-1	NA-US	target groups	standard	indoor-outdoor	@	@	parking	@	Standards
[passenger loading zones] 503.4 Floor and Ground Surfaces. Vehicle pull-up spaces and access aisles serving them shall comply with 302. Access aisles shall be at the same level as the vehicle pull-up space they serve.	ADA.5-10	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards
[passenger loading zones] 503.5 Vertical Clearance. Vehicle pull-up spaces, access aisles serving them, and a vehicular route from an entrance to the passenger loading zone, and from the passenger loading zone to a vehicular exit shall provide a vertical clearance of 114 inches (2895 mm) minimum.	ADA.5-11	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[stairways] 504.2 Treads and Risers. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Risers shall be 4 inches (100 mm) high minimum and 7 inches (180 mm) high maximum. Treads shall be 11 inches (280 mm) deep minimum.	ADA.5-12	NA-US	target groups	standard	indoor-outdoor	@	@	stairway	@	Standards
[stairways] 504.3 Open Risers. Open risers are not permitted.	ADA.5-13	NA-US	target groups	standard	indoor-outdoor	@	stairway	@	@	Standards
[stairways] Advisory 504.4 Tread Surface. Consider providing visual contrast on tread nosings, or at the leading edges of treads without nosings, so that stair treads are more visible for people with low vision.	ADA.5-14	NA-US	low vision	standard	indoor-outdoor	@	@	stairway	@	Standards
[stairways] 504.5 Nosings. The radius of curvature at the leading edge of the tread shall be ½ inch (13 mm) maximum. Nosings that project beyond risers shall have the underside of the leading edge curved or beveled. Risers shall be permitted to slope under the tread at an	ADA.5-15	NA-US	target groups	standard	indoor-outdoor	@	@	stairway	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
angle of 30 degrees maximum from vertical. The permitted projection of the nosing shall extend 1½ inches (38 mm) maximum over the tread below.										
[stairways] 504.7 Wet Conditions. Stair treads and landings subject to wet conditions shall be designed to prevent the accumulation of water.	ADA.5-16	NA-US	target groups	standard	indoor-outdoor	@	stairway	@	@	Standards
[handrails] 505.2 Where Required. Handrails shall be provided on both sides of stairs and ramps.	ADA.5-17	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards
[handrails] 505.3 Continuity. Handrails shall be continuous within the full length of each stair flight or ramp run. Inside handrails on switchback or dogleg stairs and ramps shall be continuous between flights or runs.	ADA.5-18	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[handrails] 505.4 Height. Top of gripping surfaces of handrails shall be 34 inches (865 mm) minimum and 38 inches (965 mm) maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above walking surfaces, stair nosings, and ramp surfaces.	ADA.5-19	NA-US	target groups	standard	indoor-outdoor	@	@	handrail	@	Standards
[parking spaces] 502.3 Access Aisle. Access aisles serving parking spaces shall comply with 502.3. Access aisles shall adjoin an accessible route. Two parking spaces shall be permitted to share a common access aisle.	ADA.5-2	NA-US	target groups	standard	indoor-outdoor	@	@	parking	@	Standards
[handrails] 505.5 Clearance. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1½ inches (38 mm) minimum.	ADA.5-20	NA-US	target groups	standard	indoor-outdoor	@	@	handrail	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[handrails] 505.6 Gripping Surface. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20 percent of their length. Where provided, horizontal projections shall occur 1½ inches (38 mm) minimum below the bottom of the handrail gripping surface.	ADA.5-21	NA-US	target groups	standard	indoor-outdoor	@	@	handrail	@	Standards
[handrails] 505.7.1 Circular Cross Section. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1¼ inches (32 mm) minimum and 2 inches (51 mm) maximum.	ADA.5-22	NA-US	target groups	standard	indoor-outdoor	@	@	handrail	@	Standards
[handrails] 505.7.2 Non-Circular Cross Sections. Handrail gripping surfaces with a non-circular cross section shall have a perimeter dimension of 4 inches (100 mm) minimum and 6¼ inches (160 mm) maximum, and a	ADA.5-23	NA-US	target groups	standard	indoor-outdoor	@	@	handrail	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
cross-section dimension of 2¼ inches (57 mm) maximum.										
[handrails] 505.8 Surfaces. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.; 505.9 Fittings. Handrails shall not rotate within their fittings.	ADA.5-24	NA-US	target groups	standard	indoor-outdoor	@	@	handrail	@	Standards
[handrails] 505.10.1 Top and Bottom Extension at Ramps. Ramp handrails shall extend horizontally above the landing for 12 inches (305 mm) minimum beyond the top and bottom of ramp runs. Extensions shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent ramp run.	ADA.5-25	NA-US	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[handrails] 505.10.2 Top Extension at Stairs. At the top of a stair flight, handrails shall extend horizontally above the landing for 12 inches (305 mm) minimum beginning directly above the first riser nosing. Extensions shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent stair flight.	ADA.5-26	NA-US	target groups	standard	indoor-outdoor	@	@	stairway	@	Standards
[handrails] 505.10.3 Bottom Extension at Stairs. At the bottom of a stair flight, handrails shall extend at the slope of the stair flight for a horizontal distance at least equal to one tread depth beyond the last riser nosing. Extension shall return to a wall, guard, or the landing surface, or shall be continuous to the handrail of an adjacent stair flight.	ADA.5-27	NA-US	target groups	standard	indoor-outdoor	@	@	stairway	@	Standards
[parking spaces] 502.3.1 Width. Access aisles serving car and van parking spaces shall be 60 inches (1525 mm) wide minimum.; 502.3.2 Length.	ADA.5-3	NA-US	target groups	standard	indoor-outdoor	@	@	parking	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Access aisles shall extend the full length of the parking spaces they serve. 502.3.3 Marking. Access aisles shall be marked so as to discourage parking in them.										
[parking spaces] 502.3.4 Location. Access aisles shall not overlap the vehicular way. Access aisles shall be permitted to be placed on either side of the parking space except for angled van parking spaces which shall have access aisles located on the passenger side of the parking spaces.; Advisory 502.3.4 Location. Wheelchair lifts typically are installed on the passenger side of vans. Many drivers, especially those who operate vans, find it more difficult to back into parking spaces than to back out into comparatively unrestricted vehicular lanes. For this reason, where a van and car share an access aisle, consider locating the van space so that the access aisle is on the passenger side of the	ADA.5-4	NA-US	wheelchair-general	standard	indoor-outdoor	@	@	parking	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
van space.										
[parking spaces] 502.5 Vertical Clearance. Parking spaces for vans and access aisles and vehicular routes serving them shall provide a vertical clearance of 98 inches (2490 mm) minimum.	ADA.5-5	NA-US	target groups	standard	indoor-outdoor	@	@	parking	@	Standards
[parking spaces] 502.6 Identification. Parking space identification signs shall include the International Symbol of Accessibility complying with 703.7.2.1. Signs identifying van parking spaces shall contain the designation "van accessible." Signs shall be 60 inches	ADA.5-6	NA-US	target groups	standard	indoor-outdoor	@	@	parking	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
(1525 mm) minimum above the finish floor or ground surface measured to the bottom of the sign.										
[parking spaces] 502.7 Relationship to Accessible Routes. Parking spaces and access aisles shall be designed so that cars and vans, when parked, cannot obstruct the required clear width of adjacent accessible routes.	ADA.5-7	NA-US	target groups	standard	indoor-outdoor	@	@	route	@	Standards
[passenger loading zones] 503.2 Vehicle Pull-Up Space. Passenger loading zones shall provide a vehicular pull-up space 96 inches (2440 mm) wide minimum and 20 feet (6100 mm) long minimum.	ADA.5-8	NA-US	target groups	standard	outdoor	@	@	entrance	@	Standards
[passenger loading zones] 503.3.1 Width. Access aisles serving vehicle pull-up spaces shall be 60 inches (1525 mm) wide minimum.; 503.3.2 Length. Access aisles shall extend the full length	ADA.5-9	NA-US	target groups	standard	outdoor	@	@	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
of the vehicle pull-up spaces they serve. 503.3.3 Marking. Access aisles shall be marked so as to discourage parking in them.										
[toilet and bathing rooms] 603.2.3 Door Swing. Doors shall not swing into the clear floor space or clearance required for any fixture.	ADA.6-1	NA-US	target groups	standard	transition	@	@	bathroom	@	Standards
[water closets and toilet compartments] 604.7 Dispensers. Toilet paper dispensers shall comply with 309.4 and shall be 7 inches (180 mm) minimum and 9 inches (230 mm) maximum in front of the water closet measured to the centerline of the dispenser. The outlet of the dispenser shall be 15 inches (380 mm) minimum and 48 inches (1220 mm) maximum above the finish floor and shall not be located behind grab bars.	ADA.6-10	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[water closets and toilet compartments] 604.8.1.1 Size. Wheelchair accessible compartments shall be 60 inches (1525 mm) wide minimum measured perpendicular to the side wall, and 56 inches (1420 mm) deep minimum for wall hung water closets and 59 inches (1500 mm) deep minimum for floor mounted water closets measured perpendicular to the rear wall.	ADA.6-11	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards
[water closets and toilet compartments] Advisory 604.8.1.1 Size. The minimum space required in toilet compartments is provided so that a person using a wheelchair can maneuver into position at the water closet.	ADA.6-12	NA-US	wheelchair-general	standard	indoor	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[water closets and toilet compartments] 604.8.1.2 Doors. Toilet compartment doors, including door hardware, shall comply with 404 except that if the approach is to the latch side of the compartment door, clearance between the door side of the compartment and any obstruction shall be 42 inches (1065 mm) minimum. Doors shall be located in the front partition or in the side wall or partition farthest from the water closet. Where located in the front partition, the door opening shall be 4 inches (100 mm) maximum from the side wall or partition farthest from the water closet. Where located in the side wall or partition, the door opening shall be 4 inches (100 mm) maximum from the front partition. The door shall be self-closing. A door pull complying with 404.2.7 shall be placed on both sides of the door near the latch. Toilet	ADA.6-13	NA-US	target groups	standard	transition	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
compartment doors shall not swing into the minimum required compartment area.										
[water closets and toilet compartments] 604.8.1.4 Toe Clearance. The front partition and at least one side partition shall provide a toe clearance of 9 inches (230 mm) minimum above the finish floor and 6 inches (150 mm) deep minimum beyond the compartment-side face of the partition, exclusive of partition support members.	ADA.6-14	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[urinals] 605.2 Height and Depth. Urinals shall be the stall-type or the wall-hung type with the rim 17 inches (430 mm) maximum above the finish floor or ground. Urinals shall be 13½ inches (345 mm) deep minimum measured from the outer face of the urinal rim to the back of the fixture.	ADA.6-15	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards
[lavatories and sinks] 606.3 Height. Lavatories and sinks shall be installed with the front of the higher of the rim or counter surface 34 inches (865 mm) maximum above the finish floor or ground.	ADA.6-16	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards
[lavatories and sinks] 606.4 Faucets. Controls for faucets shall comply with 309. Hand-operated metering faucets shall remain open for 10 seconds minimum.	ADA.6-17	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards
[lavatories and sinks] 606.5 Exposed Pipes and Surfaces. Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or	ADA.6-18	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
abrasive surfaces under lavatories and sinks.										
[toilet and bathing rooms] 603.3 Mirrors. Mirrors located above lavatories or countertops shall be installed with the bottom edge of the reflecting surface 40 inches (1015 mm) maximum above the finish floor or ground. Mirrors not located above lavatories or countertops shall be installed with the bottom edge of the reflecting surface 35 inches (890 mm) maximum above the finish floor or ground.	ADA.6-2	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards
[toilet and bathing rooms] 603.4 Coat Hooks and Shelves. Coat hooks shall be located within one of the reach ranges specified in 308. Shelves shall be located 40 inches (1015 mm) minimum and 48 inches (1220 mm) maximum above	ADA.6-3	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
the finish floor.										
[water closets and toilet compartments] 604.2 Location. The water closet shall be positioned with a wall or partition to the rear and to one side. The centerline of the water closet shall be 16 inches (405 mm) minimum to 18 inches (455 mm) maximum from the side wall or partition, except that the water closet shall be 17 inches (430 mm) minimum and 19 inches (485 mm) maximum from the side wall or partition in the ambulatory accessible toilet compartment specified in 604.8.2. Water closets shall be arranged for a left-hand or right-hand approach.	ADA.6-4	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards
[water closets and toilet compartments] 604.3.1 Size. Clearance around a water closet shall be 60 inches (1525 mm) minimum measured perpendicular from	ADA.6-5	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
the side wall and 56 inches (1420 mm) minimum measured perpendicular from the rear wall.										
[water closets and toilet compartments] 604.4 Seats. The seat height of a water closet above the finish floor shall be 17 inches (430 mm) minimum and 19 inches (485 mm) maximum measured to the top of the seat. Seats shall not be sprung to return to a lifted position.	ADA.6-6	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards
[water closets and toilet compartments] 604.5 Grab Bars. Grab bars for water closets shall comply with 609. Grab bars shall be provided on the side wall closest to the water closet and on the rear wall.	ADA.6-7	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards
[water closets and toilet compartments] 604.5.1 Side Wall. The side wall grab bar shall be 42 inches (1065 mm) long minimum, located 12 inches (305 mm) maximum from the rear wall and extending 54 inches (1370 mm) minimum from the rear wall.	ADA.6-8	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[water closets and toilet compartments] 604.5.2 Rear Wall. The rear wall grab bar shall be 36 inches (915 mm) long minimum and extend from the centerline of the water closet 12 inches (305 mm) minimum on one side and 24 inches (610 mm) minimum on the other side.	ADA.6-9	NA-US	target groups	standard	indoor	@	@	bathroom	@	Standards
[signs] 703.1 General. Signs shall comply with 703. Where both visual and tactile characters are required, either one sign with both visual and tactile characters, or two separate signs, one with visual, and one with tactile characters, shall be provided.	ADA.7-1	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards
[signs] Advisory 703.5.1 Finish and Contrast. Signs are more legible for persons with low vision when characters contrast as much as possible with their background. Additional factors affecting the ease with which the text can be distinguished from its background	ADA.7-10	NA-US	low vision	standard	indoor-outdoor	@	signage	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
include shadows cast by lighting sources, surface glare, and the uniformity of the text and its background colors and textures.										
[signs] 703.5.2 Case. Characters shall be uppercase or lowercase or a combination of both.; 703.5.3 Style. Characters shall be conventional in form. Characters shall not be italic, oblique, script, highly decorative, or of other unusual forms.; 703.5.4 Character Proportions. Characters shall be selected from fonts where the width of the uppercase letter "O" is 55 percent minimum and 110 percent maximum of the height of the uppercase letter "I".	ADA.7-11	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards
[signs] 703.5.5 Character Height. Minimum character height shall comply with Table 703.5.5. Viewing distance shall be measured as the horizontal	ADA.7-12	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
distance between the character and an obstruction preventing further approach towards the sign. Character height shall be based on the uppercase letter “I”.										
[signs] 703.5.6 Height From Finish Floor or Ground. Visual characters shall be 40 inches (1015 mm) minimum above the finish floor or ground. EXCEPTION: Visual characters indicating elevator car controls shall not be required to comply with 703.5.6.; 703.5.7 Stroke Thickness. Stroke thickness of the uppercase letter “I” shall be 10 percent minimum and 30 percent maximum of the height of the character.; 703.5.8 Character Spacing. Character spacing shall be measured between the two closest points of adjacent characters, excluding word spaces. Spacing between individual characters shall be 10 percent minimum and 35 percent maximum of character height.;	ADA.7-13	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
703.5.9 Line Spacing. Spacing between the baselines of separate lines of characters within a message shall be 135 percent minimum and 170 percent maximum of the character height.										
[signs] 703.6.1 Pictogram Field. Pictograms shall have a field height of 6 inches (150 mm) minimum. Characters and braille shall not be located in the pictogram field.	ADA.7-14	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards
[signs] 703.6.2 Finish and Contrast. Pictograms and their field shall have a non-glare finish. Pictograms shall contrast with their field with either a light pictogram on a dark field or a dark pictogram on a light field.	ADA.7-15	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[signs] 703.6.3 Text Descriptors. Pictograms shall have text descriptors located directly below the pictogram field.	ADA.7-16	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards
[signs] 703.7.1 Finish and Contrast. Symbols of accessibility and their background shall have a non-glare finish. Symbols of accessibility shall contrast with their background with either a light symbol on a dark background or a dark symbol on a light background.	ADA.7-17	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards
[detectable warnings] 705.1.1 Dome Size. Truncated domes in a detectable warning surface shall have a base diameter of 0.9 inch (23 mm) minimum and 1.4 inches (36 mm) maximum, a top diameter of 50 percent of the base diameter minimum to 65 percent of the base diameter maximum, and a height of 0.2 inch (5.1 mm).; 705.1.2 Dome Spacing. Truncated domes in a detectable warning surface shall have a center-tocenter	ADA.7-18	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
spacing of 1.6 inches (41 mm) minimum and 2.4 inches (61 mm) maximum, and a base-tobase spacing of 0.65 inch (17 mm) minimum, measured between the most adjacent domes on a square grid.; 705.1.3 Contrast. Detectable warning surfaces shall contrast visually with adjacent walking surfaces either light-on-dark, or dark-on-light.										
[detectable warnings] 705.2 Platform Edges. Detectable warning surfaces at platform boarding edges shall be 24 inches (610 mm) wide and shall extend the full length of the public use areas of the platform.	ADA.7-19	NA-US	target groups	standard	indoor-outdoor	@	@	transit-stop	@	Standards
[signs] Advisory 703.2 Raised Characters. Signs that are designed to be read by touch should not have sharp or abrasive edges.	ADA.7-2	NA-US	low vision	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[signs] 703.2.1 Depth. Raised characters shall be 1/32 inch (0.8 mm) minimum above their background. 703.2.2 Case. Characters shall be uppercase.; 703.2.3 Style. Characters shall be sans serif. Characters shall not be italic, oblique, script, highly decorative, or of other unusual forms.; 703.2.4 Character Proportions. Characters shall be selected from fonts where the width of the uppercase letter "O" is 55 percent minimum and 110 percent maximum of the height of the uppercase letter "I".; 703.2.5 Character Height. Character height measured vertically from the baseline of the character shall be 5/8 inch (16 mm) minimum and 2 inches (51 mm) maximum based on the height of the uppercase letter "I".	ADA.7-3	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[signs] 703.2.6 Stroke Thickness. Stroke thickness of the uppercase letter "I" shall be 15 percent maximum of the height of the character.; 703.2.7 Character Spacing. Character spacing shall be measured between the two closest points of adjacent raised characters within a message, excluding word spaces. Where characters have rectangular cross sections, spacing between individual raised characters shall be 1/8 inch (3.2 mm) minimum and 4 times the raised character stroke width maximum. Where characters have other cross sections, spacing between individual raised characters shall be 1/16 inch (1.6 mm) minimum and 4 times the raised character stroke width maximum at the base of the cross sections, and 1/8 inch (3.2 mm) minimum and 4 times the raised character stroke width maximum at	ADA.7-4	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
the top of the cross sections. Characters shall be separated from raised borders and decorative elements 3/8 inch (9.5 mm) minimum.; 703.2.8 Line Spacing. Spacing between the baselines of separate lines of raised characters within a message shall be 135 percent minimum and 170 percent maximum of the raised character height.										
[signs] 703.3.1 Dimensions and Capitalization. Braille dots shall have a domed or rounded shape and shall comply with Table 703.3.1. The indication of an uppercase letter or letters shall only be used before the first word of sentences, proper nouns and names, individual	ADA.7-5	NA-US	low vision	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
letters of the alphabet, initials, and acronyms.										
[signs] 703.3.2 Position. Braille shall be positioned below the corresponding text. If text is multi-lined, braille shall be placed below the entire text. Braille shall be separated 3/8 inch (9.5 mm) minimum from any other tactile characters and 3/8 inch (9.5 mm) minimum from raised borders and decorative elements.	ADA.7-6	NA-US	low vision	standard	indoor-outdoor	@	@	signage	@	Standards
[signs] 703.4.1 Height Above Finish Floor or Ground. Tactile characters on signs shall be located 48 inches (1220 mm) minimum above the finish floor or ground surface, measured from the baseline of the lowest tactile character and 60 inches (1525 mm) maximum above the finish floor or ground surface, measured from the baseline of the highest tactile	ADA.7-7	NA-US	low vision	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
character.										
[signs] 703.4.2 Location. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leafs, the sign shall be located to the right of the right hand door. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall. Signs containing tactile characters shall be located so that a clear floor space of 18 inches (455 mm) minimum by 18 inches (455 mm)	ADA.7-8	NA-US	low vision	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.										
[signs] 703.5.1 Finish and Contrast. Characters and their background shall have a non-glare finish. Characters shall contrast with their background with either light characters on a dark background or dark characters on a light background.	ADA.7-9	NA-US	target groups	standard	indoor-outdoor	@	@	signage	@	Standards
[wheelchair spaces, companion seats, and designated aisle seats] 802.1.2 Width. A single wheelchair space shall be 36 inches (915 mm) wide minimum Where two adjacent wheelchair spaces are provided, each	ADA.8-1	NA-US	wheelchair-general	standard	indoor	@	@	seating	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
wheelchair space shall be 33 inches (840 mm) wide minimum.										
[transportation facilities] 810.2.3 Connection. Bus stop boarding and alighting areas shall be connected to streets, sidewalks, or pedestrian paths by an accessible route complying with 402.; 810.2.4 Slope. Parallel to the roadway, the slope of the bus stop boarding and alighting area shall be the same as the roadway, to the maximum extent practicable. Perpendicular to the roadway, the slope of the bus stop boarding and alighting area shall not be steeper than1:48.	ADA.8-10	NA-US	target groups	standard	outdoor	@	@	transit-stop	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[transportation facilities] 810.5.1 Slope. Rail platforms shall not exceed a slope of 1:48 in all directions. EXCEPTION: Where platforms serve vehicles operating on existing track or track laid in existing roadway, the slope of the platform parallel to the track shall be permitted to be equal to the slope (grade) of the roadway or existing track.; 810.5.2 Detectable Warnings. Platform boarding edges not protected by platform screens or guards shall have detectable warnings complying with 705 along the full length of the public use area of the platform.; 810.5.3 Platform and Vehicle Floor Coordination. Station platforms shall be positioned to coordinate with vehicles in accordance with the applicable requirements of 36 CFR Part 1192. Lowlevel platforms shall be 8 inches (205 mm) minimum above top of rail.	ADA.8-11	NA-US	target groups	standard	indoor-outdoor	@	@	transit-stop	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[transportation facilities] 810.6.2 Routes and Destinations. Lists of stations, routes and destinations served by the station which are located on boarding areas, platforms, or mezzanines shall comply with 703.5. At least one tactile sign identifying the specific station and complying with 703.2 shall be provided on each platform or boarding area.	ADA.8-12	NA-US	low vision	standard	indoor	@	@	transit-stop	@	Standards
[transportation facilities] 810.8 Clocks. Where clocks are provided for use by the public, the clock face shall be uncluttered so that its elements are clearly visible. Hands, numerals and digits shall contrast with the background either light-on-dark or dark-on-light. Where clocks are installed overhead, numerals and digits shall comply with 703.5.	ADA.8-13	NA-US	target groups	standard	indoor-outdoor	@	@	transit-general	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[wheelchair spaces, companion seats, and designated aisle seats] 802.1.3 Depth. Where a wheelchair space can be entered from the front or rear, the wheelchair space shall be 48 inches (1220 mm) deep minimum. Where a wheelchair space can be entered only from the side, the wheelchair space shall be 60 inches (1525 mm) deep minimum.	ADA.8-2	NA-US	wheelchair-general	standard	indoor	@	@	seating	@	Standards
[wheelchair spaces, companion seats, and designated aisle seats] 802.2.1.1 Lines of Sight Over Heads. Where spectators are provided lines of sight over the heads of spectators seated in the first row in front of their seats, spectators seated in wheelchair spaces shall be afforded lines of sight over the heads of seated spectators in the first row in front of wheelchair spaces.	ADA.8-3	NA-US	wheelchair-general	standard	indoor	@	@	seating	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[wheelchair spaces, companion seats, and designated aisle seats] 802.2.1.2 Lines of Sight Between Heads. Where spectators are provided lines of sight over the shoulders and between the heads of spectators seated in the first row in front of their seats, spectators seated in wheelchair spaces shall be afforded lines of sight over the shoulders and between the heads of seated spectators in the first row in front of wheelchair spaces.	ADA.8-4	NA-US	wheelchair-general	standard	indoor	@	@	seating	@	Standards
[wheelchair spaces, companion seats, and designated aisle seats-companion seats] 802.3.1 Alignment. In row seating, companion seats shall be located to provide shoulder alignment with adjacent wheelchair spaces. The shoulder alignment point of the wheelchair space shall be measured 36 inches (915 mm) from the front of the wheelchair space. The floor surface of the companion seat	ADA.8-5	NA-US	wheelchair-general	standard	indoor	@	@	seating	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
shall be at the same elevation as the floor surface of the wheelchair space.; 802.3.2 Type. Companion seats shall be equivalent in size, quality, comfort, and amenities to the seating in the immediate area. Companion seats shall be permitted to be movable.										
[dressing, fitting, and locker rooms] 803.3 Door Swing. Doors shall not swing into the room unless a clear floor or ground space complying with 305.3 is provided beyond the arc of the door swing.	ADA.8-6	NA-US	target groups	standard	indoor	@	indoor space	@	@	Standards
[dressing, fitting, and locker rooms] 803.5 Coat Hooks and Shelves. Coat hooks provided within the room shall be located within one of the reach ranges specified in 308. Shelves shall be 40 inches (1015 mm) minimum and 48 inches (1220 mm) maximum above the finish floor or ground.	ADA.8-7	NA-US	target groups	standard	indoor	@	@	service	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[transportation facilities] 810.2.1 Surface. Bus stop boarding and alighting areas shall have a firm, stable surface.	ADA.8-8	NA-US	target groups	standard	outdoor	@	@	transit-stop	@	Standards
[transportation facilities] 810.2.2 Dimensions. Bus stop boarding and alighting areas shall provide a clear length of 96 inches (2440 mm) minimum, measured perpendicular to the curb or vehicle roadway edge, and a clear width of 60 inches (1525 mm) minimum, measured parallel to the vehicle roadway.	ADA.8-9	NA-US	target groups	standard	outdoor	@	@	transit-stop	@	Standards
[outdoor public use eating areas] Design of eating areas: Accessible tables must have enough clearance under the table to allow a person using a mobility device, such as a wheelchair, to access the table.	AODA.S-33	NA-CAN	wheelchair-general	standard	outdoor	@	@	seating	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[outdoor public use eating areas] Surface area: The area approaching and surrounding the accessible tables must be level, firm, and stable so that a person using a mobility device can get to the table and move up to and around the table. A level surface is one with no noticeable slope, which makes it safer and easier for a person with a wheeled mobility device to approach and sit at an accessible table.	AODA.S-34	NA-CAN	wheelchair-general	standard	outdoor	@	@	seating	seating	Standards
[exterior paths of travel] Minimum clear width: The minimum clear width of a new or redeveloped outdoor sidewalk or walkway must be 1,500 mm. This is wide enough to accommodate a greater range of twoway traffic, including pedestrians who use mobility devices.	AODA.S-35	NA-CAN	target groups	standard	outdoor	@	@	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[exterior paths of travel] Minimum clear width: The minimum 1,500 mm clear width must be free from any obstructions. Any obstructions such as advertising boards, planters and newspaper boxes must be placed outside of the pedestrian route to meet the minimum 1,500 mm clear width requirement.	AODA.S-36	NA-CAN	target groups	standard	outdoor	@	pedestrian path	pedestrian path	@	Standards
[exterior path of travel] Minimum head room clearance: Head room clearance refers to the area above the surface of the sidewalk/ walkway. This area must be clear of any obstacle that a person may have to duck under, such as tree branches or signs. Obstacles in the overhead area are safety hazards for people who have low or no vision.	AODA.S-37	NA-CAN	low vision	standard	outdoor	@	pedestrian path	@	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[exterior path of travel] Minimum head room clearance: In cases where the minimum head room clearance cannot be achieved due to existing infrastructure, a barrier capable of being detected by a cane, such as a rail, with a hard edge should be placed beneath any object in the head room area. The barrier will help cane users detect the object.	AODA.S-38	NA-CAN	low vision	standard	outdoor	@	@	pedestrian path	public object	Standards
[exterior path of travel] Openings in the surface: Openings on a sidewalk or walkway must not allow for the passage of an object that is greater than 20 mm in diameter. This will help to minimize injuries that occur when mobility device casters (small front wheels) and tips of canes become stuck in wider openings.	AODA.S-39	NA-CAN	target groups	standard	outdoor	@	pedestrian path	pedestrian path	pedestrian path	Standards
[exterior path of travel] Openings in the surface: For elongated openings (e.g. those that are not square), such as those on certain grates, length should	AODA.S-40	NA-CAN	target groups	standard	outdoor	@	pedestrian path	pedestrian path	pedestrian path	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
be placed at a right angle to the direction of travel to prevent slipping.										
[exterior path of travel] Running slope: The running slope of outdoor sidewalks and walkways should not exceed a slope ratio of 1:20	AODA.S-41	NA-CAN	target groups	standard	outdoor	@	@	pedestrian path	@	Standards
[exterior path of travel] Cross slope: The type of surface on a sidewalk or walkway can affect drainage. When water pools, it can make pedestrian travel difficult and sometimes even dangerous. For example, pooled water can freeze in the winter and can increase the chances of pedestrian slips and falls.	AODA.S-42	NA-CAN	target groups	standard	outdoor	@	pedestrian path	@	pedestrian path	Standards
[exterior path of travel] Cross slope: Unpaved surfaces are sometimes more difficult to drain. In these cases, cross slopes can be steeper (1:10) to allow for better drainage.; Because paved surfaces are easier to drain, cross slopes on	AODA.S-43	NA-CAN	target groups	standard	outdoor	@	@	pedestrian path	pedestrian path	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
these types of sidewalks or walkways must be more gentle (1:20).										
[exterior path of travel] Changes in level: Where possible, changes in level should be reduced to make exterior paths of travel as flat as possible. This will also reduce the need to install other features, such as ramps or stairs.; Bevels, slopes, curb ramps and ramps are required on sidewalks and walkways where there are changes in level along the surface of the route. Where a small change in level exists, a bevel can help a person using a mobility device to move over the level change.	AODA.S-44	NA-CAN	target groups	standard	outdoor	@	@	pedestrian path	pedestrian path	Standards
[exterior path of travel] Entrances: Sidewalk or walkway entrances must have a minimum clear opening of 850 mm, whether the entrance is a gate, a bollard or	AODA.S-45	NA-CAN	target groups	standard	transition	@	@	pedestrian path	pedestrian path	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
any other entrance design. This measurement provides a clear passage for people who use mobility devices, canes and support animals.										
[ramps] Minimum clear width: Ramps must have a minimum clear width of 900 mm. This is wide enough to accommodate a range of wheeled mobility devices. It is also narrow enough to allow people with different mobility challenges to reach across and grasp both handrails for support as they travel up or down the ramp.	AODA.S-46	NA-CAN	wheelchair-general	standard	outdoor	@	@	ramp	@	Standards
[ramps] Running slope: The maximum slope ratio on a ramp is 1:15. This makes it easier for people using mobility devices to go up and down the ramp.; A gentle ramp slope means that users of wheeled mobility devices can use less effort to climb the ramp and maintain a safe, controlled descent. This supports the safe use of the ramp,	AODA.S-47	NA-CAN	wheelchair-general	standard	outdoor	@	ramp	ramp	ramp	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
particularly when it becomes slippery due to poor weather conditions.										
[ramps] Landings: Landings are level areas where people can stop safely and/or turn on the ramp. This is important for mobility device users who need enough space on the landing to align their devices with the direction of the ramp.; Landings are required: at the top and bottom of ramps every 9 m on long in-line ramps; and, when there is an abrupt change in direction of the ramp.; Landings must be: a minimum of 1,670 mm by 1,670 mm at the top and bottom of the ramp; and where there is an abrupt change in direction of the ramp.; Landings on in-line ramps must be a minimum of 1,670	AODA.S-48	NA-CAN	target groups	standard	outdoor	@	@	ramp	ramp	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
mm in length and the same width of the ramp.; All landings must have a cross slope that is not steeper than 1:50. A cross slope of 1:50 allows for drainage but provides a mostly flat surface for a person using a mobility device to safely stop.										
[ramps] Openings in the surface: Openings in the surface of a ramp must not allow for the passage of an object that is greater than 20 mm in diameter. This is so that mobility device casters (small front wheels) or cane tips cannot pass through them.; For elongated openings (i.e., those that are not square), such as those on certain grates, length should be placed at a right angle to the direction of travel to prevent slipping.	AODA.S-49	NA-CAN	target groups	standard	outdoor	@	ramp	ramp	ramp	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[ramps] Handrails: When an organization installs a ramp on an exterior path of travel, it must have handrails on both sides to give people using a mobility device, such as a wheelchair, the ability to pull themselves up the ramp or to control their descent. Graspable handrails are important to lend support to ramp users and to help prevent falls.	AODA.S-50	NA-CAN	wheelchair-general	standard	outdoor	@	@	ramp	ramp	Standards
[ramps] Handrails: The design and construction requirements for handrails include: A continuously graspable surface along the entire length of the handrail; Specific dimension ranges for rounded or square handrails; Height range for handrail placement; Direction on how the handrail should end at the top and bottom of the ramp, so that it does not protrude into the pedestrian path of travel or create a hazard; Minimum clearance between the	AODA.S-51	NA-CAN	target groups	standard	outdoor	@	@	handrail	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
wall and the handrail so that people can get their hands around it; A load-bearing capacity to withstand the weight of a person who uses the handrail to stand										
[ramps] Intermediate Handrails: In cases where a ramp is more than 2,200 mm wide, organizations must provide one or more additional handrails so a person using a mobility device, such as a wheelchair, has access to a handrail on either side of their chair. These handrails are called intermediate handrails.	AODA.S-52	NA-CAN	wheelchair-general	standard	outdoor	@	@	ramp	@	Standards
[ramps] Guards: A guard prevents ramp users from accidentally falling over the edge of a ramp from one level to another.	AODA.S-53	NA-CAN	target groups	standard	outdoor	@	@	ramp	ramp	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[ramps] Edge Protection: Edge protection is a small curb constructed on the side of the ramp that prevents a mobility device from rolling over the side and provides people with low or no vision with a detectable edge.	AODA.S-54	NA-CAN	target groups	standard	outdoor	@	@	ramp	ramp	Standards
[stairs] Application: Stairs are a barrier for many forms of disability, and as such should not be the only way of continuing along an exterior path of travel.	AODA.S-55	NA-CAN	target groups	standard	outdoor	@	pedestrian path	@	@	Standards
[stairs] Closed risers: Open risers can cause people using canes to have trouble maintaining their balance if their cane slides into the opening. People with vision loss can also experience vertigo due to the "strobing" effect of the stair treads and the light between each tread.	AODA.S-56	NA-CAN	low vision	standard	outdoor	@	stairway	@	stairway	Standards
[stairs] High tonal contrast markings: Tonal contrast strips help people with reduced sight visually detect the end of each step.	AODA.S-57	NA-CAN	low vision	standard	outdoor	@	@	stairway	stairway	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[stairs] Tactile walking surface indicators: Tactile walking surface indicators provide important cues for people with low or no vision. These indicators can alert all pedestrians to potential hazards, such as stair edges that can result in falls or injuries.; Tactile walking surface indicators are required to: be placed at the top of stairs; have raised tactile profiles. This makes them detectible underfoot for someone who cannot visually detect the edge of a step; have a high tonal contrast with the surrounding surface; cover the full tread width and be set back from the stair edge. They should not be located right at the edge of the step	AODA.S-58	NA-CAN	low vision	standard	outdoor	@	@	stairway	stairway	Standards
[curb ramps] Align with direction of travel: An important requirement for all curb ramps is that they must align with the direction of travel. This can mean aligning the curb	AODA.S-59	NA-CAN	target groups	standard	outdoor	@	@	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
ramp with a pedestrian crossing (where there is one), or aligning the curb ramp with the general direction of the pedestrian route (where no pedestrian crossing is present).										
[curb ramps] Minimum clear width: The minimum clear width of a new or redeveloped curb ramp must be 1,200 mm (exclusive of any flared sides). This is required so pedestrians using mobility devices and those travelling on foot can use the curb ramp at the same time. Organizations should consider building wider curb ramps at busier, more heavily used intersections.	AODA.S-60	NA-CAN	target groups	standard	outdoor	@	@	ramp	@	Standards
[curb ramps] Tactile walking surface indicators: Tactile walking surface indicators provide important cues for people with low or no vision. These indicators can alert all pedestrians to potential hazards, such as the imminent danger of oncoming traffic.	AODA.S-61	NA-CAN	low vision	standard	outdoor	@	pedestrian crossing	pedestrian crossing	pedestrian crossing	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[curb ramps] Tactile walking surface indicators: Tactile walking surface indicators are required to: have raised tactile profiles. This makes them detectible underfoot for someone that cannot visually detect the curb edge. Depressed grooves in concrete do not meet this requirement; have a high tonal contrast with the surrounding surface be placed at the bottom of curb ramps so that they can be detected before entering the roadway, but set back from the curb edge. They should not be placed right before the roadway; extend the full width of the curb ramp have a minimum depth of 610mm	AODA.S-62	NA-CAN	low vision	standard	outdoor	@	@	pedestrian crossing	pedestrian crossing	Standards
[depressed curbs] Running slope: A maximum running slope of 1:20 is required for depressed curbs. This will provide a gradual, seamless transition from sidewalks to pedestrian crossing	AODA.S-63	NA-CAN	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
areas for people using mobility devices, families with strollers and visitors with luggage.										
[depressed curbs] Tactile walking surface indicators: tactile walking surface indicators are required at pedestrian crossings. It is important to provide tactile walking surface indicators here, because they compensate for the absence of a hard detectable curb edge that would otherwise be used to indicate where the sidewalk ends and roadway begins.	AODA.S-64	NA-CAN	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards
[accessible pedestrian signals] Application: provide audible signals that indicate when it is safe to cross the road.;	AODA.S-65	NA-CAN	low vision	standard	outdoor	@	@	pedestrian crossing	pedestrian crossing	Standards
[accessible pedestrian signals] Application: Requirements for accessible pedestrian signals in the Standard include: a locator tone; proximity to edge of curb; tactile push-button arrows;	AODA.S-66	NA-CAN	target groups	standard	outdoor	@	@	pedestrian crossing	pedestrian crossing	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
mounting height distance; capacity for both manual and automatic activation, and audible and vibro-tactile walk indicators.										
[accessible pedestrian signals] Locator tone: Accessible pedestrian signal systems must include a locator tone. This will help people with various disabilities find the activation unit and press the button to cross the road.	AODA.S-67	NA-CAN	target groups	standard	outdoor	@	@	pedestrian crossing	pedestrian crossing	Standards
[accessible pedestrian signals] Proximity to curb edge and mointing height: The push button signal device/box must be located within 1,500 mm of the curb edge. This gives pedestrians enough time to press the button and return to the curb edge to respond to the walk indicator tone. These devices can also be located closer to the curb edge.; The device must not be placed more than 1,100 mm above the ground, so that someone using a	AODA.S-68	NA-CAN	target groups	standard	outdoor	@	@	pedestrian crossing	pedestrian crossing	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
mobility device can reach it.										
[accessible pedestrian signals] Tactile arrow: A tactile arrow-shaped button pointing in the direction of travel is required and helps pedestrians locate the pedestrian crossing at a crosswalk or intersection. It also helps pedestrians align themselves with the direction of travel and remain within the pedestrian crossing area where a pedestrian crossing is not positioned at perfect right angles to the roadway.	AODA.S-69	NA-CAN	target groups	standard	outdoor	@	pedestrian crossing	pedestrian crossing	pedestrian crossing	Standards
[accessible pedestrian signals] Audible and vibro-tactile walk indicators: The audible walk indicator tone is very important for alerting pedestrians when it is safe to cross the road.	AODA.S-70	NA-CAN	target groups	standard	outdoor	@	@	pedestrian crossing	pedestrian crossing	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[accessible pedestrian signals] Audible and vibro-tactile walk indicators: two devices can be installed on a single post. In this case, a verbal announcement is required to indicate when it is safe to cross the road.	AODA.S-71	NA-CAN	low vision	standard	outdoor	@	@	pedestrian crossing	pedestrian crossing	Standards
[access aisles] Access aisles provide users with a space to transfer into and out of their vehicles safely. The total width of a Type A accessible parking space and access aisle is intended to accommodate the combined width of a van, the length of a wheelchair ramp and the wheelchair itself.	AODA.S-72	NA-CAN	target groups	standard	outdoor	@	@	parking	parking	Standards
[access aisles] Other strategies can be used to discourage parking in access aisles on unpaved surfaces, such as: marking the access aisle location with additional signage or infrastructure, or providing a contrasting ground surface treatment	AODA.S-73	NA-CAN	target groups	standard	outdoor	@	@	parking	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[minimum number and type of accessible parking spaces] if it would provide equivalent/greater accessibility in terms of distance from accessible entrances or user convenience. For example, preferred lots may be located closer to more commonly used buildings on a university campus or high traffic entrances to a hospital or health-care complex to improve user convenience. Preferred lots may also be equipped with better lighting, other security provisions or areas that provide protection from the weather.	AODA.S-74	NA-CAN	target groups	standard	outdoor	@	@	parking	@	Standards
[service counters] An accessible service counter must be designed so that a person seated in a mobility device can reach any objects intended for customer use, such as a point of sale terminal. It should also be designed so that a person seated in a mobility device can see objects that are intended to be	AODA.S-75	NA-CAN	wheelchair-general	standard	indoor	@	@	service	service	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
viewed, and to carry out tasks that are intended to be done at the counter, such as writing a signature.										
[service counters] Additionally, if service counters are approached from the front (e.g., in situations where they provide face-to-face interaction with a receptionist), the counter must provide enough clear space so that a person's knees can be accommodated under the front of the counter when seated in a mobility device. There must also be enough space in front of the counter so a person using a mobility device, such as a wheelchair, can turn their chair and pull up to the counter.	AODA.S-76	NA-CAN	wheelchair-general	standard	indoor	@	@	service	service	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[fixed queuing guides] Fixed queuing guides must be placed far enough apart to allow people using mobility devices to pass through them and turn where the guides change direction. Since some mobility devices, such as wheelchairs or scooters, can be longer than they are wide, more space should be provided for turning when the line changes direction.	AODA.S-77	NA-CAN	wheelchair-general	standard	indoor	@	@	service	service	Standards
[fixed queuing guides] Fixed queuing guides must be designed to include an element that can be detected by a person using a cane. This refers to long white canes used by people with visual disabilities, rather than canes used to help people walk. Canes used by people with visual disabilities have a specific detection range that allows the user to know what is in front of them and prepare them for any obstructions in their route. Cane-	AODA.S-78	NA-CAN	low vision	standard	indoor	@	@	service	service	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
detectable elements, such as posts and railings, should be low to the ground and spaced closely enough together to help a person navigate through the queue.										
[waiting areas] Waiting areas with fixed seating must include dedicated spaces for people who use mobility devices, such as wheelchairs. The number of spaces must equal 3% of the total number of seats, with one space being the minimum required.; Dedicated spaces should be in the same area as the rest of the fixed seating to allow customers with and without disabilities to wait together.	AODA.S-79	NA-CAN	target groups	standard	indoor	@	@	seating	@	Standards
[using ramps, bridge plates and lifts] When requested, operators must deploy or put in place the ramps, portable bridge plates	AODA.T-1	NA-CAN	target groups	standard	transit vehicle	@	@	entrance	transit vehicle	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
or lifting devices that are used to help people with disabilities board or deboard vehicles.										
[on board announcements] Conventional transportation service providers must make sure that all destination points or stops are electronically announced on board their vehicles while they are travelling.	AODA.T-10	NA-CAN	target groups	standard	transit vehicle	@	@	transit-stop	transit vehicle	Standards
[on board announcements] For example, the next stop of “Queen Street” must be audibly communicated through an electronic system, as well as legibly displayed on an electronic system. This means that passengers have the option of reading or hearing “Queen Street”.	AODA.T-11	NA-CAN	target groups	standard	transit vehicle	@	@	transit-stop	signage	Standards
[Grab bars, handholds, handrails, and stanchions] Grab bars, handholds, handrails, and stanchions that are located at an entrance or exit must be accessible from	AODA.T-12	NA-CAN	target groups	standard	transit vehicle	@	@	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
ground level and mounted so that they are inside the vehicle when the doors are closed.										
[Grab bars, handholds, handrails, and stanchions] They must be distributed throughout the vehicle, as appropriate to the vehicle's design, so that they assist with independent and safe boarding, moving on the vehicle, sitting down, standing up, and deboarding for people with disabilities.	AODA.T-13	NA-CAN	target groups	standard	transit vehicle	@	@	indoor space	transit vehicle	Standards
[Grab bars, handholds, handrails, and stanchions] They must be positioned so they do not interfere with the turning and manoeuvring space needed to allow people with disabilities using mobility aids to reach the allocated space from the entrance.	AODA.T-14	NA-CAN	wheelchair-general	standard	transit vehicle	@	@	indoor space	indoor space	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[Grab bars, handholds, handrails, and stanchions] They must be high colour-contrasted with their background to assist with visual recognition.; They must be sturdy, rounded and free of any sharp or abrasive element.; They must have an exterior diameter that permits easy grasping by a full range of passengers and that has sufficient clearance from the surface to which it is attached.	AODA.T-15	NA-CAN	target groups	standard	transit vehicle	@	@	handrail	handrail	Standards
[Grab bars, handholds, handrails, and stanchions] They must have a slip resistant surface.	AODA.T-16	NA-CAN	target groups	standard	transit vehicle	@	@	handrail	@	Standards
[Floors and carpeted surfaces] Floor surfaces must produce minimal glare, and they must be slip resistant.; Note - Slip-resistant surfaces offer a level of friction that allows people with disabilities, particularly those who use mobility assistive devices, to travel safely in the vehicle.	AODA.T-17	NA-CAN	target groups	standard	transit vehicle	@	@	hallway	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[Floors and carpeted surfaces] Carpeted surfaces must have low, firm and level pile or loop and be securely fastened to reduce the risk of a passenger tripping. Note - The term "securely fastened" means the surface must be stable, firm, and slip-resistant and not pose a tripping hazard. The term does not mean that the entire carpet or pad must be adhered to the floor surface.	AODA.T-18	NA-CAN	target groups	standard	transit vehicle	@	@	hallway	transit vehicle	Standards
[allocated mobility aid spaces] For vehicles with a seating capacity of 24 passengers or less, each allocated mobility aid space must be at a minimum 1220 millimetres by 685 millimetres.; For vehicles with a seating capacity of more than 24 passengers, each allocated mobility aid space must be at a minimum 1220 millimetres by 760 millimetres.	AODA.T-19	NA-CAN	target groups	standard	transit vehicle	@	@	indoor space	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[providing adequate time] Operators must provide enough time for people with disabilities to safely board and deboard the vehicles, as well as to secure mobility aids. Operators must also provide assistance for these activities, when requested.	AODA.T-2	NA-CAN	target groups	standard	transit vehicle	@	@	transit vehicle	transit vehicle	Standards
[allocated mobility aid spaces] Vehicles must be equipped with devices to secure mobility aids in each of the allocated spaces, where they are appropriate.; A securement device is designed to prevent mobility aids from tipping over or from rolling or sliding out of the allocated spaces.; Securement devices can include wheel clamps and floor or wall mounted straps that secure the mobility aids.	AODA.T-20	NA-CAN	target groups	standard	transit vehicle	@	@	indoor space	transit vehicle	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[stop requests and emergency response controls] Auditory and Visual Indicators: They must provide both auditory and visual indications that the request has been made so that people with a range of disabilities are aware of the request. Location: They must be located no higher than 1220 millimetres and no lower than 380 millimetres above the floor to allow for access and to allow people with disabilities to independently activate the controls.; Operation: They must be able to be operated with one hand, and not require tight grasping, pinching or twisting of the wrist, to assist people with disabilities who have difficulty with arm or hand movements.; Colour Contrast: They must be high colour-contrasted with the equipment on which the controls are mounted so that they are easily identified from the surrounding material, or the objects on	AODA.T-21	NA-CAN	target groups	standard	transit vehicle	@	@	transit vehicle	transit vehicle	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
which they are placed.; Tactile Information: Emergency response controls must include tactile information. Tactile refers to raised lettering or Braille, used to communicate the purpose of the control to people with visual disabilities or low vision.										

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[lighting features] Ground Level Lighting: When a passenger access door is open, the lights located above or beside each door must illuminate the ground surface for a distance of at least 0.9 metres perpendicular to the tread on the bottom step or the outer edge of the lift.; Ground surface could be the road, sidewalk, station platform, or whatever surface a passenger would deboard onto. The ground level lighting will help passengers see the bottom step or the edge of the lift when they are boarding a vehicle, and to see the ground in front of them when they are exiting a vehicle.; Protecting from Glare: The lights located above or beside each passenger access door must be shielded to protect the eyes of passengers as they enter and exit the vehicle.; When lights are not shielded, passengers can be temporarily blinded	AODA.T-22	NA-CAN	target groups	standard	transit vehicle	@	entrance	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
as they board and deboard the vehicles, which could cause disorientation, tripping, etc.										
[signage] All conventional transportation service providers must make sure that all of their transportation vehicles display the route or direction of the vehicle or its destination or next major stop.	AODA.T-23	NA-CAN	target groups	standard	transit vehicle	@	@	transit-stop	@	Standards
[signage] Consistency in signage will help people with disabilities recognize the transportation vehicle they are looking for or intending to board.	AODA.T-24	NA-CAN	target groups	standard	transit vehicle	@	@	transit-general	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
This is especially important along routes served by more than one vehicle, which travel to different destinations										
[signage] The signs must have a glare-free surface.; A glare-free surface is a surface that does not easily reflect light from the sun or artificial lights which can make it difficult to see or read a sign.; A glare-free surface makes it easier to see and read what is written on it. A glare free surface is based on the material used or how the surface is treated.; The signs must be positioned to avoid shadow areas and glare.; The exact position of a sign to avoid glare and shadows will vary depending on the type of vehicle.; Avoiding shadow areas and glare on the signs will help people with disabilities to properly identify the information on the sign, regardless of the time of day or	AODA.T-25	NA-CAN	target groups	standard	transit vehicle	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
weather conditions.										
[signage] The text must be high colour-contrasted with its background, such as the wall or the frame on which the sign is mounted, or in the case of electronic signage, the background would be the screen colour as distinct from the text colour.	AODA.T-26	NA-CAN	target groups	standard	transit vehicle	@	@	signage	@	Standards
[lifting devices, ramps, or portable bridge plates] Conventional transportation service providers must make sure that all of their transportation vehicles are equipped with lifting devices, ramps, or portable bridge plates.; Lifting devices, ramps, and	AODA.T-27	NA-CAN	target groups	standard	transit vehicle	@	@	entrance	transit vehicle	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
portable bridge plates are pieces of equipment that help people with disabilities to safely board and deboard vehicles.										
[lifting devices, ramps, or portable bridge plates] A Colour Strip: The colour strip must run the full width of the bottom edge of the lifting device, ramp, or portable bridge plate.; The strip must be high colour-contrasted with its background. A high colourcontrasted strip will assist people with disabilities in distinguishing where the edge of the lifting device, ramp, or portable bridge plate meets the ground, or the transition from a sloped surface to a flat surface.; A Slip-resistant Platform Surface: A slip-resistant surface is one that even when wet provides friction between the surface and a person's footwear, mobility aid or mobility assistive device. This	AODA.T-28	NA-CAN	target groups	standard	transit vehicle	@	ramp	ramp	transit vehicle	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
reduces the risk of slipping.; Raised Edges: The raised edges must be high enough to prevent or hinder a mobility aid from rolling off the edge while boarding or deboarding the vehicles.										
[steps] Edging: The top outer edge of each step must be marked by a colour strip. The colour of this strip must be high colour-contrasted with the colour of the background to help people with disabilities distinguish the edge of the step.	AODA.T-29	NA-CAN	target groups	standard	transit vehicle	@	@	stairway	@	Standards
[fares] Some people with disabilities may have trouble placing coins or tokens into fare boxes, while others may have problems with the	AODA.T-3	NA-CAN	target groups	standard	indoor-outdoor	@	transit-general	@	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
machines used for purchasing tickets.										
[steps] Surfaces: The steps must have slip-resistant surfaces and produce minimal glare.; A slip-resistant surface is one that, even when wet, provides enough friction between the surface and a person's footwear, mobility aid, or mobility assistive device to reduce the risk of slipping.	AODA.T-30	NA-CAN	target groups	standard	transit vehicle	@	stairway	stairway	transit vehicle	Standards
[steps] Heights and Depths: The risers of the steps must be closed. This refers to the back vertical portion of the steps. Open riser heights can be a tripping hazard for a foot or mobility assistive device.	AODA.T-31	NA-CAN	low vision	standard	transit vehicle	@	stairway	stairway	stairway	Standards
[rail cars] Accessible Washroom: Conventional transportation service providers that operate light rail, commuter rail or inter-city rail must make sure that where washrooms are provided on the rail cars there is at least one washroom that is	AODA.T-32	NA-CAN	target groups	standard	transit vehicle	@	@	transit vehicle	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
accessible to people with disabilities who use mobility aids.; The mobility aid accessible washroom must be located on the rail car that is accessible to mobility aids.										
[transit-stop] Barriers: An operator of a transit bus notices a large crack in the sidewalk in front of the transit-stop. The operator decides to stop the bus several metres away from the official transit-stop so that people with disabilities can board and deboard safely.	AODA.T-4	NA-CAN	target groups	standard	outdoor	@	pedestrian path	entrance	transit vehicle	Standards
[courtesy seating] Location: Seating for people with disabilities must be accessible and located as close as practicable to the entrances of the vehicles.	AODA.T-5	NA-CAN	target groups	standard	transit vehicle	@	@	transit vehicle	@	Standards
[pre-boarding announcements] Verbal Requirements: When requested, conventional transportation service providers will provide spoken pre-boarding	AODA.T-6	NA-CAN	target groups	standard	indoor-outdoor	@	@	transit-stop	transit-stop	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
announcements of the routes, directions, destinations or next major stops of their vehicles.										
[pre-boarding announcements] Electronic Requirements: Conventional transportation service providers must provide electronic preboarding announcements of the routes, directions, destinations or next major stops of their vehicles.; This information must be electronically announced at the boarding point.	AODA.T-7	NA-CAN	target groups	standard	indoor-outdoor	@	@	transit-stop	transit-stop	Standards
[on board announcements] Conventional transportation service providers must make sure that all destination points or stops are audibly announced on board their vehicles while they are travelling.	AODA.T-9	NA-CAN	low vision	standard	transit vehicle	@	@	transit-stop	@	Standards
[general building access requirement] Where a ramp complying with AS 1428.1 or a passenger lift is installed: (a) to the entrance doorway of each sole-	DDA.P-1	OA-AU	target groups	standard	indoor	@	@	room	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
occupancy unit; and (b) to and within rooms or spaces for use in common by the residents,										
[tactile indicators] if handrails incorporating a raised dome button in accordance with the requirements for stairway handrails in AS 1428.1 are provided to warn people who are blind or have a vision impairment that they are approaching a stairway or ramp.	DDA.P-10	OA-AU	low vision	standard	indoor	@	@	handrail	stairway	Standards
[ramps] On an accessway: (a) a series of connected ramps must not have a combined vertical rise of more than 3.6 m; and (b) a landing for a step ramp must not overlap a landing for another step ramp or ramp.	DDA.P-11	OA-AU	target groups	standard	indoor	@	@	ramp	@	Standards
[glazing on an accessway] On an accessway, where there is no chair rail, handrail or transom, all frameless or fully glazed doors, sidelights and any glazing capable of being mistaken for a doorway or opening, must be clearly	DDA.P-12	OA-AU	target groups	standard	indoor	@	@	interior doorway	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
marked in accordance with AS 1428.1.										
[location of braille and tactile signs] Signs including symbols, numbering and lettering must be designed and installed as follows: (a) braille and tactile components of a sign must be located not less than 1 200 mm and not higher than 1 600 mm above the floor or ground surface; (b) signs with single lines of characters must have the line of tactile characters not less than 1 250 mm and not more than 1 350 mm above the floor or ground surface;	DDA.P-13	OA-AU	low vision	standard	indoor	@	@	signage	@	Standards
[location of braille and tactile signs] (c) signs identifying rooms containing features or facilities listed in clause D3.6 must be located: (i) on the wall on the latch side of the door with the leading edge of the sign located between 50 mm and	DDA.P-14	OA-AU	low vision	standard	indoor	@	@	room	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
300 mm from the architrave; and (ii) where (i) is not possible, the sign may be placed on the door itself.										
[braille and tactile sign specification] (1) Tactile characters must be raised or embossed to a height of not less than 1 mm and not more than 1.5 mm. (2) Sentence case (upper case for the first letter of each main word and lower case for all other letters) must be used for all tactile characters; and (i) upper case tactile characters must have a height of not less than 15 mm and not more than 55 mm; and (ii) lower case tactile characters must have a height of 50% of the related upper case characters. (3) Tactile characters, symbols, and the like, must have rounded edges. (4) The entire sign, including any frame, must have all edges rounded. (5) The background, negative space or fill	DDA.P-15	OA-AU	low vision	standard	indoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
of signs must be of matt or low sheen finish. (6) The characters, symbols, logos and other features on signs must be matt or low sheen finish. (7) The minimum letter spacing of tactile characters on signs must be 2 mm. (8) The minimum word spacing of tactile characters on signs must be 10mm. (9) The thickness of letter strokes must be not less than 2 mm and not more than 7 mm. (10) Tactile text must be left justified, except that single words may be centre justified. (11) Tactile text must be Arial typeface.										
[luminance contrast] The following apply to luminance contrast: (a) the background, negative space, fill of a sign or border with a minimum width of 5 mm must have a luminance contrast with the surface on which it is mounted of not less than 30%;	DDA.P-16	OA-AU	target groups	standard	indoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
(b) tactile characters, icons and symbols must have a minimum luminance contrast of 30% to the surface on which the characters are mounted; (c) luminance contrasts must be met under the lighting conditions in which the sign is to be located.										
[accessible sanitary facilities] (g) where two or more of each type of accessible unisex sanitary facility are provided, the number of left and right handed mirror image facilities, must be provided as evenly as possible	DDA.P-17	OA-AU	target groups	standard	indoor	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[accessways] (3) The minimum unobstructed width of an accessway must be 1.2 m, except that: (a) the minimum unobstructed width of a moving walkway forming part of an accessway may be not less than 850 mm; and (b) the minimum unobstructed width of a doorway in an accessway may be not less than 850 mm. (4) Poles, columns, stanchions, bollards and fixtures must not project into an accessway. (5) Obstacles that abut an accessway must have a luminance contrast with a background of not less than 30%. (6) Manoeuvring areas that allow a 180 degree wheelchair turn must comply with clause 6.2 of AS 1428.2. (7) A passing area must be provided at least every 6 metres along any two-way accessway that is less than 1 800 mm wide.	DDA.P-18	OA-AU	target groups	standard	indoor	@	@	transit-stop	public object	Standards
[handrails and grabrails] (4) A grabrail or handrail must be provided at fixed locations where	DDA.P-19	OA-AU	target groups	standard	indoor	@	@	transit-stop	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
passengers are required to pay fares.										
[access to buildings] In a building required to be accessible, an accessway must be provided through the principal pedestrian entrance, and: (a) through not less than 50% of all pedestrian entrances including the principal pedestrian entrance; and (b) in a building with a total floor area more than 500 m2, a pedestrian entrance which is not accessible must not be located more than 50 m from an accessible pedestrian entrance;	DDA.P-2	OA-AU	target groups	standard	transition	@	@	building	@	Standards
[access to buildings] Where a doorway on an accessway has multiple leaves, (except an automatic opening door) one of those leaves must have a clear opening width of not less than 850 mm in accordance with AS 1428.1.	DDA.P-3	OA-AU	target groups	standard	transition	@	@	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[parts of buildings to be accessible] (c) accessways must have: (i) passing spaces complying with AS 1428.1 at maximum 20 m intervals on those parts of an accessway where a direct line of sight is not available; and (ii) turning spaces complying with AS 1428.1: (A) within 2 m of the end of accessways where it is not possible to continue travelling along the accessway; and (B) at maximum 20 m intervals along the accessway; (d) an intersection of accessways satisfies the spatial requirements for a passing and turning space; (e) a passing space may serve as a turning space;	DDA.P-4	OA-AU	target groups	standard	indoor	@	@	hallway	@	Standards
[signage] In a building required to be accessible: (a) braille and tactile signage complying with Part D4 and incorporating the international symbol of access or deafness, as appropriate, in accordance with AS 1428.1 must identify each: (i) sanitary	DDA.P-5	OA-AU	target groups	standard	indoor	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
facility, except a sanitary facility sole-occupancy unit in a Class 1b or Class 3 building;										
[signage] where a pedestrian entrance is not accessible, directional signage incorporating the international symbol of access, in accordance with AS 1428.1 must be provided to direct a person to the location of the nearest accessible pedestrian entrance	DDA.P-6	OA-AU	target groups	standard	transition	@	@	entrance	signage	Standards
[tactile indicators] For a building required to be accessible, tactile ground surface indicators must be provided to warn people who are blind or have a vision impairment that they are approaching: (a) a stairway, other than a fire-isolated stairway;	DDA.P-7	OA-AU	low vision	standard	indoor	@	@	stairway	@	Standards
[tactile indicators] (i) an overhead obstruction less than 2 m above floor level, other than a doorway	DDA.P-8	OA-AU	target groups	standard	indoor	@	@	hallway	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[tactile indicators] (ii) an accessway meeting a vehicular way adjacent to any pedestrian entrance to a building, excluding a pedestrian entrance serving an area referred to in clause D3.4, if there is no kerb or kerb ramp at that point	DDA.P-9	OA-AU	target groups	standard	transition	@	@	pedestrian path	@	Standards
[access paths] Minimum unobstructed width: (1) The minimum unobstructed width of an access path must be 1200 mm (AS1428.2 (1992) Clause 6.4, Width of path of travel). (2) However, the minimum unobstructed width of a moving footway may be 850 mm.	DDA.T-1	OA-AU	target groups	standard	indoor-outdoor	@	@	route	@	Standards
[boarding] Width and surface of boarding devices: A boarding device must: (a) be a minimum of 800 mm wide; and (b) have a slip-resistant surface.	DDA.T-10	OA-AU	target groups	standard	transit vehicle	@	@	ramp	@	Standards
[allocated space] Minimum size for allocated space: The minimum allocated space for a single wheelchair or similar mobility aid is 800 mm by 1300 mm (AS1428.2 (1992)	DDA.T-11	OA-AU	target groups	standard	transit vehicle	@	@	seating	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Clause 6.1, Clear floor or ground space for a stationary wheelchair).										
[allocated space] Minimum head room: (1) The minimum head room in an allocated space is 1410 mm. Note See section 12.5 in relation to minimum doorway opening. (2) For a conveyance entering service on or after 1 January 2013, the minimum headroom is 1500 mm.	DDA.T-12	OA-AU	target groups	standard	transit vehicle	@	@	seating	@	Standards
[handrails and grabrails] Handrails to be provided on access paths: (1) Handrails must be placed along an access path wherever passengers are likely to require additional support or passive guidance.	DDA.T-13	OA-AU	target groups	standard	indoor-outdoor	@	@	pedestrian path	@	Standards
[doorways and doors] Weight activated doors and sensors: (1) A pressure pad of a weight activated door must be sensitive enough to detect a 15 kg service animal.	DDA.T-14	OA-AU	target groups	standard	transition	@	@	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[doorways and doors] Weight activated doors and sensors: (2) Any other type of sensor on an access path must be able to detect movement between ground level and 500 mm above the access path.	DDA.T-15	OA-AU	target groups	standard	transition	@	@	entrance	@	Standards
[doorways and doors] Vertical height of doorways: (2) For a conveyance entering service on or after 1 January 2013, the minimum unobstructed doorway height must be 1500 mm.	DDA.T-16	OA-AU	target groups	standard	transit vehicle	@	@	entrance	@	Standards
[doorways and doors] Automatic or power-assisted doors: (1) Doors may be fully automatic. (2) Power-assisted doors must not require passengers to grip or twist controls in order to operate opening devices.	DDA.T-17	OA-AU	target groups	standard	transit vehicle	@	entrance	entrance	entrance	Standards
[toilets] Requirements for accessible toilets-ferries and accessible rail cars: (1) An accessible toilet must: (a) comply with the requirements set out in this section; and (b) allow passengers in wheelchairs or mobility aids to enter,	DDA.T-18	OA-AU	target groups	standard	transit vehicle	@	@	bathroom	bathroom	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
position their aids and exit.										
[toilets] Requirements for accessible toilets-ferries and accessible rail cars: (2) The minimum dimension from the centre line of the pan to the near-side wall must be 450 mm (AS1428.1 (2001) Figure 22). (3) The minimum dimension from the centre line of the pan to the far-side wall must be 1150 mm (AS1428.1 (2001) Figure 22). (4) The minimum dimension from the back wall to the front edge of the pan must be 800 mm (AS1428.1 (2001) Figure 22). (5) The toilet seat must be between 460 mm and 480 mm above the floor (AS1428.1 (2001) Figure 18). (6) Hand washing facilities must be provided either inside or outside the toilet (AS1428.1 (2001) Clause 10.2.1 (b), Water closets).	DDA.T-19	OA-AU	target groups	standard	transit vehicle	@	@	bathroom	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[access paths] Poles and obstacles, etc: (1) Poles, columns, stanchions, bollards and fixtures must not project into an access path. (2) Obstacles that abut an access path must have a luminance contrast with a background of not less than 30%.	DDA.T-2	OA-AU	target groups	standard	indoor-outdoor	@	route	route	public object	Standards
[symbols] International symbols for accessibility and deafness: (1) The international symbols for accessibility and deafness (AS1428.1 (2001) Clause 14.2, International symbol and Clause 14.3, International symbol for deafness) must be used to identify an access path and which facilities and boarding points are accessible.	DDA.T-20	OA-AU	target groups	standard	outdoor	@	@	transit-general	@	Standards
[symbols] Accessibility symbols to incorporate directional arrows: The symbol for accessibility must incorporate directional arrows and words or, if possible, pictograms, to show passengers the way to accessible facilities such as toilets.	DDA.T-21	OA-AU	target groups	standard	indoor-outdoor	@	@	signage	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[signs] Raised lettering or symbols or use of Braille: (1) If a sign incorporates raised lettering or symbols, they must be at least 0.8 mm above the surface of the sign. (2) If an operator or provider supplements a notice with Braille characters, they must be placed to the left of the raised characters.	DDA.T-22	OA-AU	low vision	standard	indoor-outdoor	@	@	signage	@	Standards
[tactile ground surface indicators] Location: Tactile ground surface indicators must be installed on an access path to indicate stairways, ramps, changes of direction, overhead obstructions below a height of 2000 mm, and hazards within a circulation space or adjacent to a path of travel (AS1428.2 (1992) Clause 18.1, Tactile ground surface indicators).	DDA.T-23	OA-AU	target groups	standard	indoor-outdoor	@	@	pedestrian path	@	Standards
[tactile ground surface indicators] Instalment (sp) at accessible bus boarding points: Colour-contrasted tactile indicators must be installed at	DDA.T-24	OA-AU	target groups	standard	outdoor	@	@	transit-stop	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
accessible boarding points at bus stops or in bus zones.										
[tactile ground surface indicators] Instalment (sp) at railway stations: Colour contrasted tactile indicators must be installed at the edges of railway platforms as prescribed by AS1428.4 (1992) Clause 6.7.	DDA.T-25	OA-AU	target groups	standard	indoor-outdoor	@	@	transit-stop	@	Standards
[lighting] Illumination levels-conveyances: (2) Lighting should be at least 150 lux at the entrance and at the point where a passenger pays his or her fare.	DDA.T-26	OA-AU	target groups	standard	transit vehicle	@	@	entrance	transit-general	Standards
[controls] Signal devices for conveyances that stop on request: (2) If a signal is operated by a button or pad, one surface dimension must be at least 25 mm.	DDA.T-27	OA-AU	target groups	standard	transit vehicle	@	@	transit-general	@	Standards
[booked services] Locations of carers, assistants and service animals: (3) If a passenger is travelling with a service animal, the	DDA.T-28	OA-AU	target groups	standard	transit vehicle	@	@	transit-general	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
animal must be able to accompany the passenger at all times and to travel without encroaching onto an access path.										
[access paths] Conveyances: (1) Subject to subsection (3) and section 2.7, an access path that allows continuous and unhindered passage must be provided with a minimum width of at least 850 mm.	DDA.T-3	OA-AU	target groups	standard	transit vehicle	@	@	transit vehicle	@	Standards
[access paths] Extent of path: (1) An access path must extend from the entrance of a conveyance to the facilities or designated spaces provided for passengers with disabilities. (2) Up to 50 mm of an adjacent allocated space may be used as part of the access path. (3) If an access path cannot be provided, the operator must provide equivalent access by direct assistance.	DDA.T-4	OA-AU	target groups	standard	transit vehicle	@	@	indoor space	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[passing areas] Minimum width: A passing area must have a minimum width of 1800 mm (AS1428.2 (1992) Clause 6.5 (a), Passing space for wheelchairs). (1) A ferry designed to carry more than 1 wheelchair must include at least 1 passing area for each accessible deck. (2) A train designed to carry more than 1 wheelchair must include at least 1 passing area for each accessible rail car. (3) The passing area must enable passengers travelling in mobility aids (conforming with the assumptions indicated in Part 40.1 of the Guidelines) to pass each other.	DDA.T-5	OA-AU	wheelchair-general	standard	transit vehicle	@	@	route	@	Standards
[passing areas] Conveyances: (1) A ferry designed to carry more than 1 wheelchair must include at least 1 passing area for each accessible deck. (2) A train designed to carry more than 1 wheelchair must include at least 1 passing area for each	DDA.T-6	OA-AU	wheelchair-general	standard	transit vehicle	@	@	indoor space	indoor space	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
accessible rail car. (3) The passing area must enable passengers travelling in mobility aids (conforming with the assumptions indicated in Part 40.1 of the Guidelines) to pass each other.										
[ramps] Minimum allowable width: The minimum allowable width of a ramp is 800 mm.	DDA.T-7	OA-AU	target groups	standard	indoor-outdoor	@	@	ramp	@	Standards
[ramps] Slope of external boarding ramps: The slope of an external boarding ramp must not exceed: (a) 1 in 14 for unassisted access (AS/NZS3856.1 (1998) Clause 2.1.8 (e) (including the notes)); and (b) 1 in 8 for unassisted access where the ramp length is less than 1520 mm (AS1428.2 (1992) Clause 8.4.2 (a) and AS1428.1 (2001) Figure 8); and (c) 1 in 4 for assisted access (AS/NZS3856.1 (1998) Clause 2.1.8 (e)).	DDA.T-8	OA-AU	target groups	standard	transit vehicle	@	@	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[boarding] When boarding devices must be provided: (1) A manual or power assisted boarding device must be available at any accessible entrance to a conveyance that has: (a) a vertical rise or gap exceeding 12 mm (AS/NZS3856.1 (1998) Clause 2.1.7 (f)); or (b) a horizontal gap exceeding 40 mm (AS/NZS3856.1 (1998) Clause 2.1.8 (g)).	DDA.T-9	OA-AU	target groups	standard	transit vehicle	@	@	entrance	@	Standards
However, the complex then starts building work and this encroaches on paths within the complex, making it difficult for assistance dog users to negotiate their way around.	EA.7-1	EU-UK	low vision	standard	indoor	@	hallway	@	@	Standards
[removing the physical feature] Display units at the entrance of a small shop restrict the ability of wheelchair users to enter the shop. The owner decides that, without any significant loss of selling space, the display units can be removed and repositioned	EA.7-2	EU-UK	wheelchair-general	standard	transition	@	entrance	entrance	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
elsewhere in the shop.										
[altering the physical feature] A private members' club has a high bar that puts wheelchair users at a substantial disadvantage when wanting to be served at the bar. The club lowers the bar so that wheelchair users can be served more easily.	EA.7-3	EU-UK	wheelchair-general	standard	indoor	@	service	service	@	Standards
[providing a reasonable means of avoiding the physical feature] The meeting room has two steps into it, which means that those who are wheelchair users or people with mobility impairments cannot use the room. The probation service decides to install a permanent ramp at the side of the two steps to enable disabled offenders to attend meetings.	EA.7-4	EU-UK	wheelchair-general	standard	transition	@	room	room	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[providing a reasonable means of avoiding the physical feature] The entrance to a local authority's planning office is up a flight of stairs. At ground level there is a bell and a sign saying 'Please ring for disabled access'. However, the bell is not answered promptly, even in bad weather, so that a disabled person meeting officials often has to wait for an unreasonable amount of time before gaining access to the building.	EA.7-5	EU-UK	target groups	standard	transition	@	entrance	@	@	Standards
[normal day-to-day activities] using public transport	EA.App-1	EU-UK	target groups	standard	outdoor	@	@	@	transit-general	Standards
[normal day-to-day activities] going to the toilet	EA.App-2	EU-UK	target groups	standard	indoor	@	@	@	bathroom	Standards
[pedestrian access route] R302.3 Continuous Width. Except as provided in R302.3.1, the continuous clear width of pedestrian access routes shall be 1.2 m (4.0 ft) minimum, exclusive of the width of the curb.	PROW-1	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[pedestrian access route-cross slope] Advisory R302.7.1 Vertical Alignment. Pedestrian access route surfaces must be generally planar and smooth. Surfaces should be chosen for easy rollability. Surfaces that are heavily textured, rough, or chamfered and paving systems consisting of individual units that cannot be laid in plane will greatly increase rolling resistance and subject pedestrians who use wheelchairs, scooters, and rolling walkers to the stressful and often painful effects of vibration.	PROW-10	NA-US	wheelchair-general	standard	outdoor	@	@	pedestrian path	@	Standards
[pedestrian access route-cross slope] R302.7.2 Vertical Surface Discontinuities. Vertical surface discontinuities shall be 13 mm (0.5 in) maximum. Vertical surface discontinuities between 6.4 mm (0.25 in) and 13 mm (0.5 in) shall be beveled with a slope not steeper than 50 percent. The bevel	PROW-11	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
shall be applied across the entire vertical surface discontinuity.										
[pedestrian access route-cross slope] R302.7.3 Horizontal Openings. Horizontal openings in gratings and joints shall not permit passage of a sphere more than 13 mm (0.5 in) in diameter. Elongated openings in gratings shall be placed so that the long dimension is perpendicular to the dominant direction of travel.	PROW-12	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards
[pedestrian access route-cross slope] R302.7.4 Flangeway Gaps. Flangeway gaps at pedestrian at-grade rail pedestrian crossings shall be 64 mm (2.5 in) maximum on non-freight rail track and 75 mm (3 in) maximum on freight rail track.	PROW-13	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[pedestrian access route-cross slope] Advisory R302.7.4 Flangeway Gaps. Flangeway gaps are necessary to allow the passage of train wheel flanges. Flangeway gaps pose a potential hazard to pedestrians who use wheelchairs because the gaps can entrap the wheelchair casters.	PROW-14	NA-US	wheelchair-general	standard	outdoor	@	@	pedestrian path	@	Standards
[curb ramps and blended transitions-perpendicular curb ramps] R304.2.1 Turning Space. A turning space 1.2 m (4.0 ft) minimum by 1.2 m (4.0 ft) minimum shall be provided at the top of the curb ramp and shall be permitted to overlap other turning spaces and clear spaces. Where the turning space is constrained at the back-of-sidewalk, the turning space shall be 1.2 m (4.0 ft) minimum by 1.5 m (5.0 ft) minimum. The 1.5 m (5.0 ft) dimension shall be provided in the direction of the ramp run.	PROW-15	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[curb ramps and blended transitions-perpendicular curb ramps] R304.2.2 Running Slope. The running slope of the curb ramp shall cut through or shall be built up to the curb at right angles or shall meet the gutter grade break at right angles where the curb is curved. The running slope of the curb ramp shall be 5 percent minimum and 8.3 percent maximum but shall not require the ramp length to exceed 4.5 m (15.0 ft). The running slope of the turning space shall be 2 percent maximum.	PROW-16	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards
[curb ramps and blended transitions-perpendicular curb ramps] R304.2.3 Flared Sides. Where a pedestrian circulation path crosses the curb ramp, flared sides shall be sloped 10 percent maximum, measured parallel to the curb line.	PROW-17	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[curb ramps and blended transitions-parallel curb ramps] R304.3.1 Turning Space. A turning space 1.2 m (4.0 ft) minimum by 1.2 m (4.0 ft) minimum shall be provided at the bottom of the curb ramp and shall be permitted to overlap other turning spaces and clear spaces. If the turning space is constrained on 2 or more sides, the turning space shall be 1.2 m (4.0 ft) minimum by 1.5 m (5.0 ft). The 1.5 m (5.0 ft) dimension shall be provided in the direction of the pedestrian street pedestrian crossing.	PROW-18	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards
[curb ramps and blended transitions-parallel curb ramps]R304.3.2 Running Slope. The running slope of the curb ramp shall be in-line with the direction of sidewalk travel. The running slope of the curb ramp shall be 5 percent minimum and 8.3 percent maximum but shall not require the ramp length to exceed 4.5 m (15.0 ft)	PROW-19	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
minimum. The running slope of the turning space shall be 2 percent maximum.										
[pedestrian access routes-continuous width] R302.3.1 Medians and Pedestrian Refuge Islands. The clear width of pedestrian access routes within medians and pedestrian refuge islands shall be 1.5 m (5.0 ft) minimum.	PROW-2	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards
[curb ramps and blended transitions-blended transitions] R304.4.1 Running Slope. The running slope of blended transitions shall be 5 percent maximum.	PROW-20	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards
[curb ramps and blended transitions-blended transitions] R304.5.1 Width. The clear width of curb ramp runs (excluding any flared sides), blended transitions, and turning spaces shall be 1.2 m (4.0 ft) minimum.	PROW-21	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[curb ramps and blended transitions-blended transitions] R304.5.2 Grade Breaks. Grade breaks at the top and bottom of curb ramp runs shall be perpendicular to the direction of the ramp run. Grade breaks shall not be permitted on the surface of ramp runs and turning spaces. Surface slopes that meet at grade breaks shall be flush.	PROW-22	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards
[curb ramps and blended transitions-blended transitions] R304.5.3 Cross Slope. The cross slope of curb ramps, blended transitions, and turning spaces shall be 2 percent maximum. At pedestrian street pedestrian crossings without yield or stop control and at midblock pedestrian street pedestrian crossings, the cross slope shall be permitted to equal the street or highway grade.	PROW-23	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[curb ramps and blended transitions-blended transitions] R304.5.4 Counter Slope. The counter slope of the gutter or street at the foot of curb ramp runs, blended transitions, and turning spaces shall be 5 percent maximum.	PROW-24	NA-US	target groups	standard	outdoor	@	@	ramp	@	Standards
[curb ramps and blended transitions-blended transitions] R304.5.5 Clear Space. Beyond the bottom grade break, a clear space 1.2 m (4.0 ft) minimum by 1.2 m (4.0 ft) minimum shall be provided within the width of the pedestrian street pedestrian crossing and wholly outside the parallel vehicle travel lane.	PROW-25	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards
[detectable warning surfaces] R305.1.1 Dome Size. The truncated domes shall have a base diameter of 23 mm (0.9 in) minimum and 36 mm (1.4 in) maximum, a top diameter of 50 percent of the base diameter minimum and 65 percent of the base diameter maximum, and a height of 5 mm (0.2	PROW-26	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
in).										
[detectable warning surfaces] R305.1.2 Dome Spacing. The truncated domes shall have a center-to-center spacing of 41 mm (1.6 in) minimum and 61 mm (2.4 in) maximum, and a base-to-base spacing of 17 mm (0.65 in) minimum, measured between the most adjacent domes.	PROW-27	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards
[detectable warning surfaces] R305.1.3 Contrast. Detectable warning surfaces shall contrast visually with adjacent gutter, street or highway, or pedestrian access route surface, either light-on-dark or dark-on-light.	PROW-28	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards
[detectable warning surfaces] Advisory R305.1.3 Contrast. Visual contrast may be provided on the full surface of the curb ramp but should not extend to flared sides. Visual contrast	PROW-29	NA-US	wheelchair-general	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
also helps pedestrians who use wheelchairs to locate the curb ramp from the other side of the street.										
[pedestrian access route] R302.4 Passing Spaces. Where the clear width of pedestrian access routes is less than 1.5 m (5.0 ft), passing spaces shall be provided at intervals of 61 m (200.0 ft) maximum. Passing spaces shall be 1.5 m (5.0 ft) minimum by 1.5 m (5.0 ft) minimum. Passing spaces are permitted to overlap pedestrian access routes.	PROW-3	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards
[detectable warning surfaces] R305.1.4 Size. Detectable warning surfaces shall extend 610 mm (2.0 ft) minimum in the direction of pedestrian travel. At curb ramps and blended transitions, detectable warning surfaces shall extend the full width of the ramp run (excluding any flared sides), blended transition, or	PROW-30	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
turning space. At pedestrian at-grade rail pedestrian crossings not located within a street or highway, detectable warnings shall extend the full width of the pedestrian crossing.										
[detectable warning surfaces-size] At boarding platforms for buses and rail vehicles, detectable warning surfaces shall extend the full length of the public use areas of the platform. At boarding and alighting areas at sidewalk or street level transit-stops for rail vehicles, detectable warning surfaces shall extend the full length of the transit-stop.	PROW-31	NA-US	target groups	standard	outdoor	@	@	transit-stop	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[detectable warning surfaces] R305.2.1 Perpendicular Curb Ramps. On perpendicular curb ramps, detectable warning surfaces shall be placed as follows: 1. Where the ends of the bottom grade break are in front of the back of curb, detectable warning surfaces shall be placed at the back of curb. 2. Where the ends of the bottom grade break are behind the back of curb and the distance from either end of the bottom grade brake to the back of curb is 1.5 m (5.0 ft) or less, detectable warning surfaces shall be placed on the ramp run within one dome spacing of the bottom grade break. 3. Where the ends of the bottom grade break are behind the back of curb and the distance from either end of the bottom grade brake to the back of curb is more than 1.5 m (5.0 ft), detectable warning surfaces shall be placed on the lower	PROW-32	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
landing at the back of curb.										
[detectable warning surfaces] R305.2.2 Parallel Curb Ramps. On parallel curb ramps, detectable warning surfaces shall be placed on the turning space at the flush transition between the street and sidewalk.	PROW-33	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[detectable warning surfaces] R305.2.3 Blended Transitions. On blended transitions, detectable warning surfaces shall be placed at the back of curb. Where raised pedestrian street pedestrian crossings, depressed corners, or other level pedestrian street pedestrian crossings are provided, detectable warning surfaces shall be placed at the flush transition between the street and the sidewalk.	PROW-34	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards
[detectable warning surfaces] R305.2.4 Pedestrian Refuge Islands. At cut-through pedestrian refuge islands, detectable warning surfaces shall be placed at the edges of the pedestrian island and shall be separated by a 610 mm (2.0 ft) minimum length of surface without detectable warnings.	PROW-35	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[detectable warning surfaces] R305.2.5 Pedestrian At-Grade Rail pedestrian crossings. At pedestrian at-grade rail pedestrian crossings not located within a street or highway, detectable warning surfaces shall be placed on each side of the rail pedestrian crossing. The edge of the detectable warning surface nearest the rail pedestrian crossing shall be 1.8 m (6.0 ft) minimum and 4.6 m (15.0 ft) maximum from the centerline of the nearest rail. Where pedestrian gates are provided, detectable warning surfaces shall be placed on the side of the gates opposite the rail.	PROW-36	NA-US	target groups	standard	outdoor	@	@	pedestrian crossing	@	Standards
[detectable warning surfaces] R305.2.6 Boarding Platforms. At boarding platforms for buses and rail vehicles, detectable warning surfaces shall be placed at the boarding edge of the platform.	PROW-37	NA-US	target groups	standard	indoor-outdoor	@	@	transit-stop	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[detectable warning surfaces] R305.2.7 Boarding and Alighting Areas. At boarding and alighting areas at sidewalk or street level transit-stops for rail vehicles, detectable warning surfaces shall be placed at the side of the boarding and alighting area facing the rail vehicles.	PROW-38	NA-US	target groups	standard	outdoor	@	@	transit-stop	@	Standards
[pedestrian street pedestrian crossings] Advisory R306.3 Roundabouts. Pedestrian street pedestrian crossings at roundabouts can be difficult for pedestrians who are blind or have low vision to identify because the pedestrian crossings are located off to the side of the pedestrian circulation path around the street or highway. The continuous traffic flow at roundabouts removes many of the audible cues that pedestrians who are blind use to navigate pedestrian street pedestrian crossings. Water fountains and other features that	PROW-39	NA-US	low vision	standard	outdoor	@	@	pedestrian crossing	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
produce background noise should not be placed in the middle island of a roundabout because pedestrians who are blind use auditory cues to help detect gaps in traffic.										
[pedestrian access routes] R302.5 Grade. Except as provided in R302.5.1, where pedestrian access routes are contained within a street or highway right-of-way, the grade of pedestrian access routes shall not exceed the general grade established for the adjacent street or highway. Where pedestrian access routes are not contained within a street or highway right-of-way, the grade of pedestrian access routes shall be 5 percent maximum.	PROW-4	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[pedestrian street pedestrian crossings] R306.3.1 Separation. Where sidewalks are flush against the curb and pedestrian street pedestrian crossing is not intended, a continuous and detectable edge treatment shall be provided along the street side of the sidewalk. Detectable warning surfaces shall not be used for edge treatment. Where chains, fencing, or railings are used for edge treatment, they shall have a bottom edge 380 mm (15 in) maximum above the sidewalk.	PROW-40	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards
[transit-stops and transit shelters] Advisory R308.1 transit-stops. transit-stops should be located so that there is a level and stable surface for boarding vehicles. Locating transit-stops at signalized intersections increases the usability for pedestrian with disabilities.	PROW-41	NA-US	target groups	standard	outdoor	@	@	transit-stop	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[transit-stops and transit shelters] R308.1.1.1 Dimensions. Boarding and alighting areas shall provide a clear length of 2.4 m (8.0 ft) minimum, measured perpendicular to the curb or street or highway edge, and a clear width of 1.5 m (5.0 ft) minimum, measured parallel to the street or highway.	PROW-42	NA-US	target groups	standard	outdoor	@	@	transit-stop	@	Standards
[transit-stops and transit shelters] R308.1.1.2 Grade. Parallel to the street or highway, the grade of boarding and alighting areas shall be the same as the street or highway, to the extent practicable. Perpendicular to the street or highway, the grade of boarding and alighting areas shall not be steeper than 2 percent.	PROW-43	NA-US	target groups	standard	outdoor	@	@	transit-stop	@	Standards
[transit-stops and transit shelters] R308.1.2.2 Slope. Boarding platforms shall not exceed a slope of 2 percent in any direction. Where boarding platforms serve vehicles operating on existing track or existing	PROW-44	NA-US	target groups	standard	indoor-outdoor	@	@	transit-stop	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
street or highway, the slope of the platform parallel to the track or the street or highway is permitted to be equal to the grade of the track or street or highway.										
[transit-stops and transit shelters] R308.1.3.2 Connection. Boarding and alighting areas and boarding platforms shall be connected to streets, sidewalks, or pedestrian circulation paths by pedestrian access routes complying with R302.	PROW-45	NA-US	target groups	standard	indoor-outdoor	@	@	transit-stop	@	Standards
[transit-stops and transit shelters] R308.2 Transit Shelters. Transit shelters shall be connected by pedestrian access routes complying with R302 to boarding and alighting areas or boarding platforms complying with R308.1. Transit shelters shall provide a minimum clear space complying with R404 entirely within the shelter. Where seating is provided	PROW-46	NA-US	target groups	standard	indoor	@	@	transit-stop	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
within transit shelters, the clear space shall be located either at one end of a seat or shall not overlap the area within 460 mm (1.5 ft) from the front edge of the seat. Environmental controls within transit shelters shall be proximity-actuated. Protruding objects within transit shelters shall comply with R402.										
[transit-stops and transit shelters] Advisory R308.2 Transit Shelters. The clear space must be located entirely within the transit shelter and not interfere with other persons using the seating.	PROW-47	NA-US	target groups	standard	indoor	@	@	transit-stop	@	Standards
[on-street parking spaces] Advisory R309.2 Parallel Parking Spaces. The sidewalk adjacent to accessible parallel parking spaces should be free of signs, street furniture, and other obstructions to permit deployment of a van side-lift or ramp or the vehicle occupant to transfer to a wheelchair or	PROW-48	NA-US	target groups	standard	outdoor	@	pedestrian path	parking	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
scooter. Accessible parallel parking spaces located at the end of the block face are usable by vans that have rear lifts and cars that have scooter platforms.										
[on-street parking spaces] R309.2.1 Wide Sidewalks. Where the width of the adjacent sidewalk or available right-of-way exceeds 4.3 m (14.0 ft), an access aisle 1.5 m (5.0 ft) wide minimum shall be provided at street level the full length of the parking space and shall connect to a pedestrian access route. The access aisle shall comply with R302.7 and shall not encroach on the vehicular travel lane.	PROW-49	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards
[pedestrian access routes] R302.5.1 Pedestrian Street pedestrian crossings. Where pedestrian access routes are contained within pedestrian street pedestrian crossings, the grade of the	PROW-5	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
pedestrian access route shall be 5 percent maximum.										
[on-street parking spaces] R309.2.1.1 Alterations. In alterations where the street or sidewalk adjacent to the parking spaces is not altered, an access aisle shall not be required provided the parking spaces are located at the end of the block face.	PROW-50	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards
[on-street parking spaces] R309.2.2 Narrow Sidewalks. An access aisle is not required where the width of the adjacent sidewalk or the available right-of-way is less than or equal to 4.3 m (14.0 ft). When an access aisle is not provided, the parking spaces shall be located at the end of the block face.	PROW-51	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[on-street parking spaces] R309.3 Perpendicular or Angled Parking Spaces. Where perpendicular or angled parking is provided, an access aisle 2.4 m (8.0 ft) wide minimum shall be provided at street level the full length of the parking space and shall connect to a pedestrian access route. The access aisle shall comply with R302.7 and shall be marked so as to discourage parking in the access aisle. Two parking spaces are permitted to share a common access aisle.	PROW-52	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards
[on-street parking spaces] R309.4 Curb Ramps or Blended Transitions. Curb ramps or blended transitions complying with R304 shall connect the access aisle to the pedestrian access route. Curb ramps shall not be located within the access aisle.	PROW-53	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[on-street parking spaces] Advisory R309.4 Curb Ramps or Blended Transitions. At parallel parking spaces, curb ramps and blended transitions should be located so that a van side-lift or ramp can be deployed to the sidewalk and the vehicle occupant can transfer to a wheelchair or scooter. Parking spaces at the end of the block face can be served by curb ramps or blended transitions at the pedestrian street pedestrian crossing. Detectable warning surfaces are not required on curb ramps and blended transitions that connect the access aisle to the sidewalk, including where the sidewalk is at the same level as the parking spaces, unless the curb ramps and blended transitions also serve pedestrian street pedestrian crossings (see R208).	PROW-54	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[on-street parking spaces] R309.5.1 Location. At accessible parallel parking spaces, parking meters shall be located at the head or foot of the parking space.	PROW-55	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards
[on-street parking spaces] R309.5.2 Displays and Information. Displays and information shall be visible from a point located 1.0 m (3.3 ft) maximum above the center of the clear space in front of the parking meter or parking pay station.	PROW-56	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards
[passenger loading zones] R310.2 Vehicle Pull-Up Space. Passenger loading zones shall provide a vehicular pull-up space 2.4 m (8.0 ft) wide minimum and 6.1 m (20.0 ft) long minimum.; R310.3 Access Aisle. Passenger loading zones shall provide access aisles complying with R310.3 adjacent to the vehicle pull-up space. Access aisles shall be at the same level as the vehicle	PROW-57	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
pull-up space they serve and shall not overlap the vehicular travel lane. Curb ramps or blended transitions complying with R304 shall connect the access aisle to the pedestrian access route. Curb ramps are not permitted within the access aisle.										
[passenger loading zones] R310.3.1 Width. Access aisles serving vehicle pull-up spaces shall be 1.5 m (5.0 ft) wide minimum. R310.3.2 Length. Access aisles shall extend the full length of the vehicle pull-up spaces they serve. R310.3.3 Marking. Access aisles shall be marked so as to discourage parking in them.	PROW-58	NA-US	target groups	standard	outdoor	@	@	parking	@	Standards
[pedestrian access routes] R302.6 Cross Slope. Except as provided in R302.6.1 and R302.6.2, the cross slope of pedestrian access routes shall be 2 percent maximum.	PROW-6	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[pedestrian access routes] R302.6.1 Pedestrian Street pedestrian crossings Without Yield or Stop Control. Where pedestrian access routes are contained within pedestrian street pedestrian crossings without yield or stop control, the cross slope of the pedestrian access route shall be 5 percent maximum.	PROW-7	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards
[pedestrian access routes] R302.6.2 Midblock Pedestrian Street pedestrian crossings. Where pedestrian access routes are contained within midblock pedestrian street pedestrian crossings, the cross slope of the pedestrian access route shall be permitted to equal the street or highway grade.	PROW-8	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
[pedestrian access routes] R302.7.1 Vertical Alignment. Vertical alignment shall be generally planar within pedestrian access routes (including curb ramp runs, blended transitions, turning spaces, and gutter areas within pedestrian access routes) and surfaces at other elements and spaces required to comply with R302.7 that connect to pedestrian access routes. Grade breaks shall be flush. Where pedestrian access routes cross rails at grade, the pedestrian access route surface shall be level and flush with the top of rail at the outer edges of the rails, and the surface between the rails shall be aligned with the top of rail.	PROW-9	NA-US	target groups	standard	outdoor	@	@	pedestrian path	@	Standards
can go anywhere we choose, no fixed route, no cost	Challenges 1	NA-US	blind	member	outdoor	@	transit-general	@	@	Survey
I would use Pittsburgh's subway system more if I had a basic understanding of each station's layout. We go to PNC Park often for games, and even	Challenges 100	NA-US	blind	member	outdoor	transit-stop	transit-stop	outdoor space	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
knowing where to find the Subway stop is more a challenge than walking across the bridge to find a bus home.										
Traffic, even with pedestrian crossing signals, is confusing in intersections. J-walking between intersections is less confusing.	Challenges 101	NA-US	low vision	member	outdoor	@	pedestrian crossing	@	@	Survey
Noisy intersecitons in downtown are no easy for me to negotiate,	Challenges 102	NA-US	low vision	member	outdoor	@	pedestrian crossing	@	@	Survey
Many downtown sidewalks and streets have big potholes in them and are in terrible shape.	Challenges 103	NA-US	co-vision	member	outdoor	@	pedestrian path	@	@	Survey
Uneven terrain and badly maintained sidewalks are difficult to travel over.	Challenges 106	NA-US	wheelchair-power	member	outdoor	@	pedestrian path	@	@	Survey
Finding an empty seat can be problematic. Also knowing when to get off at my stop can be difficult, depending on whether announcements are made.	Challenges 11	NA-US	blind	member	transit vehicle	@	transit vehicle	@	@	Survey
getting adequate information in advance	Challenges 12	NA-US	blind	member	outdoor	transit-general	wayfinding	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
knowing what to expect en route, encountering unexpected obstacles en route	Challenges 13	NA-US	blind	member	outdoor	route-obstacles	@	@	@	Survey
If I haven't been to the destination before, I can get to the right block but may not know where the destination is located in the block.	Challenges 14	NA-US	blind	member	outdoor	route-destination	destination	@	@	Survey
Where is the bus stop? Sometimes they're not always at the corner.	Challenges 15	NA-US	blind	member	outdoor	transit-stop	transit-stop	@	@	Survey
Sidewalk contours - sometimes need to go much, much slower. These are the occasional times when you'd like to have a guide dog guide you and need to be 150% attentive to what your cane and ears are able to pick up.	Challenges 16	NA-US	blind	member	outdoor	@	pedestrian path	@	pedestrian path	Survey
Finding non-obvious entrances to buildings.	Challenges 17	NA-US	low vision	member	transition	@	building	@	entrance	Survey
It's sometimes hard to tell where you are especially if it's very noisy or there are a lot of obstacles to go around.	Challenges 18	NA-US	blind	member	outdoor	@	outdoor space	@	@	Survey
not knowing what to expect, no familiar or known route-landmarks	Challenges 19	NA-US	blind	member	outdoor	route-landmarks	outdoor space	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
If I called you and asked the running time between PIT and PHL on Megabus. What are my 3 choices from PIT to PHL on a weekday. Then they'll ask what date I want. But I just want some general information.	Challenges 2	NA-US	blind	member	outdoor	tourism	@	@	@	Survey
If I haven't been to the destination before, I don't know the route-landmarks to use. If the destination has a lot of open space finding my way is more difficult.	Challenges 20	NA-US	blind	member	outdoor	@	destination	@	@	Survey
Total unfamiliarity and noise cover all of the difficulties for me.	Challenges 21	NA-US	blind	member	outdoor	@	outdoor space	@	@	Survey
In unfamiliar areas, I have to locate route-landmarks for orientation -- sound, archetecture, smells, grass, etc.	Challenges 22	NA-US	blind	member	outdoor	@	@	outdoor space	outdoor space	Survey
If I'm unfamiliar with surroundings, it's often hard to figure out on my own where I need to go to get to a specific destination. E.G. Market Square is difficult for me.	Challenges 23	NA-US	blind	member	outdoor	@	outdoor space	@	@	Survey
Depending on how familiar I was with the outdoor spaces, in may be challenging in reaching my	Challenges 24	NA-US	low vision	member	outdoor	@	outdoor space	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
destination. For example, being on a college campus with varying paths of travel.										
Market Square; construction	Challenges 25	NA-US	co-vision	member	outdoor	@	outdoor space	@	@	Survey
not knowing the building lay-out, no known route-landmarks, wide open spaces with no means of setting a clear direction due to lack of any way-finding information	Challenges 27	NA-US	blind	member	indoor	building-layout	indoor space	@	@	Survey
If there are braille signs on the rooms the task is easier, but sometimes it's hard to find the braille signs.	Challenges 28	NA-US	blind	member	indoor	@	indoor space	@	@	Survey
Open spaces are also challenging. Finding elevators is also hard in a new environment.	Challenges 29	NA-US	blind	member	indoor	@	building	@	@	Survey
Getting accessible street layout and transit route info is sometimes difficult. Also just getting familiar with the general layout of a city can be troublesome.	Challenges 3	NA-US	blind	member	outdoor	wayfinding	@	@	@	Survey
If I don't know the place, I have to figure out the layout of the halls and room numbering system. Signage is often not accessible. If there are huge open spaces,	Challenges 30	NA-US	blind	member	indoor	building-layout	indoor space	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
it can be worse than outdoors										
If the location is unfamiliar, it's difficult to figure out where you need to be without some assistance or if you're lucky, you find raised numbers or letters on doors that assist.	Challenges 31	NA-US	blind	member	indoor	@	general mobility	building	@	Survey
It's hard to plan the indoor part of a route, since building information isn't usually available in advance.	Challenges 32	NA-US	blind	member	indoor	building-layout	wayfinding	@	@	Survey
Difficulty in the change of sound cues from indoor and outdoor and vice versa.	Challenges 33	NA-US	blind	member	transition	@	entrance	@	@	Survey
it is difficult to find information on where bus stops are located or what kind of street pedestrian crossings there is.	Challenges 34	NA-US	blind	member	outdoor	street layout	@	@	@	Survey
Inability to access clear directions.	Challenges 35	NA-US	blind	member	outdoor	route-directions	@	@	@	Survey
I can get info through the computer or my phone, but I still feel I lack necessary information about street layout and such.	Challenges 36	NA-US	blind	member	outdoor	street layout	@	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
It takes some adjusting. All kinds of sound cues, even tactual cues and what you pick up through your shoes or you feet. An example for sound would be going from indoor to outdoor if its windy - that can provide a terrible challenge. Going from rug environment on the inside to Lord knows what you might hit on the outside.	Challenges 37	NA-US	blind	member	transition	@	entrance	entrance	@	Survey
steps or flooring differences	Challenges 39	NA-US	wheelchair-manual	member	transition	@	entrance	@	@	Survey
learning what transportation is available	Challenges 4	NA-US	low vision	member	outdoor	transit-general	@	@	@	Survey
hall intersections, audible cues such as blowers or elevators carpet change to tile braille signs.	Challenges 40	NA-US	blind	member	indoor	@	@	indoor space	@	Survey
dorrways, steps, carpeted areas and surfaces.	Challenges 41	NA-US	blind	member	indoor	@	@	indoor space	@	Survey
I use the wall to follow to find things within a bathroom	Challenges 42	NA-US	blind	member	indoor	@	@	bathroom	@	Survey
I can hear openings such as doorways; different floor types or coverings; listening for elevator bells, escalator hums, etc.; listening for clues from other people; smells; listening for relevant	Challenges 43	NA-US	blind	member	indoor	@	@	indoor space	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
sounds--cash registers, etc.;										
I'd use number of doors and braille signage if available.	Challenges 44	NA-US	blind	member	indoor	route-landmarks	@	indoor space	@	Survey
Difference in feel of passing through one sized room through the doorway through another, always the texture of the floor (carpet vs. no carpet), even the different textures of rug (rubbery vs. softer). The sound - even though things are quiet, when you get used to it, your ears do pick up the difference between a very large room as opposed to smaller rooms. You can feel/hear when you're near a wall and a door frame you pass through and those kinds of things.	Challenges 45	NA-US	blind	member	indoor	@	@	indoor space	@	Survey
I use sound a lot indoors. Things like running water fountains, flushjing commodes, humming lights, printers, phone ringing, etc. I also tap my metal-tipped cane a bit now and then for the echo effect.	Challenges 46	NA-US	blind	member	indoor	@	@	indoor space	indoor space	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
noises like pop machines or air conditioners, doorways, walls or polls, windows, Echoes sometimes give clues. inclines or declines in terrain. Stairwells, if a door is opened to the outside, then sometimes that's a navigational clueI know there's more.	Challenges 47	NA-US	blind	member	indoor	@	@	indoor space	@	Survey
signs	Challenges 48	NA-US	low vision	member	indoor	@	@	indoor space	@	Survey
sinages, audio or talking signage	Challenges 49	NA-US	low vision	member	indoor	@	@	indoor space	@	Survey
What is available for assistance	Challenges 5	NA-US	wheelchair-manual	member	outdoor	assistance	@	@	@	Survey
Hall intersections, elevator bells, carpeting vs tile, ice makers or waterfountains humming, hearing hand dryers in restrooms, indoor decorative fountains	Challenges 50	NA-US	low vision	member	indoor	@	@	indoor space	@	Survey
Doorways, staircases, desks, entryways, open areas, basically any change in space or topography.	Challenges 51	NA-US	low vision	member	indoor	@	@	indoor space	@	Survey
windows, signage	Challenges 52	NA-US	low vision	member	indoor	@	@	indoor space	@	Survey
Windows	Challenges 53	NA-US	co-vision	member	indoor	@	@	indoor space	@	Survey
signs	Challenges 56	NA-US	wheelchair-manual	member	indoor	@	@	indoor space	@	Survey
Doors	Challenges 57	NA-US	wheelchair-power	member	indoor	@	@	indoor space	@	Survey
plaques	Challenges 58	NA-US	wheelchair-	member	indoor	@	@	indoor	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
			manual					space		
The trouble comes in unfamiliar areas, such as traveling from a hotel to a transit-stop in a strange city.	Challenges 6	NA-US	blind	member	outdoor	@	general mobility	@	@	Survey
poles, trees benches changes in sidewalks or terraine	Challenges 60	NA-US	blind	member	outdoor	@	@	outdoor space	@	Survey
sound	Challenges 61	NA-US	blind	member	outdoor	@	@	outdoor space	@	Survey
I listen for the sound of the train station, and sometimes I can tell by the smell. I will also follow the building line to know where I am.	Challenges 62	NA-US	blind	member	outdoor	@	@	transit-stop	transit-stop	Survey
listening to traffic flow; accessible pedestrian signals when they exist; obstacles such as poles, signs, garbage cans, etc.; different pavement types--sidewalk vs. road vs. driveway;	Challenges 63	NA-US	blind	member	outdoor	@	@	outdoor space	outdoor space	Survey
I'd use number of street pedestrian crossings, buildings, grassy areas next to side walks.	Challenges 64	NA-US	blind	member	outdoor	@	@	outdoor space	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Texture of sidewalks, we notice polls as we pass them, you can hear/feel parked cars along the curb. Something as big as buildings we don't like walking along the sidewalks where buildings and things are set way, way, way back because we lose one of our sound cues that way. It can be harder to stay in the middle of the sidewalk, if oyu will, because you don't have the building route-landmarks off to the side of you. When pedestrian crossing streets, we use the traffic moving in our direction for a good route-landmarks.	Challenges 65	NA-US	blind	member	outdoor	@	@	outdoor space	outdoor space	Survey
I might add that I use the sun quite often, as well as curbs, grasslines, traffic sounds, echoes off of buildings. I use a cane with a metal tip that gives me good echo information. Sometimes I even stomp my feet for the echo, like in a deserted parking lot when I need to find a building.	Challenges 66	NA-US	blind	member	outdoor	@	@	parking	outdoor space	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
Posts, bus shelters, crosswalks, audible pedestrian traffic signals	Challenges 67	NA-US	blind	member	outdoor	@	@	outdoor space	@	Survey
signs	Challenges 68	NA-US	low vision	member	outdoor	@	@	outdoor space	@	Survey
Traffic, talking pedestrian signals, other pedestrians, restaurant smells, music from a particular store, trunkated domes on sidewalks	Challenges 69	NA-US	low vision	member	outdoor	@	@	outdoor space	@	Survey
Unfamiliar or no accessability pedestrian crossings	Challenges 7	NA-US	low vision	member	outdoor	@	pedestrian path	@	@	Survey
I have low vision so I use some visual cues. I use sidewalks, stairs, building lines, streets, doorways, and I find myself using auditory things such as fountains.	Challenges 70	NA-US	low vision	member	outdoor	@	@	outdoor space	@	Survey
buildings, statues	Challenges 71	NA-US	low vision	member	outdoor	@	@	outdoor space	@	Survey
Roads	Challenges 72	NA-US	co-vision	member	outdoor	@	@	outdoor space	@	Survey
sinage	Challenges 74	NA-US	wheelchair-manual	member	outdoor	@	@	outdoor space	@	Survey
Buildings, street names	Challenges 75	NA-US	wheelchair-power	member	outdoor	@	@	outdoor space	@	Survey
awnings, ashtrays curbs	Challenges 77	NA-US	blind	member	transition	@	@	entrance	@	Survey
I work a dog, and its job is to keep the handler from encountering physical route-landmarks. I use hearing and sense of direction along	Challenges 78	NA-US	blind	member	transition	@	@	entrance	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
with knowing the type of surface, e.g. sidewalk, carpet etc.										
I just have to use my cane to find stairways and also I can hear traffic outside if I'm trying to find the exit to go outside.	Challenges 79	NA-US	blind	member	transition	@	@	entrance	@	Survey
curb cuts, sidewalk surfaces	Challenges 8	NA-US	wheelchair-manual	member	outdoor	@	pedestrian path	@	@	Survey
I'd use traffic pattterns,audible pedestrian signals, echoes from buildings or other solid objects in the environment, noises made by other pedestrians, smells in the environment such as a bakery or gas station	Challenges 80	NA-US	blind	member	transition	@	@	entrance	@	Survey
Door thresholds, steps/stairs, doorways	Challenges 81	NA-US	blind	member	transition	@	@	entrance	@	Survey
I use things like the sun on my face, sounds of spaces opening up, threshholds, etc.	Challenges 82	NA-US	blind	member	transition	@	@	entrance	@	Survey
Door thresholds, echos can if in courtyard transitioning between buildings. Stairs, grassy areas, sidewalks.	Challenges 83	NA-US	blind	member	transition	@	@	entrance	@	Survey
white cane or contrast	Challenges 84	NA-US	low vision	member	transition	@	@	entrance	@	Survey
Stairs, thresholds, carpeting,	Challenges 85	NA-US	low vision	member	transition	@	@	entrance	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
There are usually thresholds and stairs, light and doors.	Challenges 86	NA-US	low vision	member	transition	@	@	entrance	@	Survey
light sensitivity	Challenges 87	NA-US	co-vision	member	transition	@	@	entrance	@	Survey
Doorways	Challenges 90	NA-US	wheelchair-power	member	transition	@	@	entrance	@	Survey
Audible Pedestrian Signals are very good to have.	Challenges 93	NA-US	blind	member	outdoor	@	@	pedestrian path	@	Survey
It can be very difficult if there is a lot of noise and if there are a lot of obstacles to go around.	Challenges 94	NA-US	blind	member	outdoor	@	outdoor space	@	@	Survey
I used to think all I'd need to have in order to travel more independently was access to street sign information--but even with a GPS device there are still things which can cause problems--obstacles, construction, poorly-paved sidewalks, and tricky intersections.	Challenges 95	NA-US	blind	member	outdoor	street layout	outdoor space	@	@	Survey
I have traveled with my husband and his guide dog and many more of the challenges are mitigated by the presence of the dog.	Challenges 96	NA-US	blind	member	outdoor	@	@	general mobility	@	Survey
Construction makes traveling more difficult. I have to find the best way to get around it.	Challenges 97	NA-US	blind	member	outdoor	@	pedestrian path	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
I can only emphasize the factor of distractions, mostly of which are noise.	Challenges 98	NA-US	blind	member	outdoor	@	outdoor space	@	@	Survey
Traffic noise and heavy traffic volumes are terrible for me. Lot of stress. Even in familiar environments.	Challenges 99	NA-US	blind	member	outdoor	@	outdoor space	@	@	Survey
Using an App like BlindSquare along with Navigon provides very useful information about the environment.	Technology 1	NA-US	blind	member	outdoor	wayfinding	@	@	@	Survey
I have some basic peripheral vision and telescopes assist me.	Technology 10	NA-US	low vision	member	indoor-outdoor	@	@	general mobility	@	Survey
If I could get virbal instruction from them, they could be a help.	Technology 11	NA-US	low vision	member	indoor-outdoor	route-directions	@	@	@	Survey
There is a device called a mini guide I believe that might be useful in some situations for finding verticle objects, since the dog I work is trained to avoid them.	Technology 12	NA-US	blind	member	indoor-outdoor	public object	destination	@	@	Survey
My impression is that all the devices I have listed provide more detailed information about POIs and street layout than the solutions I currently use.	Technology 13	NA-US	blind	member	outdoor	street layout	@	@	@	Survey
I would like Seri to be able to find the next bus or other mass transit to my	Technology 14	NA-US	low vision	member	outdoor	transit-general	@	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
destination.										
I also sometimes use Navigon to get route instructions ahead of time.	Technology 15	NA-US	blind	member	outdoor	route-directions	@	@	@	Survey
I attempt to use the step-by-step directions to a destination to get an idea of what to expect on the route and general street layout.	Technology 16	NA-US	blind	member	outdoor	route-directions	@	@	@	Survey
I have also attempted to get street layout information from the graphics presentations in Apple Maps and Ariadne,	Technology 17	NA-US	blind	member	outdoor	street layout	@	@	@	Survey
It has bus and T schedules and I find it easy to use.	Technology 18	NA-US	blind	member	outdoor	transit-general	@	@	@	Survey
google maps inc. public transit + street view	Technology 19	NA-US	low vision	member	outdoor	transit-general	@	@	@	Survey
I find GPS useful because I get information I wouldn't otherwise have, such as names of intersections and route-landmarks.	Technology 2	NA-US	blind	member	outdoor	wayfinding	@	@	@	Survey
simple turn by turn driving directions (for travel by car)	Technology 20	NA-US	wheelchair-general	member	outdoor	route-directions	@	@	@	Survey
Explain about intersections and bus stops.	Technology 21	NA-US	blind	member	outdoor	wayfinding	@	@	@	Survey
Allow you to plan an indoor route in a	Technology 22	NA-US	blind	member	indoor	route-general	@	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
public building.										
It should give turn by turn directions and give me information as to what I'm passing along the way.	Technology 23	NA-US	blind	member	outdoor	route-directions	@	@	@	Survey
It would guide me from one point to another, avoiding obstacles, giving information about intersection configuration if needed,	Technology 24	NA-US	blind	member	outdoor	pedestrian crossing	@	@	@	Survey
It would be able to navigate inside buildings as well, providing details of the indoor environment as well.	Technology 25	NA-US	blind	member	indoor	building-general	@	@	@	Survey
The tool would list intersections and route-landmarks. It would also let me look at the intersections and route-landmarks when I was still at my home so I could familiarize myself with the area before actually going out.	Technology 26	NA-US	blind	member	outdoor	wayfinding	@	wayfinding	@	Survey
I would like real time accurate announcement of approaching intersections with details about the type of intersection and sidewalks.	Technology 27	NA-US	blind	member	outdoor	pedestrian crossing	@	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
I'd be able to travel to a shopping mall and know where each store is in that mall based on info I'd get from the tool.	Technology 28	NA-US	blind	member	indoor	building-layout	@	@	@	Survey
provide 'driving directions' for taking public transit in unfamiliar city	Technology 29	NA-US	low vision	member	outdoor	transit-general	@	@	@	Survey
I also like setting my own points of interest.	Technology 3	NA-US	blind	member	outdoor	route-destination	@	@	@	Survey
I think that I would like a vest or jackett covered with sensors so that I could get from place to place with out worrying about obsticals or steps up or down.	Technology 30	NA-US	low vision	member	indoor-outdoor	@	wayfinding	@	@	Survey
it would also give turn by turn navigation.	Technology 31	NA-US	low vision	member	outdoor	route-directions	@	@	@	Survey
Could have the ability to save a route for future reference.	Technology 32	NA-US	blind	member	outdoor	route-general	@	@	@	Survey
it would indicate when you were approaching a signal controled intersetction.	Technology 33	NA-US	blind	member	outdoor	pedestrian path	@	@	@	Survey
Give as much information as possible. It would be nice if it could tell me what buses come at a specific bus stop.	Technology 34	NA-US	blind	member	outdoor	transit-stop	@	@	@	Survey
the ability to learn new environments	Technology 35	NA-US	blind	member	outdoor	wayfinding	@	@	wayfinding	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
The option to use a tactile graphical display in real time for street and POI layout.	Technology 36	NA-US	blind	member	outdoor	street layout	@	@	@	Survey
Turn-by-turn directions, directional information, left or right side of a street named for a destination	Technology 37	NA-US	blind	member	outdoor	route-directions	@	@	@	Survey
Also it would have the capacity to offline plan and trace a route prior to travel.	Technology 38	NA-US	blind	member	outdoor	route-general	@	@	@	Survey
Would give me specific route-landmarks for where I was; smellavision	Technology 39	NA-US	blind	member	outdoor	route-landmarks	@	@	@	Survey
I would like to see better software that explains a route completely. Some planning tools don't give good walking directions, for example.	Technology 4	NA-US	blind	member	outdoor	route-directions	@	@	@	Survey
'here is your bus, get on'. 'get off at next stop' 'next bus stop is in two blocks east'	Technology 40	NA-US	low vision	member	transit vehicle	route-directions	@	@	@	Survey
it would need to know where bus/train is (not just official schedule)	Technology 41	NA-US	low vision	member	transit vehicle	transit-general	@	@	@	Survey
There is an equal need for way-finding assistance indoors and this is one area still not covered by any current technologies.	Technology 42	NA-US	blind	member	indoor	wayfinding	@	@	@	Survey

Segment of text	Segment #	Location	Traveler	Source	Environment	Information	Barrier	Facilitator	Action	Dataset
I would like to use voice commands to find directions and to locate the bus or other vehicle	Technology 43	NA-US	blind	member	outdoor	route-directions	@	@	@	Survey
to locate transit-stops and know which side of the street I need to be on.	Technology 44	NA-US	low vision	member	outdoor	transit-stop	@	@	@	Survey
I use BlindSquare for knowing what is in the environment	Technology 6	NA-US	blind	member	outdoor	wayfinding	@	@	@	Survey
Navigon when I need to plan a route.	Technology 7	NA-US	blind	member	outdoor	route-general	@	@	@	Survey
With up and down arrow, I can virtually walk a path. It is extremely exact and it even gives you the number of feet between streets. You can end up getting the total mileage of the trip. You get the compass directions as you make turns.	Technology 8	NA-US	blind	member	outdoor	route-general	@	@	@	Survey
Seeing Eye GPS gives better turn by turn directions, but BS is more accurate.	Technology 9	NA-US	blind	member	outdoor	route-directions	@	@	@	Survey

APPENDIX C

WAYFINDING INFORMATION NEEDS

This appendix lists the queries extracted from the coding of wayfinding information needs.

Table 34 Wayfinding Information Needs

Wayfinding Information Need	Traveler	Location	Data sources
TRANSIT STOP			
Where is the station entrance?	Low vision	NA	Dialogue-29
What is the route from the station entrance to the platform and vice versa?	Low vision	NA	Dialogue-29, Dialogue-34, Technology-29
	WCU	NA	Dialogue-1
What is the station's layout?	Blind	NA	Challenges-100
Where is the transit stop or station, exactly? (e.g., which side of the street Hara-4 & Tech-44)	Blind	NA	Challenges-15, Challenges-100
	Target groups	NA	Dialogue-38
	Low vision	NA	Hara-4, Technology-44

		EU	Laakso12-18
What type of bus stop is it? What is at the bus stop?	Blind	Asia	Chen-18
		NA	Technology-21
What is the bus stop made of?	Low vision	EU	Hine-3
What direction does the bus/train go?	Blind	Asia	Chen-18
	Low vision	EU	Laakso12-15
I want to know about transit stops	Target groups	EU	Laakso11-13
	Blind	Asia	Chen-4
		NA	Dialogue-52
	Low vision	NA	Dialogue-32
		EU	Pressl10-1
What is the bus stop number?	Target groups	NA	Dialogue-38
When is the bus next bus coming?	Target groups	NA	Dialogue-38
	WCU	NA	Dialogue-55
Which metro is coming next?	Low vision	EU	Laakso12-15
		NA	Hara-12, Technology-14
What landmarks are at the transit stop?	Low vision	NA	Hara-10
Is the bus stop accessible?	WCU	NA	Ding-6
Which buses come to this bus stop?	Blind	NA	Technology-34
PUBLIC TRANSIT			
How frequently does the bus come? I want timetables for a specific route.	Low vision	EU	Laakso12-15
		NA	Dialogue-31
	Blind	NA	Technology-18
		Asia	Chen-18

What public transportation is available? What transit routes are available?	Low vision	EU	Laakso12-15
		NA	Challenges-4, Dialogue-31, Technology-19
		Asia	Yau-2
	Target groups	NA	Dialogue-27, Dialogue-53
		Asia	Packer07-6
	Blind	NA	Dialogue-52, Challenges-3
	WCU	NA	Ding-6
		EU	Menkens-13
I want detailed transportation information.	Blind	Asia	Chen-10
	Low vision	EU	Laakso12-23
Which bus should I take?	Low vision	NA	Dialogue-29, Hara-3
Which stop should I deboard?	Low vision	NA	Dialogue-29, Hara-3, Technology-40
Has this transit route been changed lately?	Target groups	NA	Dialogue-53
Where is the bus now?	WCU	NA	Dialogue-55
	Low vision	NA	Technology-41
What time does the bus arrive?	Target groups	NA	Dialogue-37
What physical obstacles will I encounter at public transit?	Target groups	Asia	Poria-2
TOURISM			
I want comprehensive information about the accessibility of potential holiday destinations.	WCU	OA	Darcy-2
I want *general* information about options for long distance public transportation.	Blind	NA	Challenges-2
What accommodations (e.g., hotels) are accessible?	WCU	OA	Darcy-1
	Target	Asia	Packer07-5

	groups		
What attractions (e.g., scenic spots) are accessible?	WCU	OA	Darcy-1
		EU	Pressl10-18
	Low vision	Asia	Yau-1
What restaurants, shops and leisure facilities are in the area?	WCU	EU	Menkens-11
What sites and museums are in the area?	WCU	EU	Pressl10-19
BATHROOMS			
Are their accessible bathrooms available?	WCU	Asia	Israeli-6
		EU	Matthews-18, Pressl10-17
	Low vision	Asia	Yau-1
		EU	Pressl10-15
ENTRANCES			
Are their doors that require key access?	WCU	NA	Pusch-5
Is the entrance ramped?	WCU	Asia	Israeli-5
		EU	Menkens-9
		NA	Ding-1
What kind of door is at the building entrance (manual, automatic)?	WCU	NA	Ding-1
Which entrance is accessible?	Blind	Asia	Chen-11
Where is the entrance to the building, exactly?	Blind	Asia	Chen-2
	Low vision	EU	Laakso12-39
ASSISTANCE			
What assistance is available?	Target groups	Asia	Yau-3, Packer07-7
	WCU	NA	Challenges-5
STREET LAYOUT			
What do the street signs say?	Blind	NA	Challenges-95

What obstacles or barriers are in the area?	WCU	EU	Bromley-10
What kind of intersections are in the area?	Blind	NA	Challenges-95, Challenges-34
	Low vision	EU	Hine-1
What is in the environment?* (houses, house numbers)	Blind	EU	Strothotte-1
		NA	Technology-6; Technology-1; Technology 35
	Low vision	EU	Laakso12-27
What POIs are in the area? (medical care facilities, shops/shopping facilities, public telephones, public clinics)	Blind	NA	Technology-13, Technology-36
		EU	Strothotte-4, Kammoun-1
	WCU	EU	Menkens-14
	Low vision	EU	Laakso12-19, Laakso12-30, Volkel-1, Pressl10-14, Hine-2
What is the layout of the streets in the area?	Blind	NA	Technology-13, Technology-17, Technology-16, Technology-36, Challenges-36, Challenges-3
	Low vision	NA	Dialogue-30
	Low vision	EU	Hine-1
Where are bus stops located in the area?	Blind	NA	Challenges-34
Is street X accessible?	Low vision	NA	Dialogue-33
Is a certain stretch (segment) of street X accessible?	Low vision	NA	Dialogue-33
What landmarks are in the area? (bus shelter, hedge, newspaper rack, coffee shop, hot dog stand, different sounds, vertical objects).	Blind	NA	Technology-12
	Low vision	NA	Hara-11
		EU	Laakso12-3
Are their large open spaces (squares/parks) in the area?	Low vision	EU	Laakso12-1, Pressl10-5
SERVICE ANIMALS			

Where can my dog relieve itself?	Target groups	NA	Dialogue-26
ROUTE-OBSTACLES			
What obstacles are on the route? (ice or water)	Blind	NA	Challenges-13
	Low vision	EU	Laakso12-20
	Target groups	Asia	Poria-1
Where are the obstacles located along the route?	Blind	Asia	Chen-5
ROUTE-LANDMARKS			
What landmarks are along the route? (surrounding streets, POIs, changes in ground texture, telephone poles, traffic lights; location of trees, fire hydrants, utility poles, bike racks)	Blind	EU	Kammoun-8, Kammoun-2
		NA	Challenges-19, Technology-2, Technology-26
	Low vision	EU	Laakso12-30
		NA	Hara-13, Helal-1
What landmarks are inside the building? (number of doors, braille signage)	Blind	NA	Challenges-44, Challenges-27
What visible landmarks are along the route? (towers, fountains, benches)	Target groups	EU	Laakso11-14, Laakso11-6
What sonic landmarks are along the route? (water fountains, basins, natural creeks, ditches, rivers with running water)	Target groups	EU	Laakso11-14, Laakso11-18
What olfactory landmarks are along the route?	Blind	NA	Technology-39
ROUTE-GRADIENT			
Does the route have a steep slope?	Low vision	EU	Laakso12-32
	WCU	EU	Menkens-5
ROUTE-GENERAL			

What are the possible routes to my destination?*	Blind	EU	Strothotte-1
		Asia	Chen-9
What is the route from my origin to the transit stop?	Low vision	NA	Dialogue-29, Technology-40
	Blind	Asia	Chen-10
What is the route from the transit stop to my destination?	Low vision	NA	Dialogue-29
What is the number of feet between each street along the route?	Blind	NA	Technology-8
What is the total length of the trip?	Blind	NA	Technology-8
	Low vision	EU	Laakso12-4
	WCU	EU	Menkens-7
Which route should I take to the destination?	Target groups	NA	Dialogue-28
	Blind	NA	Technology-38, Technology-7
What is the total time of the trip?	WCU	EU	Menkens-7
I want information about the route. (direction of travel, grade of road, nearest pedestrian crossing, obstacles)	Blind	EU	Strothotte-2, Strothotte-3
		NA	Technology-4
Is the route safe?	Low vision	EU	Laakso12-35
What intersections are along the route?	Blind	NA	Technology-2; Technology-26
What kind of intersections are along the route?	Blind	NA	Technology-21
Is the route accessible?	Low vision	Asia	Yau-4
		NA	Dialogue-34
	WCU	NA	Dialogue-36
ROUTE-ENROUTE			
What turns are included in the route?	Low vision	EU	Laakso12-21
Which streets will I cross before turning?	Low vision	EU	Laakso12-21
ROUTE DIRECTIONS			
What are the turn-by-turn directions along the route?	Low vision	EU	Laakso12-17, Hara-7

		NA	Technology-31
	Blind	NA	Technology-23, Technology-15, Technology-16, Technology-37, Technology-4, Technology-9, Technology-42
		Asia	Chen-1
	Target groups	NA	Dialogue-37
What are the turn-by-turn directions along the route (driving)?	WCU	NA	Technology-20
Are clear directions available?	Blind	NA	Challenges-35
What routing options are available? (fastest time, all bus, all rail, shortest walking distance)	Low vision	NA	Dialogue-34
ROUTE-DESTINATION			
I want information about my destination (e.g., business hours, side of the street, where in the block)	Blind	Asia	Chen-20
		NA	Technology-37, Challenges-14
Where is the nearest transit stop? [add to list of POI?]	Blind	EU	Strothotte-5
Which POI are accessible?	WCU	EU	Menkens-6
PARKING			
What accessible parking spaces are available?	Target groups	NA	Dialogue-21
	WCU	Asia	Israeli-3
		EU	Menkens-12, Pressl10-16, Bromley-10
What are the turn-by-turn directions to the parking space?	Target groups	NA	Dialogue-21
Where should I park to have the best accessibility?	Target groups	NA	Dialogue-4
What is the width of available parking spaces and loading zones?	WCU	NA	Ding-5

LIGHTING			
Are streetlights present along the path?	Target groups	EU	Laakso11-16
	WCU	NA	Ding-4
ELEVATOR			
Does the building have an elevator?	WCU	Asia	Israeli-2
		EU	Menkens-9
	Target groups	EU	Laakso11-10
BUILDING-LAYOUT			
What is the layout of the building or facility?	Blind	NA	Challenges-27, Challenges-30, Challenges-32, Technology-28, Technology-25
Does the building have wide open spaces?	Blind	NA	Challenges-27, Challenges-30
What is the layout of the store?	WCU	EU	Bromley-10
Is emergency egress information available?	Low vision	OA	Packer08-4
What does the building look like (shape, material)?	Blind	Asia	Chen-19
Does the building have stairs inside?	WCU	Asia	Israeli-1
PEDESTRIAN PATH			
What is the length of the handrail?	Blind	Asia	Chen-6
Which sidewalks are accessible (steep slopes, stairs, traffic lights without audible pedestrian signals)?	WCU	Asia	Israeli-4
	Target groups	EU	Laakso11-7
Do non-signalized stairs have tactile paving?	Low vision	EU	Laakso12-41
Are their obstacles along the path?	Blind	Asia	Chen-12
Does the path have surface irregularities?	Blind	Asia	Chen-12
What is the sidewalk condition (cracks, potholes, materials)?	WCU	NA	Ding-2
		EU	Volkel-3

	Blind	NA	Challenges-95
	Low vision	EU	Laakso12-16
Is the sidewalk congested with pedestrian traffic?	WCU	NA	Ding-2
What is the width of the sidewalk?	WCU	NA	Ding-2
		EU	Menkens-5
	Low vision	EU	Laakso12-36
	Target groups	EU	Laakso11-9
What is the slope of the sidewalk?	WCU	NA	Ding-2
		EU	Menkens-5
	Low vision	EU	Laakso12-32
	Target groups	EU	Laakso11-9
What is the grade of the sidewalk?	WCU	NA	Ding-2
Are their steps along the sidewalk?	WCU	NA	Ding-2
		EU	Pressl10-6, Volkel-3
	Target groups	EU	Laakso11-2
What is the height of the curb?	WCU	NA	Ding-3
		EU	Menkens-5
What type of street is it?	Target groups	EU	Laakso11-1
What is the surface of the sidewalk?	Low vision	EU	Laakso12-36, Pressl10-4
	WCU	EU	Menkens-10, Pressl10-7
	Target groups	EU	Laakso11-1
What is the smoothness of the sidewalk?	Target groups	EU	Laakso11-1
Where are pedestrian subways, overpasses, bridges, tunnels?	Target groups	EU	Laakso11-12, Laakso11-3

I want information about the pedestrian path (obstacles, high curbs, construction sites, maintenance, snow removal)	Target groups	EU	Laakso11-17
Do the steps have handrails?	Target groups	EU	Laakso11-2
What obstacles are on the sidewalk? (stairs, blocks, traps, trees, pedestrian crossings; construction, scaffolding, bollards, bars; cordons and gates; traffic signs and rubbish bins)	Blind	NA	Challenges-95
	Low vision	NA	Dialogue-39
		EU	Laakso12-43, Laakso12-37
	WCU	EU	Pressl10-9
Is there construction near the area?*	Blind	NA	Challenges-95
	WCU	EU	Menkens-8
Are their construction sites along the sidewalk? (obstacle)	Low vision	EU	Pressl10-2
What are the details of the sidewalk?	Blind	NA	Technology-27
PEDESTRIAN CROSSING			
How is the intersection configured?	Blind	NA	Technology-24
What type of intersection is it?	Blind	NA	Technology-27
Where is the pedestrian crossing?	Blind	Asia	Chen-3
How many lanes of traffic (how wide an area) need to be crossed?	Target groups	NA	Dialogue-15
	Blind	Asia	Chen-7
What is the state of the pedesrian signal?	Blind	NA	Dialogue50
What street and direction is associated with the button I just pushed?	Blind	NA	Dialogue50
Is the pedestrian crossing present?	Blind	EU	Kammoun-4
Does the pedestrian crossing have an audible signal?	Target	EU	Laakso11-11

	groups		
	Low vision	EU	Laakso12-37, Pressl10-3
Is there a traffic light at the pedestrian crossing?	Low vision	EU	Laakso12-40, Pressl10-3
Does the crossing have tactile paving?	Low vision	EU	Laakso12-41, Pressl10-13
What is the width of the curb cut?	WCU	NA	Ding-3
What is the slope of the curb cut?	WCU	NA	Ding-3
How long is the landing of the ramp?	WCU	NA	Ding-3
Does the sidewalk have a curb cut?	Low vision	EU	Laakso12-42
	WCU	EU	Pressl10-8, Volkel-3
Is the crossing signal controlled?	Blind	NA	Technology-33
Does the crossing have a traffic island?	WCU	EU	Volkel-3
	Low vision	EU	Laakso12-40
	Target groups	EU	Laakso11-4

APPENDIX D

BARRIERS, FACILITATORS AND ACTIONS

This appendix includes four tables. Table 35 and Table 36 report barriers and facilitators to specific actions in the environment for people with low to no vision across six continents. Table 37 and Table 38 do the same for people who travel in wheelchairs.

Table 35 Barriers for People with Low to No Vision

hinder-LNV	Action	North America	Europe	Oceania	Asia, Africa, South America
route	Orient	trafficHeavy (Challenges-99M), obstacles (Challenges-18M, Swobodzinski-2R, Yaagoubi13-1R), unfamiliar (Challenges-21M, 23M, 19M)	no signAudible, no signTactile (Laakso11-18R)	obstacles (DDA.T-2)	
routeIndoor	Listen	noise (Gossett-5R)			
routeOutdoor	Listen	noise (Challenges-98M, 21M, 99M),		soundBouncing (Packer08-2M)	
routeOutdoor	Touch	dogGuide (Technology-12M)			
routeInToOut	Orient	transitionSound (Challenges-33), transitionTexture (Challenges-37)			
bathroom	moveInSpace				ASIA: plastic handrails, floorSigns (Siu-9R)
entrance	openDoor	heavy door (Johnson-3R)			

entrance	passThroughDoorway	revolving door (ADA.4-6)		revolving door (Packer08-9M)	
entrance	approachDoorway			flight of stairs (Packer08-9M)	
interior door	readSign		locating the sign (Richards-1M)		ASIA: constant traffic through the entrance (Siu-7R)
interior door	passThroughDoorway		raised sill (Manuel-Sa-4R)		
elevator	discernWhichElevatorArrived			bank of elevators (Packer08-1M)	ASIA: no auditory cues (Packer07-1R)
elevator	pushButton	recessed ashtray (ADA.4-37)			
elevator	readSign				SOUTH AMERICA: braille symbols too small, incorrect braille (Nascimento-5R)
stairway	maintainBalance	OUT: cane slips into riser (AODA.S-56, ADA.5-13)	IN: no slip-resistant surfaces (Manual-Sa-3R), handrails not on both sides (Manual-Sa-3R)		
stairway	detectFlightStairs		non-signalized stairs (Laakso12-11R, Manuel-Sa-3R)		
stairway	approachStairway	OUT: wet conditions (ADA.5-16)			
building	moveInSpace	no braille signs or audio indicators (Freeman-3R), open spaces (Challenges-29M, 27M, 30M), poor lighting (Thapar-4R), protruding objects (Swobodzinski-1R)		open spaces (Packer08-8M)	ASIA: Protruding objects with sharp edges (Kutintara-1R) SOUTH AMERICA: non-signalized overhead obstacles (Nascimento-3R),
building	moveDownHallway		construction work in hallway (EA.7-1)		

building	locateEntrance				ASIA: sharp edges and door jambs (Siu-3R)
building	locateDestination	no signage and directories (Thapar-5R) poor lighting (Thapar-6R)			
building	approachEntrance				SOUTH AMERICA: steep paths to the entrance (Nascimento-4R)
destination	recognizeArrival	open space (Challenges-20M)			
destination	locateEntrance	poor lighting (Thapar-6R)			
ramp	stayOnRamp	no guiderail (Gossett-4R)			
ramp	ascendRamp	openings in surface (AODA.S-49)			
service	interactWithEmployees				SOUTH AMERICA: tactile path leads to wrong counter (Ferrer-1R)
service	seeDisplayedItems			poor lighting (Packer08-5M)	
path	moveAlongPath	obstacles [open manhole cover, basement doors, excessive street furniture, stairs, trees, open squares, construction] (Challenges-97M, Technology-30M, Kirchner-4R, Dialogue-39M, Challenges-25M), poor pavement maintenance (Challenges-103M), obstructions [construction] (Challenges-97M), openings on path (AODA.S-39), overhangs on the pathway [signs, tree branches] (AODA.S-37)	obstacles [ice or water, construction, bars, scaffolding, bollards, trash can, lamppoles] on path (Laakso12-20R, Laakso12-43R, Carlsson-4R), poor lighting (Laakso12-12R), overhangs on the pathway (Pressl06-2)	uneven surface (Packer08-6R), overhangs on pathway (Packer08-6R)	ASIA: obstacles [lamppole, advertising board, construction] (Chen-15R), steep slope (Chen-12R)
path	changeLevel	steps (Technology-30M, AODA.S-55)	steps (Carlsson-2R), non-signalized stairs (Laakso12-41R), high curb (Carlsson-2R)		
path	passPeople				ASIA: crowds (Evans-2M)

path	crossOpenSpace		no terrain differences, no useful sounds (Mehigan-3R)		
crossing	enterRoadway	oncoming traffic (AODA.S-61), position of ramp (AODA.S-69)	poorly signalized zebra (Laakso12-10R), bicycle lane (Pressl06-2R)		
crossing	hearSignal	noise (Challenges-102M), signal too soft (Dialogue-11M, Dialogue-49M), no pedestrian signal (Yaagoubi12-1R)	no pedestrian signal (Laakso12-8R, Miri-2R, Kammoun-6R)		
crossing	enterSidewalk		light is too short (Laakso12-14R)		
crossing	stayInCrosswalk	no pedestrian crosswalk (Yaagoubi12-1R)	no pedestrian crosswalk (Miri-2R)		
crossing	stopAtCurb	dropped curb (Laakso12-42R)	dropped curb (Volkel-4R)		
crossing	crossStreet	no pedestrian crossing (Challenges-7M)	no pedestrian crossing (Kammoun-6R), no traffic light (Pressl10-3R, Miri-2R)		
stop	findStop	OUT: not uniformly placed on block (Hara-4R, Challenges-15), not uniformly marked (Hara-5R), IN: do not know station layout (Challenges-100M)			
stop	waitAtStop		OUT: no weather protection (Carlsson-5R), transparent bus shelter (Hine-3R)		
stop	recognizeVehicle	noise (Dialogue-54M)			
vehicle	takeSeat secureChair	identifying empty seats (Challenges-11M)			
vehicle	boardVehicle	lack slip-resistant steps (AODA.T-30), lack slip resistant ramp (AODA.T28), open risers on steps (AODA.T-31), low contrast on ramp edge (AODA.T-28)			
vehicle	deboardVehicle		irregularities in the ped surface (Carlsson-1R)		
vehicle	makeStopRequest	no announcements (Challenges-11M)			
vehicle	rideVehicle	no paratransit eligibility out of state (Dialogue-51R)			

sign	readTactilely	locating the sign (Challenges-28M)	locating the sign (Richards-1M), no braille signs (Freeman-1R)		
sign	readVisually	dim lighting on signs, print too small (Reid-4R), shadows from lighting source, surface glare, no background contrast (ADA.7-10), no vision (Hara-1R)			
sign	hearAnnouncements		no announcements (Freeman-1R)		

Table 36 Facilitators for People with Low to No Vision

enable-LNV	Action	North America	Europe	Oceania	Asia, Africa, South America
route	orient	smell cues (Challenges-80M), sound cues (Challenges-45), tactile cues (Challenges-44), visual cues (Challenges-48)	sound cues (Mehigan-2R), tactile cues, smell cues (Volkel-2R)	sound cues (Packer08-2M), tactile cues (DDA.P-5), visual cues (Darcy-22R)	
routeIndoor	listen	doorways, elevators, escalators, cashRegisters, roomSize, fountains, commodes, handDryer, iceMaker, intersections, hummingLights, printers, phones, caneTap, vendingMachines, airConditioners, walls (Challenges-43, Challenges-45, Challenges-46, Challenges-47, Challenges-50), audioSigns (Challenges-49), carpet (Gossett-5)		softFurnishings (Packer08-2M)	
routeIndoor	touch	tactileSign, floorType, slopeChange, doorCount, Braille (Challenges-44, Challenges-43, Challenges-45, Challenges-47, Challenges-31)		detectablePath (Packer08-8M), Braille and tactileSign (DDA.P-5)	ASIA: surfaceMaterial (Chen-19R)
routeIndoor	Look	visualSign (Challenges-48, Challenges-49, Stark07-14, Thapar-9R)		visualSign (Darcy-22R)	

routeIndoor	perceiveObstacle			contrast (DDA.P-18), tactileWarning (DDA.P-8)	ASIA: audibleWarning (Siu-10R), SOUTH AMERICA: tactileWarning (Nascimento-3R
routeOutdoor	listen	traffic, audibleSignals, echos, pedestrianNoise, awnings, openSpaces (Challenges-37, Challenges-80M, Challenges-77M, Challenges-82M, PROW-39)	manhole, traffic, stores, restaurants, echos (Laakso12-28R, Mehigan-2R, Volkel-2R)		
routeOutdoor	touch	curb, surfaceType, thresholds, sun, poles, busShelters, signs, bin (Challenges-37M, Challenges-77M, Challenges-78M, Challenges-82M, Challenges-67M, Challenges-63M)	curbs, stairs, fences, balustrades, surfaceType, and surfaceChanges (Volkel-2R)		
routeOutdoor	Look	buildings, statues (Challenges-71M), visualSign (Stark07-14)		visualSign (Darcy-22R)	
routeOutdoor	perceiveObstacle	poleBarrier (AODA.S-38)			
routeOutdoor	smell		restaurants, bakeries, snackBars (Volkel-2R)		
bathroom	enterStall	doorSwingOut (ADA.6-13)			
bathroom	washHands				ASIA: automaticTap (Siu-5R)
bathroom	flushToilet				ASIA: automaticFlush (Siu-5R)
entrance	openDoor			weight activated doors (DDA.T-14)	
entrance	manipulateHardware	operable with closed fist or loose grip [handles, pulls, latches, locks] (ADA.4-10, ADA.4-11)			
interior door	identifyDoor			tactile numbering (Packer08-3M, DDA.P-14)	

elevator	discernWhichElevatorArrived	visual and audio indicator (Gossett-8R, ADA.4-41), audible differentiation (ADA.4-44)			
elevator	enterElevator	automatic sliding doors (ADA.4-47, ADA.4-48), well lit (ADA.4-54)			
elevator	pushButton	braille and tactile characters (ADA.4-59), visual indicator button is 'pushed' (ADA.4-39)		tactile characters (Packer08-1M)	
elevator	hearAnnouncements	automatic verbal annunciator (ADA.4-63)		audible announcements (Packer08-1M)	
stairway	maintainBalance	closed riser (AODA.T-31), slip-resistant surface, minimal glare (AODA.T-30), handrail (ADA.5-26, ADA.5-27)			
stairway	detectStepEdge	tonal contrast strips (AODA.S-57)	distinguishable edging (Richards-2R)		
stairway	detectFlightStairs	tactile paving indicator (AODA.S-58)		tactile paving indicator (DDA.P-7)	
stairway	graspHandrail	grip clearance (AODA.S-51)	contrasting color (Richards-5R)		
building	moveInSpace	ramp (Stark98-1), good lighting (Gossett-2R), shorelining (Challenges-42), full cane sweep (Swobodzinski-2R)		non-slip surfaces (Darcy-24R), good lighting (Darcy-23R)	ASIA: clear space (Kutintara-2R), non-slip surfaces (Kutintara-3R), tactile guide paths (Siu-1R) SOUTH AMERICA: tactile guide paths (Nascimento-1R, Ferrer-1R), ramp (Ferrer-2R)
building	changeLevel				ASIA: elevator (Packer07-3R)
building	locateDestination				SOUTH AMERICA: Braille signs (Nascimento-1R)

ramp	stayOnRamp	railings/ramp guard (Gossett-4R, AODA.S-53), edge protection (AODA.S-54)			
ramp	graspHandrail	grip clearance (AODA.S-51), smooth rounded edges (ADA.5-24)	contrasting color (Richards-5R)		
service	navigateCheckoutLine	detectable posts and railings (AODA.S-78)			
service	seeDisplayedItems		good lighting (Richards-7M)	good lighting (Packer08-5M)	
service	accessService	accessible transit (Hara-2R)	good lighting (Richards-8M)		
path	moveAlongPath	good lighting (York-2R), tactile paving (Challenges-69M), dog guide (Challenges-96M), telescopes (Technology-10M), shorelining (Kulyukin-4R)	wide width (Kammoun-5R), good lighting (Carlsson-4R)		
crossing	pushButton	tactile arrows (AODA.S-67), proximity to the curb edge, locator tone (AODA.S-67)			
crossing	enterRoadway	audible signal (Dialogue-41M, Challenges-93M, AODA.S-65)	audible signal (Laakso12-37R, Miri-2R), zebra crossing, traffic light (Miri-2R)		
crossing	hearSignal	signal announces additional information [its state, street name, direction of traffic, number of lanes to cross, odd or even block numbers] (Dialogue-50R, Dialogue-14M)			
crossing	enterSidewalk	adequate time to cross (Dialogue-48M)			
crossing	locateCrossing	visual contrast (PROW-29)			
crossing	stopAtCurb	tactile paving (Dialogue-41M, AODA.S-62), hard detectable curb edge (AODA.S-64)		tactile paving (DDA.P-9)	
stop	findStop	landmarks [shelters, benches, trash cans newspaper boxes, grass shoulder] (Hara-10R), consistent stop location (Hara-6M), tactile paving (PROW-38)		good lighting (Packer08-11R), tactile paving (Packer08-15)	

stop	waitAtStop	good lighting (Dialogue-44M), weather protection (Rosenberg-11R)	weather protection (Carlsson-5R)	tactile paving (DDA.T-23)	
stop	hearAnnouncements		acoustic cues (Miri-5R)		
stop	recognizeVehicle	consistent signage (AODA.T-24)			
stop	readSignage	tactile signs (ADA.8-12)	large-print, high contrast, non glare, braille (Miri-5R)		
stop	stopToPath			access path (DDA.T-4), handrails (DDA.T-13)	
vehicle	pay fare			good lighting (DDA.T-26), handrail (DDA.P-19)	
vehicle	takeSeat secureChair	grab bars, handrails (AODA.T-13), close to front (AODA.T-5)			
vehicle	boardVehicle	grab bars, handrails (AODA.T-13), ground level lighting (AODA.T-22), adequate time (AODA.T-2)			
vehicle	deboardVehicle	grab bars, handrails (AODA.T-13), ground level lighting (AODA.T-22)			
vehicle	moveThroughVehicle	grab bars, handrails (AODA.T-13)		good lighting, free of obstruction (Packer08-11R), access path (DDA.T-3)	
vehicle	makeStopRequest	auditory and visual confirmation, contrasting color (AODA.T-21), announce destination points (AODA.T-9)			
vehicle	reachStopRequest	within reach (AODA.T-21)			
vehicle	graspStopRequest	one hand operation (AODA.T-21)			
signs	readTactilely	rounded corners (ADA.7-2), below text (ADA.7-6), within reach (ADA.7-7)		tactile signs (Packer08-12R), within reach (DDA.P-13), rounded corners (DDA.P-15)	ASIA: Braille (Siu-2R)

signs	readVisually	glare-free, shadow free (AODA.T-25, ADA.7-10), contrasting color (AODA.T-26, ADA.7-10), appropriate height (ADA.7-13)		large print and contrasting color (Packer08-12R)	
signs	hearAnnouncements			audio information [voice-activated messages, audio channel] (Packer08-12R)	ASIA: audio systems (Siu-8R)

Table 37 Barriers for People who travel in wheelchairs

hinder-WCU		North America	Europe	Oceania	Asia, Africa, South America
bathroom	enterStall	doorNarrow (OSM-419), doorSwingIn (McClain98-15R)		doorSwingIn (Darcy-16M)	AFRICA: doorNarrow (Magenuka-5M)
bathroom	closeDoor	spaceNarrow (Pusch-4M)		spaceNarrow (Darcy-16M)	
bathroom	moveInSpace	spaceNarrow (OSM-155, 235, 253, 255, 256, 276, 411, Ripat-10R, Crowe-2R), usedAsStorage (OSM-205, 270, 283), rug (OSM-273)	spaceNarrow (OSM-391, 393), usedAsStorage (OSM-299, 329, 394)		
bathroom	Transfer	no grabBars (OSM-242, 217, 231, 235, 252, 253, 255, 256, 259, 445, McClain98-15R); spaceNarrow (OSM-242), toiletHigh (McClain98-15R)		spaceNarrow (Darcy-16M)	
bathroom	turn180	spaceOddShape (OSM-223)	spaceNarrow (Matthews-16M)		AFRICA: spaceNarrow (Magenuka-5M)
bathroom	washHands	sinkHigh (OSM-217, 231, 445), no spaceUnderSink (Pusch-10M, OSM-253, 256, OSM-255), dispenserHigh (Bayne-2M, McClain98-14R, Pusch-10M, OSM-174)		no spaceUnderSink (Darcy-27M)	ASIA: sinkHigh (Evcil-6R)

bathroom	Bathe	bathtubs (Turco-1R)		slidingDoor (Darcy-10M)	
entrance	openDoor	inadequate ramp landing (Rosenberg-15R), manual door (OSM-79, 265, 135, Ripat-9R), locked door (OSM-149, 285, 423), heavy door (OSM-162, Johnson-3R, Hernandez-1R), button broken (OSM-43)	heavy door (OSM-320), manual door (OSM-377)	heavy door (OSM-32)	
entrance	manipulateHardware	grip or twist controls (ADA.4-11)		grip or twist controls (DDA.T-17),	
entrance	passThroughDoorway	outward opening door (OSM-116), narrow doorway (OSM-202, 210, Bayne-3M, Hernandez-1R), revolving door (OSM-225, ADA.4-6)		outward opening door (OSM-32), narrow doorway (Darcy-11M)	AFRICA: narrow doorway (Magenuka-1R)
entrance	enterSite	steps (OSM-184, 187), cluttered space (OSM-280)			
entrance	approachDoorway	steps (Newman-5M, Ripat-5M, OSM-284), entrance obstructed (Crowe-6R, OSM-169, 171), flight of stairs (OSM-228, 59), high single step (OSM-208, 428), narrow approach space (LaPlante-6R)	steps (Darcy-6M, Matthews-25M, Menkens-4R, OSM-297, 320), flight of stairs (EA.7.5), narrow approach space (OSM-352, 395), no lift available (OSM-382), entrance obstructed (OSM-392, EA.7-2)	steps (Darcy-11M, Darcy-4M)	ASIA: steep ramp, steps (Evcil-4R), segregated entrance (Poria-5R) AFRICA: steep path, steps (Magenuka-1R),
interior door	openDoor	locked door (OSM-283, 399, OSM-426, Pusch-5M), manual door (OSM-100, 111), heavy door (Reid-3R)	locked door (Matthews-26M), manual door (OSM-318), heavy door (Bromley11-R, Matthews-17M)	round door knob (Darcy-13M), heavy door (Darcy-13M)	
interior door	passThroughDoorway	narrow doorway (OSM 230, 161, 220, 259, 276, 411, 419, Pusch-2M, McClain98-15R, Crowe-2R, Ripat-11R, Thapar-1R), door swings inward (McClain98-15R), raised sill (OSM-45)	raised sill (Manuel-Sa-4R), narrow doorway (OSM-328), two doors swing opposite (Lawlor-2R)	door swings inward (Darcy-16M)	ASIA: locked door (Poria-6R), narrow doorway (Evicil-6R) AFRICA: narrow doorway (Magenuka-5M)

interior door	approachDoorway	steps (OSM-243, 276, 278, 287, 429, 268 Pusch-12M, Crowe-2R), incline to doorway (OSM-91)	steep ramp (OSM-374), broken lift (OSM-384), incline to doorway (Lawlor-2R), steps (EA.7-4)	steps (Darcy-10M)	
elevator	enterElevator	must reverse (Holliday-1), used as storage (OSM-400), doors close too quickly (Pusch-11M)	narrow space (Darcy-8M, OSM-347)		(@): narrow space (Daniels-11M), ASIA: elevator is full (Packer07-3R)
elevator	reachButton	obstructing decorations (ADA.4-36), button too high (OSM-442, Pusch-11M)	button too high (OSM-378)		ASIA: button too high (Rivano-Fischer-5R)
elevator	pushButton	hard to press, not raised button (Pusch-11M)			
elevator	approachElevator	steps (Pusch-13M)			
stairway	approachStairway	OUT: wet conditions (ADA.5-16)			
building	moveInSpace	cluttered space (OSM-284, 250, Turco-2R, Burnett-4R), narrow space (OSM-48, 134, Reid-6R, Dutta-1R, McClain98-13R), steps (OSM-134), sharp angles (Reid-6R), carpet (ADA.3-3, Gossett-6R)	cluttered space (Matthews-25M, OSM-305, 313), steps (Darcy-7M), narrow space (OSM-397, 396), deep pile carpet (Abraham-3R)	cluttered space (OSM-1, 34), narrow space (Darcy-12M)	(@): crowds (Daniels-4M)
building	changeLevel	elevator commonly out of order (McClain98-5R), no elevator (Ripat-12M, OSM-154, 157, 132, 401)	no elevator (Menkens-4R, OSM-333)	no elevator (OSM-292)	ASIA: no elevator (Evans-3M) SOUTH AMERICA: no elevator (Ferrer-3R)
building	moveDownHallway	narrow hallway (Thapar-1R))	narrow hallway (OSM-379, 274)	hallway used as storage (OSM-427)	(@): obstruction in hallway (Daniels-2M)
building	locateEntrance	no signage (OSM-436)			
building	locateDestination	no signage and directories (Thapar-5R), poor layout of building (Thapar-6R)			

building	approachEntrance		far away parking (OSM-323)		
destination	locateEntrance	accessible entrance is unmarked (OSM-268)			
ramp	stopOnRamp	no landing (McClain98-11R)			
ramp	turnOnRamp	sharp turn (OSM-240)	narrow turning circle (Beale-1R)		
ramp	alignToRamp		channel style ramp (Storr-1R)		
ramp	stayOnRamp	narrow ramp (OSM-156, McClain98-2R)	narrow ramp (OSM-353, 357, 360, 381, 331)		
ramp	descendRamp	no handrails (McClain93-4R), wet conditions (Rosenberg-15R, ADA.4-27, AODA.S-47)	wet conditions (OSM-356, Matthews-14M)		ASIA: no handrails (Rivano-Fischer-3R)
ramp	ascendRamp	water, snow, debris (Duggan-3M, Stark07-4, Lemaire-6R, OSM-438, Bennett-5R), truncated domes (Lee-2R), steep inclination (Meyers-3R, OSM-438), no handrails(Lemaire-5R, OSM-76), slippery handrails (Lemaire-5R), openings in surface (AODA.S-49)	steep inclination (OSM-298, 353), truncated domes (Matthews=6M)	steep inclination (OSM-294, 10)	ASIA: steep inclination (Evcil-3R), no handrails (Rivano-Fischer-3R)
ramp	graspHandrail	posts blocking the hand, snow and ice on rail (Lemaire-8R)			
ramp	streetToRamp				ASIA: no landing (Evcil-3R)
service	navigateCheckoutLine		narrow aisle (Bromley11-R)	narrow aisle (OSM-34)	ASIA: narrow aisle (Evcil-5R)
service	sit AtTable	table too high (OSM-197, 416, 435, 254), table is a booth (OSM-215, 254), table is a picnic table (OSM-416, 417), no knee clearance (McClain93-5R)	seats too small for transfer (Gross-1R), table too high (EA.7-3)		
service	interactWithEmployees	counter too high (OSM-140, 166)	counter too high (OSM-362)	counter is too hign (OSM-18, 16))	ASIA: counter is too high (Evcil-5R, Poria-7R)

service	reachItems	items too high (McClain98-13R, OSM-126)	items too high (Bromley11-R), items on floor (OSM-305)		
service	moveDownAisle	narrow aisle (OSM-213, 56, 97, Meyers-1R)	cluttered aisle (Bromley11-R), narrow aisle (Hewitt-Taylor-1R)	narrow aisle (OSM-4), series of single steps (OSM-6), cluttered aisle (OSM-8)	
service	seeDisplayedItems				ASIA: items too high (Poria-8R)
service	approachPassTable	tables too close together (OSM-112, 433, McClain93-5R)	tables too close together (OSM-311, Freeman-5R), no space (Gross-1R)		
service	useWheelchairSpace	segregatedSeating (McClain98-1R)			
service	tryOnClothing	fitting room too small (OSM-97), narrow doorway (OSM-115)	no seats, no grab bars, fitting room too small (Hewitt-Taylor-2R), used for storage (Hewitt-Taylor-3R)		
service	accessService	no bathroom (Meyers-7R, OSM-41), no parking (Meyers-8R, McClain93-1R)),		no bathroom (OSM-14), won't admit dog guide (Packer08-10M)	
parking (bold=street, red=all, italics=lot, underline=structure)	findSpace	inelligible car in space (Ripat-8R), spaces too narrow (McClain98-8R), **signs are hard to see (McClain98-9R)**	no accessible spaces (Bromley-2R), inelligible car in space (Lawlor-6, Matthews-23M), spaces too narrow (Matthews-22M)		ASIA: spaces too narrow (Rivano-Fischer-2R), inelligible car in space (Poria-4R)
parking	transferFromCar	no access aisle (McClain93-2R, Newman-3M), **obstructions on sidewalk [signs/ street furniture] (PROW-48)**			

parking	getToPath	*gravel surface* (Daniels-19M), uneven path (OSM-73), space is too far from pathway (Dialogue-20M, McClain93-2R), chord bisecting path (OSM-414), **no ramp onto sidewalk (OSM-424, Crowe-4R)**, drivers (Rosenberg-3R)	**ramp blocked (OSM-330, Matthews-22M)**, *uneven path* (OSM-359), **no ramp to sidewalk (Matthews-22M)**	slope, *gravel surface* (OSM-19)	ASIA: **no ramp onto sidewalk (Poria-3R)**
parking	moveThroughStructure	broken elevator (McClain98-10R), no elevator (Rosenberg-3R)			
parking	Pay	machine too high (OSM-164)			
path	moveAlongPath	uneven surface (Challenges-106M, 8M, Kasemsuppakorn-4R, Reid-8R), poor pavement maintenance (Challenges-106M, Kirchner-7R, Newman-4M, Duggan-1M), hills (Kirchner-5R, Rosenberg-14R), steep slope (Kasemsuppakorn-2R), obstructions [construction/ snow/ ice/ overgrowth/ advert. boards/ planters/ newspaper boxes] on path (Kirchner-6R, Newman-2R, AODA.S-42, AODA.S-36), narrow sidewalk (Kirchner-6R), openings on path (AODA.S-39), bad weather [wind, rain] (Meyers-4R, Newman-1R)	uneven surface (Bromley-3R), poor pavement maintenance (Matthews-2R, 19M), hills (Matthews-2R), steep slope (Beale-1R, Menkens-2R, OSM-344, 351), long slope (Beale-1R), camber slope (Matthews-12M), obstructions [construction, street furniture, advert. Boards, shop displays] on path (Matthews-2R, 20M, Menkens-1R), narrow sidewalk (Matthews-20M, Menkens-2R, OSM-344, 351, 366), slippery surface (Matthews-2R), gravel (Matthews-11M, Beale-3R), openings on path (Matthews-10M, Menkens-2R,)		ASIA: obstacles [lamppost, advert. board, planters, parking blocks] (Evcil-2R), narrow sidewalk (Evcil-2R), uneven surface (Evcil-2R, Evans-2M), no sidewalk (Evans-2M) AFRICA: uneven surface (Magenuka-3R)
path	changeLevel	steps (Rosenberg-24R, Kasemsuppakorn-4R, AODA.S-55)	steps (Bromley-3R, Beale-5R, Lawlor-3R)		
path	passPeople		narrow sidewalk (Matthews-2R), crowds (Bromley-3R)		
crossing	beSeen	overgrowth and parked cars (Rosenberg-12R)			
crossing	enterRoadway	lip on ramp (Bennett-4R), no dropped curb (Newman-4M, Kirchner-2R, Meyers-6R), obstructed ramp (Meyers-6R), poor ramp maintenance (Dialogue-42M)	no dropped curb (Matthews-8M, Matthews-4M, Pressl10-8R, Daniels-15R, OSM-340, 380)		AFRICA: no dropped curb (Banda-Chalwe-4R)

crossing	enterSidewalk	position of ramp (Bennett-2R), light is too short (Dialogue-7M, Rosenberg-12R), no matching dropped curb (Rosenberg-1R)	no matching dropped curb (Matthews-7M)		
crossing	stayInCrosswalk	dips or potholes (Dialogue-8M)			
crossing	crossStreet	no pedestrian crossing (Rosenberg-5R)	no pedestrian crossing (Bromley-6M)		
stop	waitAtStop		OUT: no weather protection (Carlsson-5R), IN: platform only accessible via stairs (Hewitt-Taylor-6R, Lawlor-8R, OSM-316), separate entrance for each platform (OSM-372)		(@): turnstile in station (Daniels-6R)
stop	stopToPath				ASIA: IN: no elevator (Evcil-1R)
vehicle	communicateWithOperator	OUT: no eye contact (Dialogue-47M), Not visible to operator (Dialogue-47M)			
vehicle	takeSeat secureChair	aids secured improperly (Dialogue-5R), no securement points (Dialogue-6M)			(@): no wheelchair seat (Daniels-8R)
vehicle	boardVehicle	OUT: bus is full (Pusch-14M), waiting for operator to assist (Dialogue-22M), IN: narrow door (OSM-441)	OUT: no ramp on vehicle (Bromley-1R), car parked in boarding area (OSM-307, 308), trash can in boarding area (OSM-309), no raised curb for boarding (OSM-309, 312), not enough space to deploy vehicle ramp (OSM-315), accessible spaces are full (Hewitt-Taylor-5R), IN: gap between platform and train (Lawlor-8R), accessible spaces are full (Hewitt-Taylor-5R)		
vehicle	moveThroughVehicle		narrow space (Freeman-2R)		

vehicle	rideVehicle	vehicle is inaccessible (LaPlante-7R, Crowe-5R)	vehicle is inaccessible (OSM-326, Hewitt-Taylor-4R)		AFRICA: vehicle is inaccessible (Banda-Chalwe-3R, Magenuka-7R))

Table 38 Facilitators for People who travel in wheelchairs

enable-WCU	Action	North America	Europe	Oceania	Asia, Africa, South America
route	Orient	visual cues (Challenges-75M)	visual cues (OSM-301)	visual cues (Darcy-22R)	
routeIndoor	Look	visualSign (Challenges-56, Challenges-58), doors (Challenges-57)	visualSign (OSM-301)	visualSign (Darcy-22R)	
routeOutdoor	Look	buildings, streetNames (Challenges-75M)			
bathroom	enterStall	doorSwingOut (ADA.6-13)	doorSwingOut, automaticDoor, doorWide (Manuel-Sa-5R)		
bathroom	closeDoor				
bathroom	moveInSpace	spaceWide (OSM-439, ADA.6-12, Stark07-8R, Newman-6M), occupancySingle (Pusch-2M), toeClearance (ADA.6-14)		surfaceNon-slip (Darcy-26R)	
bathroom	Transfer	handrails (OSM-439, 419, Pusch-8M, Newman-6M, Bishop-1R, ADA.6-8), high toiletTransferHeight (Pusch-9M, ADA.6-6, OSM-186), toiletClearSpace (ADA.6-5)	toiletLarge (OSM-379)	handrails (Darcy-26R)	
bathroom	turn180	turningRadiusWide (Rimmer-1R)			
bathroom	washHands	sinkAdequateHeight (Rimmer-1R, OSM-207), reachWithin (Stark07-8, OSM-226, 235), pipesInsulated (ADA.6-18), spaceUnderSink (ADA.6-16, OSM-174)		spaceUnderSink (Darcy-26R)	

bathroom	Bathe	handrails (Turco-1R), rollInShower (Pusch-8M)		rollInShower, showerBench, hoseHandHeld (Darcy-26R, Darcy-27M)	
entrance	openDoor	low opening force (ADA.4-13, OSM-150), automatic door (Ripat-13M, McClain98-4R, Thapar-8R, OSM-141, 246, 120, 110), button is outside door swing (ADA.4-17), button is visible (OSM-271)	automatic door (OSM-325, 342)	automatic doors (DDA.T-14, OSM-32)	ASIA: accessible hardware (Rivano-Fischer-4R)
entrance	manipulateHardware	operable with closed fist or loose grip [handles, pulls, latches, locks] (ADA.4-10, ADA.4-11)			
entrance	passThroughDoorway	slow door closer (ADA.4-12), low sill or step (ADA.3-5, OSM-182), wide doorway (ADA.4-16, OSM-182, 139)	clear space around doorway (EA.7.2), low sill or step (OSM-343, 367), wide doorway (OSM-366, DDA.P-3), inward opening door (OSM-348)		ASIA: wide doorway (Rivano-Fischer-4R)
entrance	approachDoorway	flat-entry (Ripat-1M, OSM-139, 178), ramp (OSM-412, 434, 141, Pusch-1M, Bishop-2R), low grade ramp (OSM-135, 245), lift available (OSM-96)	ramp (OSM-303, 369, ADA.3-7), flat-entry (OSM-310), lift available (OSM-382)	flat-entry (OSM-32, 33), ramp (OSM-7)	AFRICA: ramp (Banda-Chalwe-2R),
interior door	openDoor	automatic door (OSM-447, 185, Stark07-6R), button within reach (Stark07-6R)			
interior door	passThroughDoorway	wide doorway (LaPlante-4R, Pusch-7M, OSM-50, 54, Pusch-6M), propped doors (OSM-103, 67, 91), slow door closer (Stark07-6R)	level access (OSM-393), wide doorway (OSM-318)	level access (Darcy-25R)	
interior door	approachDoorway	lift available (OSM-47)	ramp (EA.7-4)	ramp, lift available (DDA.P-1)	
elevator	discernWhichElevatorArrived	visual indicator (Rimmer-2R, ADA.4-41)			
elevator	enterElevator	wide doorway (Rimmer-2R), good lighting (ADA.4-54)			
elevator	passPerson	doors wider than two wheelchairs (Gossett-7R)			
elevator	turn180	doors on both sides (Gossett-7R), large space (OSM-143)			

elevator	pushButton	visual indicator button is 'pushed' (ADA.4-39)			
stairway	goUpStairs				ASIA: stair lift (Poria-8R)
stairway	graspHandrail	grip clearance (AODA.S-51)			
building	moveInSpace	clear space (OSM-402), wide space (Stark07-9, ADA.3-10, OSM-107, 109, 153, 281), single level (Reid-7R, LaPlante-1R, Stark07-7R), non-slip surfaces (Stark07-10, ADA.3-1), ramp (Bayne-1M, LaPlante-2R, Stark98-1R, OSM-136, 93), good lighting (Stark07-13R)	step-free (OSM-317)	step-free (OSM-295), non-slip surfaces (Darcy-24R), ramp (OSM-5), clear space (OSM-25), good lighting (Darcy-23R)	
building	changeLevel	elevator (OSM-426, 405, Stark07-7R), stair lift, lift (LaPlante-5R)	elevator (OSM-322, 332, 302, 364, Daniels-20M), ramp (OSM-300), mini-lift (Matthews-25M)	elevator (OSM-13)	ASIA: elevator (Packer07-3R, Israeli-7R, Evans-3) AFRICA: elevator (Banda-Chalwe-1R)
building	moveDownHallway	wide hallway (LaPlante-4R, OSM-212), non-slip surfaces (AODA.T-17), clear space (OSM-229)			
building	turn180	wide space (Stark07-9)	maneuvering areas (Manuel-Sa-2R)		
building	passPerson			passing space (DDA.P-4)	
building	approachEntrance	accessible route	accessible route (Manuel-Sa-1R, OSM-306)		
ramp	stopOnRamp	landing (AODA.S-48, ADA.4-22)			ASIA: landing (Rivano-Fischer-3R)
ramp	turnOnRamp	turning space (PROW-18)			
ramp	stayOnRamp	wide ramp (AODA.S-46, ADA.4-21, Dialogue-8M), edge protection (AODA.S-54)			ASIA: wide ramp (Rivano-Fischer-3R)
ramp	descendRamp	truncated domes (Lee-3R), handrails			

		(AODA.S-50)			
ramp	ascendRamp	handrails (McClain93-4R, OSM-409, 277, AODA.S-50, ADA.5-17, Lemaire-3R), low slope (McClain93-4R, AODA.S-47, ADA.4-22, OSM-242)	handrails(OSM-387, 339, Miri-1R)	low slope (OSM-15, DDA.P-11)	ASIA: low slope, handrails (Rivano-Fischer-3R) AFRICA: handrails (Banda-Chalwe-2R)
ramp	graspHandrail	grip clearance (AODA.S-51, Lemaire-8R), smooth rounded edges (ADA.5-24)			
ramp	approachRamp	drainage grates (Bennet-5R)			
ramp	streetToRamp	both on same slope (Bennet-3R), adjacent surfaces at same level (ADA.4-28)			
service	sit AtTable	seats left out (ADA.8-2, AODA.S-79, MCClain98-6R), table raises/lowers (Newman-8M), movable chairs (OSM-144), clearance under table (AODA.S-33), flat ground (AODA.S-34, OSM-418)	movable chairs (OSM-336)	seats left out (DDA.T-11), clearance under table (Darcy-15M)	
service	interactWithEmployees	low counter (McClain98-7R, OSM-179, 183), space under counter (AODA.S-76), helpful staff (Daniels-3M, Crowe-3R, OSM-239, 175)	low counter (EA.7-3)	helpful staff (OSM-18, 16, 35), low counter (OSM-25, 27)	
service	reachItems	within reach (ADA.8-7, AODA.S-75, Stark07-11R, OSM-140)		within reach (Darcy-14M)	
service	moveDownAisle	wide aisle (Stark07-9, Crowe-3R, AODA.S-77, OSM-137, 183)		wide aisle (OSM-4)	
service	seeDisplayedItems	low display case (OSM-425, 105), clear lettering (OSM-190)			
service	approachPassTable	space around table (OSM-234)			
service	tryOnClothing	large fitting room (OSM-106)			

service	accessService	parking near entrance (OSM-407, 61, Rosenberg-3R, Pusch-M), drive-through (Stark07-5R), accessible bathroom (OSM-42), sidewalk (Dialogue-41M), having personal vehicle (Ripat-3M), public transit (Ripat-6M, Meyers-11R)	parking near entrance (OSM-389)	parking near entrance (OSM-30, 36, 37, 21), accessible bathroom (OSM-37)	ASIA: on ground floor (Evans-1M), travel partner (Yau-3R), AFRICA: accessible bathroom (Magenuka-4M)
parking	findSpace	dedicated spaces (Crowe-4R), clearly identified (ADA.5-6, McClain93-2R) IN: sign in parking structure indicating availability (Dialogue-20M)	dedicated spaces (OSM-330, 354, 368), more spaces (Bromley-8R), policing inelligible parkers (Bromley-8R)		ASIA: clearly identified (Rivano-Fischer-1R), dedicated spaces (Rivano-Fischer-2R)
parking	transferFromCar	access aisle (AODA.S-72, Rimmer-3R, McClain93-2R), access aisle is full length of space, marked (ADA.5-9), access aisle is same level as parking surface (ADA.5-10), wide spaces (ADA.5-1, McClain93-2R), wide access aisles (PROW-58)			ASIA: wide spaces (Poria-3R, Rivano-Fisher-2R)
parking	getToPath	ramp (Gossett-3R, PROW-53, OSM-406)			ASIA: access route (Rivano-Fischer-2R)
parking	moveThroughStructure	space close to entrance (OSM-164, McClain93-2R)			
parking	Pay		allow single payment, multiple space hop (Bromley-9R)		
path	moveAlongPath	low slope (Stark07-3, Meyers-14R, PROW-4, AODA.S-41, OSM-432), smooth surface (PROW-10, Rosenberg-10R), wide sidewalk (Rosenberg-10R, PROW-1, AODA.S-35, OSM-431), grass partition (Rosenberg-10R), clear sidewalk (AODA.S-36)	smooth surface (OSM-358, Bromley-7R), wide sidewalk (OSM-375)	wide sidewalk (DDA.T-1)	ASIA: sidewalk (Evans-2M)
path	changeLevel	bevel (AODA.S-44)			
path	passPeople	wide sidewalk (Rosenberg-10R), passing area (PROW-3)		passing area (DDA.T-5)	

crossing	pushButton	within reach (AODA.S-67, Dialogue-8M), low effort to push, large button (Dialogue-45M)			
crossing	enterRoadway	curb ramp (Stark07-4R, Rosenberg-13R, Kasemsuppakorn-6R, Bennet-1, Dialogue-41M, OSM-408), grade break should be flush (PROW-9), good lighting (Dialogue-8M)	curb ramp (Miri-1R, Bromley-7R, Beale-4R, Matthews-8M)	curb ramp (Darcy-18R)	
crossing	enterSidewalk	adequate time to cross (Dialogue-7M)	ramp (Miri-1R)		
crossing	locateCrossing	visual contrast (PROW-29)			
crossing	alignTravelDirection	ramp oriented toward path of travel (AODA.S-59)			
stop	waitAtStop	good lighting (Dialogue-44M), firm, stable surface (ADA.8-8	weather protection (Carlsson-5R), IN: elevator (Daniels-20M, OSM-390, 324), wide gates (OSM-390)		
stop	recognizeVehicle	consistent signage (AODA.T-24)			
stop	stopToPath	access route (PROW-45)	step-free access (OSM-386)	access route (DDA.T-4)	
vehicle	pay fare			good lighting (DDA.T-26)	
vehicle	takeSeat secureChair	wheelchair spaces (AODA.T-19), wheel clamps and mounted straps for securement (AODA.T-20), close to front of vehicle (AODA.T-5)	wheelchair spaces (Lawlor-5R)		
vehicle	boardVehicle	grab bars, handrails (AODA.T-12), contrasting ramp edge, raised edge, non-slip surface (AODA.T-28), ramp, lifting device (AODA.T-1), ground level lighting (AODA.T-22), adequate time (AODA.T-2)	ramp (OSM-376, 316)	ramp (DDA.T-9), wide, non-slip ramp (DDA.T-10), tall doorway (DDA.T-16), low slope ramp (DDA.T-8)	ASIA: lifting device (Daniels-9R)
vehicle	deboardVehicle	grab bars, handrails (AODA.T-13), ground level lighting (AODA.T-22)		power-assisted door, automatic door (DDA.T-17)	
vehicle	moveThroughVehicle			passing space (DDA.T-6), access route (DDA.T-3)	

vehicle	makeStopRequest	auditory and visual confirmation, contrasting color (AODA.T-21)			
vehicle	reachStopRequest	within reach (AODA.T-21)			
vehicle	graspStopRequest	one hand operation (AODA.T-21)			
signs	readVisually	glare-free (AODA.T-25, ADA.7-9), high color contrast (AODA.T-26, ADA.7-9), appropriate height (ADA.7-13)			

APPENDIX E

ONTOLOGY REQUIREMENTS SPECIFICATION DOCUMENT

This Appendix includes the full OSRD (Table 39) for the Ontology of Accessibility in the Context of Wayfinding, the competency questions (Table 40) and pre-glossary (Table 41).

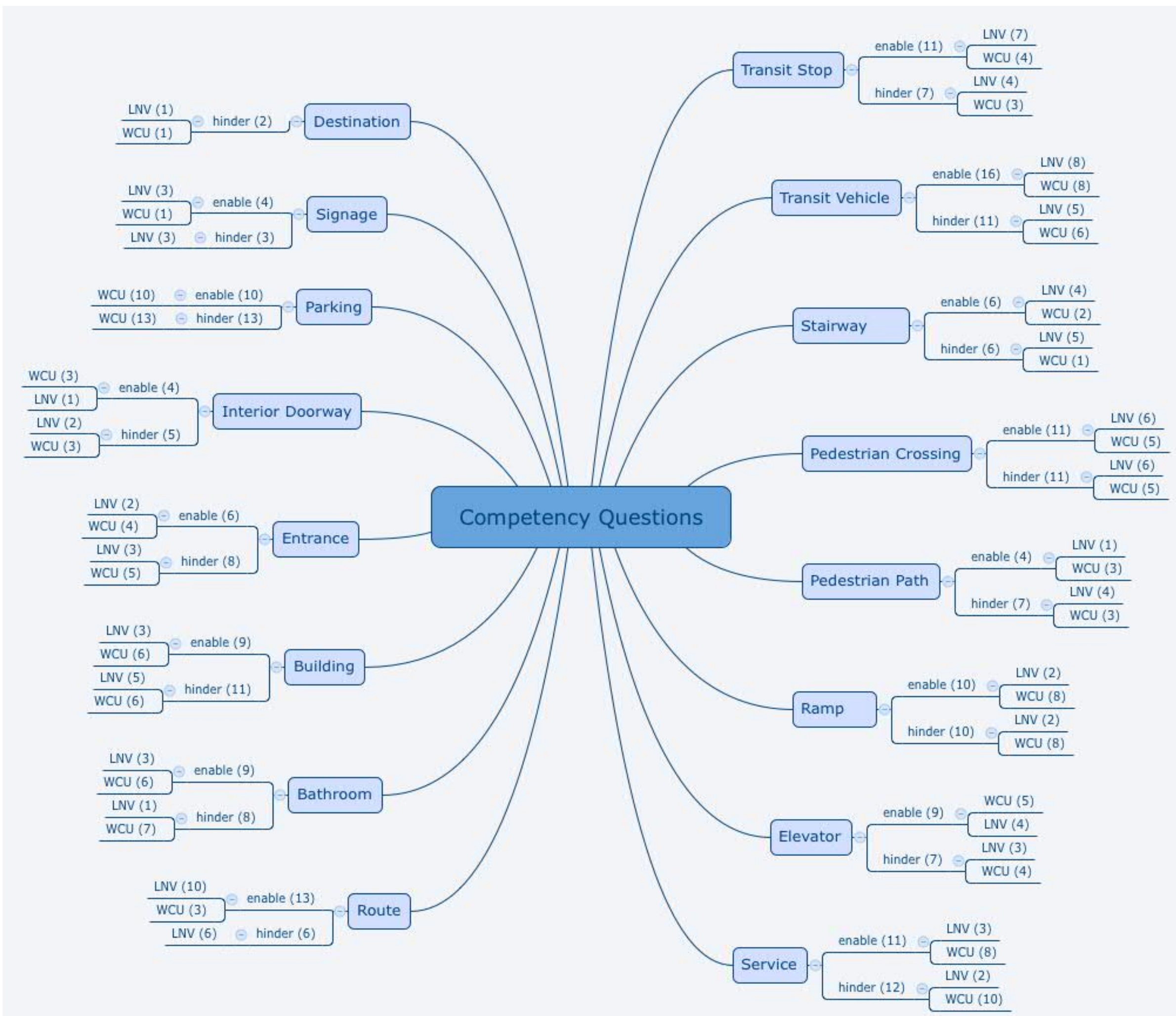
Table 39 Full ORSD

	Ontology Requirements Specification Document	
1	*Purpose*	
	to conceptualize accessibility in the context of wayfinding so that collaborative mappers, navigation service providers, and people interested in learning about accessibility in the environment can understand how people with disabilities interact with the environment in order to support (1) the design of wayfinding services and (2) interoperable data sharing of accessibility oriented data.	
2	*Scope*	
	a detailed description of barriers and facilitators in indoor, outdoor and transitional environments (buildings, pedestrian paths, entrances, and transit vehicles), and their interaction with people who travel in wheelchairs and people who have low to no vision.	
3	*Implementation language*	
	the ontology will be implemented in a future work.	
4	*Intended end users*	
	User 1. developers of collaborative databases of accessibility information, User 2. developers of services for assisting people with disabilities with wayfinding requests User 3. collaborative mappers who map the accessibility of the built environment	
5	*Intended uses*	
	Use 1. To update navigation and collaborative databases with accessibility information by developing a metadata standard based on the ontology Use 2. To help stakeholders build an understanding of accessibility of the built environment by traversing the ontology	
6	*Ontology requirements*	
	(a)	*Non-Functional requirements*
		If the ontology is to be utilized by developers or collaborative mappers who speak a language other than English, the ontology will need to be translated into the native language of the developer or mapper.
	(b)	*Functional requirements: Groups of competency questions*
		The full set of competency questions are listed in Table 40 below. A total of 260 questions

were developed. (127 related to barriers and 133 related to facilitators)

Seventeen groups of competency questions were collected

Bathroom	17	Pedestrian Path	11
Building	20	Ramp	20
Elevator	16	Route	19
Entrance	14	Service	23
Destination	2	Signage	7
Interior Doorway	9	Stairway	12
Parking	23	Transit Stop	18
Pedestrian Crossing	22	Transit Vehicle	27



7	*Pre-glossary of terms (See **Table 2** below)*	
	(a)	*Terms from competency questions*
	(b)	*Terms from answers*
	(c)	*Objects*

Table 40 Competency Questions and Answers

Question	Answer
What hinders enterStall at a bathroom for people who travel in wheelchairs?	door narrow, door swing in
What hinders closeDoor at a bathroom for people who travel in wheelchairs?	space narrow
What hinders moveInSpace at a bathroom for people who travel in wheelchairs?	space narrow, used as storage
What hinders transfer at a bathroom for people who travel in wheelchairs?	no grab bars, space narrow, toilet high
What hinders turn180 at a bathroom for people who travel in wheelchairs?	space narrow, space odd shape
What hinders washHands at a bathroom for people who travel in wheelchairs?	sink high, no space under sink, dispenser high
What hinders bathe at a bathroom for people who travel in wheelchairs?	bathtubs, sliding door
What hinders moveInSpace in a building for people who travel in wheelchairs?	cluttered space, narrow space, steps, sharp angles, carpet, crowds
What hinders changeLevel in a building for people who travel in wheelchairs?	no elevator, elevator commonly out of order
What hinders moveDownHallway in a building for people who travel in wheelchairs?	narrow hallway, used as storage, obstruction in hallway
What hinders locateEntrance in a building for people who travel in wheelchairs?	lack of signage
What hinders locateDestination in a building for people who travel in wheelchairs?	lack of signage and directories
What hinders approachEntrance in a building for people who travel in wheelchairs?	far away parking
What hinders enterElevator at an elevator for people who travel in wheelchairs?	used as storage, narrow space, elevator is full, doors close too quickly, must reverse
What hinders reachButton at an elevator for people who travel in wheelchairs?	obstructing decorations, button too high
What hinders pushButton at an elevator for people who travel in wheelchairs?	hard to press, not raised
What hinders approachElevator at an elevator for people who travel in wheelchairs?	steps
What hinders openDoor at an entranceExit for people who travel in wheelchairs?	manual door, heavy door, broken button, locked door, inadequate ramp landing
What hinders manipulateHardware at an entranceExit for people who travel in wheelchairs?	grip or twist controls
What hinders passThroughDoorway at an entranceExit for people who travel in wheelchairs?	outward opening door, narrow door, revolving door
What hinders enterSite at an entranceExit for people who travel in wheelchairs?	steps, cluttered space

What hinders approachDoorway at an entranceExit for people who travel in wheelchairs?	steps, entrance obstructed, flight of stairs, high single step, narrow approach space, no lift, steep path, steep ramp, segregated entrance
What hinders openDoor at an interiorDoorway for people who travel in wheelchairs?	locked door, manual door, heavy door, round door knob
What hinders passThroughDoorway at an interiorDoorway for people who travel in wheelchairs?	narrow doorway, raised sill, door swings inward, two doors swing opposite
What hinders approachDoorway at an interiorDoorway for people who travel in wheelchairs?	steps, incline to doorway, steep ramp, broken lift
What hinders locateEntrance at an outdoorDestination for people who travel in wheelchairs?	accessible entrance unmarked
What hinders findSpace in a parkingLot for people who travel in wheelchairs?	inelligible car in space, space too narrow, lack of accessible spaces
What hinders transferFromCar in a parkingLot for people who travel in wheelchairs?	no access aisle
What hinders getToPath in a parkingLot for people who travel in wheelchairs?	gravel surface, uneven path, space is too far from pathway, chord bisecting path, slope
What hinders pay in a parkingLot for people who travel in wheelchairs?	machine too high
What hinders findSpace at parkingStreet for people who travel in wheelchairs?	signs are hard to see, inelligible car in space
What hinders transferFromCar at parkingStreet for people who travel in wheelchairs?	obstructions on sidewalk
What hinders getToPath at parkingStreet for people who travel in wheelchairs?	no ramp on sidewalk, ramp blocked
pay at parkingStreet for people who travel in wheelchairs?	machine too high
What hinders findSpace in a parkingStructure for people who travel in wheelchairs?	inelligible car in space, space too narrow, lack of accessible spaces
What hinders transferFromCar in a parkingStructure for people who travel in wheelchairs?	no access aisle
What hinders getToPath in a parkingStructure for people who travel in wheelchairs?	space is too far from pathway, chord bisecting path, slope, drivers
What hinders moveThroughStructure in a parkingStructure for people who travel in wheelchairs?	broken elevator, no elevator
What hinders pay in a parkingStructure for people who travel in wheelchairs?	machine too high
What hinders beSeen at a pedestrianCrossing for people who travel in wheelchairs?	overgrowth, parked cars
What hinders enterRoadway at a pedestrianCrossing for people who travel in wheelchairs?	lip on ramp, no dropped curb, obstructed ramp, poor ramp maintenance
What hinders enterSidewalk at a pedestrianCrossing for people who travel	position of ramp, light too short, no matching dropped curb

in wheelchairs?	
What hinders stayInCrosswalk at a pedestrianCrossing for people who travel in wheelchairs?	dips, potholes
What hinders crossStreet at a pedestrianCrossing for people who travel in wheelchairs?	no pedestrian crossing
What hinders moveAlongPath at a pedestrianPath for people who travel in wheelchairs?	uneven surface, poor pavement maintenance, hills, steep slope, long slope, camber slope, narrow sidewalk, openings on path, no sidewalk, slippery surface, gravel, bad weather, obstacles [construction, snow, ice, overgrowth, advertisement boards, planters, newspaper boxes, street furniture, shop displays, lamp post, parking blocks]
What hinders changeLevel at a pedestrianPath for people who travel in wheelchairs?	steps
What hinders passPeople at a pedestrianPath for people who travel in wheelchairs?	narrow sidewalk, crowds
What hinders stopOnRamp at a ramp for people who travel in wheelchairs?	no landing
What hinders turnOnRamp at a ramp for people who travel in wheelchairs?	sharp turn, narrow turning circle
What hinders alignToRamp at a ramp for people who travel in wheelchairs?	channel style ramp
What hinders stayOnRamp at a ramp for people who travel in wheelchairs?	narrow ramp
What hinders descendRamp at a ramp for people who travel in wheelchairs?	no handrails, wet conditions
What hinders ascendRamp at a ramp for people who travel in wheelchairs?	water snow debris, truncated domes, steep inclination, no handrails, slippery handrails, openings in surface
What hinders graspHandrail at a ramp for people who travel in wheelchairs?	posts blocking hand, snow ice on rail
What hinders streetToRamp at a ramp for people who travel in wheelchairs?	no landing
What hinders navigateCheckoutLIne at an serviceIndoor for people who travel in wheelchairs?	narrow aisle
What hinders sitAtTable at an serviceIndoor for people who travel in wheelchairs?	table too high, table is a booth, no knee clearance, table is a picnic table, seats too small for transfer
What hinders interactWithEmployees at an serviceIndoor for people who travel in wheelchairs?	counter too high
What hinders reachItems at an serviceIndoor for people who travel in wheelchairs?	items too high, items on floor
What hinders moveDownAisle at an serviceIndoor for people who travel in wheelchairs?	narrow aisle, cluttered aisle, series of single steps
What hinders seeDisplayedItems at an serviceIndoor for people who travel in wheelchairs?	items too high
What hinders approachPassTable at an serviceIndoor for people who travel in wheelchairs?	tables too close together, lack of space

What hinders useWheelchairSpace at an serviceIndoor for people who travel in wheelchairs?	segregated seating
What hinders tryOnClothing at an serviceIndoor for people who travel in wheelchairs?	fitting room too small, no seat, narrow doorway, no grab bar, used for storage
What hinders accessService at an serviceIndoor for people who travel in wheelchairs?	no bathroom, no parking, won't admit dog guide
What hinders approachStairway at stairsSteps for people who travel in wheelchairs?	wet conditions
What hinders waitAtStop at a transitStation for people who travel in wheelchairs?	platform accessible via stairs, separate entrance for each platform, turnstile in station
What hinders waitAtStop at a transitStop for people who travel in wheelchairs?	no weather protection
What hinders stopToPath at a transitStation for people who travel in wheelchairs?	no elevator
What hinders communicateWithOperator at a transitVehicle for people who travel in wheelchairs?	no eye contact, not visible to operator
What hinders takeSeatSecureChair at a transitVehicle for people who travel in wheelchairs?	aids secured improperly, lack of securement points, no wheelchair seat
What hinders boardBus at a transitVehicle for people who travel in wheelchairs?	bus is full, waiting for operator to assist, no ramp on vehicle, car parked in boarding area, no raised curb for boarding, accessible spaces are full, not enough space to deploy ramp, trash can in boarding area
What hinders boardTrain at a transitVehicle for people who travel in wheelchairs?	narrow door, gap between platform and train, accessible spaces are full
What hinders moveThroughVehicle at a transitVehicle for people who travel in wheelchairs?	narrow space
What hinders rideVehicle at a transitVehicle for people who travel in wheelchairs?	vehicle is inaccessible
What hinders moveInSpace at a bathroom for people with low to no vision?	plastic handrails, floor signs
What hinders moveInSpace in a building for people with low to no vision?	no braille or audio indicators, open spaces, poor lighting, protruding objects, sharp edges, non-signalized overhead obstacles
What hinders moveDownHallway in a building for people with low to no vision?	construction work in hallway
What hinders locateEntrance in a building for people with low to no vision?	sharp edges, door jambs
What hinders locateDestination in a building for people with low to no vision?	lack of signage and directories, poor lighting
What hinders approachEntrance in a building for people with low to no vision?	steep path to entrance

What hinders discernWhichElevatorArrived at an elevator for people with low to no vision?	bank of elevators, no auditory cues
What hinders pushButton at an elevator for people with low to no vision?	recessed ashtray
What hinders readSign at an elevator for people with low to no vision?	braille symbols too small, incorrect braille
What hinders openDoor at an entranceExit for people with low to no vision?	heavy door
What hinders passThroughDoorway at an entranceExit for people with low to no vision?	revolving door
What hinders approachDoorway at an entranceExit for people with low to no vision?	flight of stairs
What hinders recognizeArrival at an indoorDestination for people with low to no vision?	open space, poor lighting
What hinders readSign at an interiorDoorway for people with low to no vision?	locating the sign, constant traffic through the entrance
What hinders passThroughDoorway at an interiorDoorway for people with low to no vision?	raised sill
What hinders enterRoadway at a pedestrianCrossing for people with low to no vision?	oncoming traffic, position of ramp, poorly signalized zebra, bicycle lane
What hinders hearSignal at a pedestrianCrossing for people with low to no vision?	no pedestrian signal, noise, signal too soft
What hinders enterSidewalk at a pedestrianCrossing for people with low to no vision?	light is too short
What hinders stayInCrosswalk at a pedestrianCrossing for people with low to no vision?	no pedestrian crosswalk
What hinders stopAtCurb at a pedestrianCrossing for people with low to no vision?	dropped curb
What hinders cross street at a pedestrianCrossing for people with low to no vision?	no pedestrian crossing, no traffic light
What hinders moveAlongPath at a pedestrianPath for people with low to no vision?	poor pavement maintenance, openings on path, overhangs on pathway [signs, tree branches], uneven surface, steep slope, poor lighting, obstacles [open manhole cover, basement doors, excessive street furniture, stairs, trees, open squares, construction, ice or water, bars, scaffolding, bollards, trash can, lamp poles, advertising board]
What hinders changeLevel at a pedestrianPath for people with low to no vision?	steps, non-signalized stairs
What hinders passPeople at a pedestrianPath for people with low to no vision?	crowds
What hinders crossOpenSpace at a	no terrain differences, no useful sounds

pedestrianPath for people with low to no vision?	
What hinders orient along a route for people with low to no vision?	traffic heavy, obstacles, unfamiliar, no sign audible, no sign tactile
What hinders listen along a route for people with low to no vision?	noise
What hinders listen along a route for people with low to no vision?	noise
What hinders touch along a route for people with low to no vision?	guide dog
What hinders listen along a route for people with low to no vision?	transition sound
What hinders touch along a route for people with low to no vision?	transition texture
What hinders interactWithEmployees at an serviceIndoor for people with low to no vision?	tactile path leads to wrong counter
What hinders seeDisplayedItems at an serviceIndoor for people with low to no vision?	poor lighting
What hinders readTactilely at signage for people with low to no vision?	locating the sign, no braille signs
What hinders readVisually at signage for people with low to no vision?	dim lighting on signs, print too small, shadows from light source, surface glare, no background contrast, no vision
What hinders hearAnnouncements at signage for people with low to no vision?	no announcements
What hinders maintainBalance at stairsSteps for people with low to no vision?	cane slips into riser
What hinders detectFlightStairs at stairsSteps for people with low to no vision?	non-signalized stairs
What hinders approachStairway at stairsSteps for people with low to no vision?	wet conditions
What hinders maintainBalance on a stairway for people with low to no vision?	no slip-resistant surfaces, handrails not on both sides
What hinders detectFlightStairs on a stairway for people with low to no vision?	non-signalized stairs
What hinders findStop at a transitStation for people with low to no vision?	do not know station layout
What hinders findStop at a transitStop for people with low to no vision?	not uniformly placed on block, not uniformly marked
What hinders waitAtStop at a transitStop for people with low to no vision?	transparent bus shelter, no weather protection
What hinders recognize vehicle at a transitStop for people with low to no vision?	noise
What hinders takeSeatSecureChair at a transitVehicle for people with low to no vision?	identifying empty seats
What hinders boardBus at a transitVehicle for people with low to no	no slip-resistant steps, no slip-resistant ramp, open risers on steps, low contrast on ramp edge

vision?	
What hinders deboardBus at a transitVehicle for people with low to no vision?	irregularities in the pedestrian surface
What hinders makeStopRequest at a transitVehicle for people with low to no vision?	no announcements
What hinders rideVehicle at a transitVehicle for people with low to no vision?	no paratransit eligibility out of state
What hinders stayOnRamp at a rampOutdoor for people with low to no vision?	no guiderail
What hinders ascendRamp at a rampOutdoor for people with low to no vision?	openings on surface
What enables enterStall at a bathroom for people who travel in wheelchairs?	door swing out, automatic door, door wide
What enables moveInSpace at a bathroom for people who travel in wheelchairs?	space wide, occupancy single, toe clearance, surface non-slip
What enables transfer at a bathroom for people who travel in wheelchairs?	handrails, high toilet transfer height, toilet clear space, toilet large
What enables turn180 at a bathroom for people who travel in wheelchairs?	turning radius wide
What enables washHands at a bathroom for people who travel in wheelchairs?	sink adequate height, dispenser within reach, pipes insulated, space under sink
What enables bathe at a bathroom for people who travel in wheelchairs?	handrails, roll in shower, shower bench, hose hand held
What enables moveInSpace in a building for people who travel in wheelchairs?	clear space, step-free, non-slip surfaces, ramp, good lighting, single level, wide space
What enables changeLevel in a building for people who travel in wheelchairs?	elevator, stair lift, lift, ramp
What enables moveDownHallway in a building for people who travel in wheelchairs?	wide hallway, non-slip surfaces, clear space
What enables turn180 in a building for people who travel in wheelchairs?	wide space, maneuvering areas
What enables passPerson in a building for people who travel in wheelchairs?	passing space
What enables approachEntrance in a building for people who travel in wheelchairs?	accessible route
What enables discernWhichElevatorArrived at an elevator for people who travel in wheelchairs?	visual indicator
What enables enterElevator at an elevator for people who travel in wheelchairs?	wide doorway, good lighting
What enables passPeople at an elevator for people who travel in wheelchairs?	doors wider than two wheelchairs
What enables turn180 at an elevator for people who travel in wheelchairs?	doors on both sides, large space
What enables pushButton at an elevator for people who travel in wheelchairs?	visual indicator that button is pushed

What enables openDoor at an entranceExit for people who travel in wheelchairs?	low opening force, automatic door, button is outside door swing, button is visible, accessible hardware
manipulateHardware at an entranceExit for people who travel in wheelchairs?	operable with closed fist or loose grip [handles, pulls, latches, locks]
passThroughDoorway at an entranceExit for people who travel in wheelchairs?	slow door closer, low sill, low step, wide doorway, clear space around doorway, inward opening door
approachDoorway at an entranceExit for people who travel in wheelchairs?	flat-entry, ramp, low grade ramp, lift available
What enables openDoor at an interiorDoorway for people who travel in wheelchairs?	automatic door, button within reach
passThroughDoorway at an interiorDoorway for people who travel in wheelchairs?	wide doorway, propped doors, slow door closer, level access
approachDoorway at an interiorDoorway for people who travel in wheelchairs?	lift available, ramp
What enables findSpace in a parkingLot for people who travel in wheelchairs?	dedicated spaces, clearly identified, more spaces, policing ineligible parkers
What enables transferFromCar in a parkingLot for people who travel in wheelchairs?	access aisle, access aisle is full length of space, access aisle is same level as parking space, wide spaces, wide access aisles
What enables getToPath in a parkingLot for people who travel in wheelchairs?	access route
What enables findSpace at parkingStreetParking for people who travel in wheelchairs?	dedicated spaces, clearly identified, more spaces, policing ineligible parkers
What enables getToPath at parkingStreetParking for people who travel in wheelchairs?	ramp
What enables pay at parkingStreetParking for people who travel in wheelchairs?	allow single payment, multi-space hop
What enables findSpace in a parkingStructure for people who travel in wheelchairs?	dedicated spaces, clearly identified, more spaces, policing ineligible parkers, sign indicating availablility of spaces
What enables transferFromCar in a parkingStructure for people who travel in wheelchairs?	access aisle, access aisle is full length of space, access aisle is same level as parking space, wide spaces, wide access aisles
What enables getToPath in a parkingStructure for people who travel in wheelchairs?	access route
What enables moveThroughStructure in a parkingStructure for people who travel in wheelchairs?	space close to entrance
What enables pushButton at a pedestrianCrossing for people who travel in wheelchairs?	within reach, low effort to push, large button
What enables enterRoadway at a pedestrianCrossing for people who travel in wheelchairs?	curb ramp, grade break should be flush, good lighting
What enables enterSidewalk at a pedestrianCrossing for people who travel in wheelchairs?	adequate time to cross, ramp
What enables locateCrossing at a	visual contrast

pedestrianCrossing for people who travel in wheelchairs?	
What enables alignTravelDirection at a pedestrianCrossing for people who travel in wheelchairs?	ramp oriented toward path of travel
What enables moveAlongPath at a pedestrianPath for people who travel in wheelchairs?	sidewalk, low slope, smooth surface, wide sidewalk, grass partition, clear sidewalk
What enables changeLevel at a pedestrianPath for people who travel in wheelchairs?	bevel
What enables passPeople at a pedestrianPath for people who travel in wheelchairs?	wide sidewalk, passing area
What enables stopOnRamp at a ramp for people who travel in wheelchairs?	landing
What enables turnOnRamp at a ramp for people who travel in wheelchairs?	turning space
What enables stayOnRamp at a ramp for people who travel in wheelchairs?	wide ramp, edge protection
What enables descendRamp at a ramp for people who travel in wheelchairs?	truncated domes, handrails
What enables ascendRamp at a ramp for people who travel in wheelchairs?	handrails, low slope
What enables graspHandrail at a ramp for people who travel in wheelchairs?	grip clearance, smooth round edges
What enables approachRamp at a ramp for people who travel in wheelchairs?	drainage grates
What enables streetToRamp at a ramp for people who travel in wheelchairs?	both on same slope, adjacent surfaces at same level
What enables orient along a route for people who travel in wheelchairs?	visual cues
What enables look along a routeIndoor for people who travel in wheelchairs?	visual sign
What enables look along a routeOutdoor for people who travel in wheelchairs?	buildings, street names
What enables sitAtTable at a service for people who travel in wheelchairs?	seats left out, table raises and lowers, movable chairs, clearance under table, flat ground
What enables interactWithEmployees at a service for people who travel in wheelchairs?	low counter, helpful staff, space under counter
What enables reachItems at a service for people who travel in wheelchairs?	within reach
What enables moveDownAisle at a service for people who travel in wheelchairs?	wide aisle
What enables seeDisplayedItems at a service for people who travel in wheelchairs?	low display case, clear lettering
What enables approachPassTable at a service for people who travel in wheelchairs?	space around table
What enables tryOnClothing at a service for people who travel in wheelchairs?	large fitting room
What enables accessService at a service	parking near entrance, drive-through, accessible bathroom, sidewalk,

for people who travel in wheelchairs?	having personal vehicle, public transit, on ground floor of building, travel partner
What enables readVisually at signage for people who travel in wheelchairs?	glare-free, contrasting color, appropriate height
What enables goUpstairs in a stairway for people who travel in wheelchairs?	stair lift
What enables graspHandrail in a stairway for people who travel in wheelchairs?	grip clearance
What enables waitAtStop at a transitStation for people who travel in wheelchairs?	good lighting, firm stable surface, weather protection, elevator, wide gates
What enables stopToPath at a transitStation for people who travel in wheelchairs?	access route, step-free access
What enables payFare at a transitVehicle for people who travel in wheelchairs?	good lighting
What enables waitAtStop at a transitStop for people who travel in wheelchairs?	good lighting, firm stable surface, weather protection
What enables recognizeVehicle at a transitStop for people who travel in wheelchairs?	consistent signage
What enables takeSeatSecureChair at a transitVehicle for people who travel in wheelchairs?	wheelchair spaces, wheel clamps and mounted straps for securement, close to front of vehicle
What enables boardVehicle at a transitVehicle for people who travel in wheelchairs?	grab bars, handrails, ground level lighting, adequate time, contrasting ramp edge, raised ramp edge, non-slip surface, ramp, lifting device, wide ramp with low slope, tall doorway
What enables deboardVehicle at a transitVehicle for people who travel in wheelchairs?	grab bars, handrails, ground level lighting, power-assisted door, automatic door
What enables moveThroughVehicle at a transitVehicle for people who travel in wheelchairs?	passing space, access route
What enables makeStopRequest at a transitVehicle for people who travel in wheelchairs?	auditory and visual confirmation, contrasting color
What enables reachStopRequest at a transitVehicle for people who travel in wheelchairs?	within reach
What enables graspStopRequest at a transitVehicle for people who travel in wheelchairs?	one hand operation
What enables enterStall at a bathroom for people with low to no vision?	door swing out
What enables washHands at a bathroom for people with low to no vision?	automatic tap
What enables flushToilet at a bathroom for people with low to no vision?	automatic flush
What enables moveInSpace in a building for people with low to no vision?	ramp, good lighting, non-slip surfaces, clear space, tactile guide paths, shorelining, full cane sweep
What enables changeLevel in a building for people with low to no vision?	elevator
What enables locateDestination in a building for people with low to no vision?	braille signs

What enables discernWhichElevatorArrived at an elevator for people with low to no vision?	visual and audio indicator, audible differentiation
What enables enterElevator at an elevator for people with low to no vision?	automatic sliding doors, well lit
What enables pushButton at an elevator for people with low to no vision?	braille and tactile characters, visual indicator that button is pushed
What enables hearAnnouncements at an elevator for people with low to no vision?	automatic verbal annunciator, audible announcements
What enables openDoor at an entranceExit for people with low to no vision?	weight activated doors
manipulateHardware at an entranceExit for people with low to no vision?	operable with closed fist or loose grip [handles, pulls, latches, locks]
What enables identifyDoor at an interiorDoorway for people with low to no vision?	tactile numbering
What enables pushButton at a pedestrianCrossing for people with low to no vision?	tactile arrows, proximity to curb edge, locator tone
What enables enterRoadway at a pedestrianCrossing for people with low to no vision?	audible signal, zebra crossing, traffic light
What enables hearSignal at a pedestrianCrossing for people with low to no vision?	signal announces additional information [state, street name, direction of traffic, number of lanes to cross, odd or even block numbers]
What enables enterSidewalk at a pedestrianCrossing for people with low to no vision?	adequate time to cross
What enables locateCrossing at a pedestrianCrossing for people with low to no vision?	visual contrast
What enables stopAtCurb at a pedestrianCrossing for people with low to no vision?	tactile paving, hard detectable curb edge
What enables moveAlongPath at a pedestrianPath for people with low to no vision?	good lighting, tactile paving, dog guide, telescopes, shorelining, wide width
What enables stayOnRamp at a ramp for people with low to no vision?	railings ramp guard, edge protection
What enables graspHandrail at a ramp for people with low to no vision?	grip clearance, contrasting color, smooth round edges
What enables orient along a Route for people with low to no vision?	smell cues, sound cues, tactile cues, visual cues
What enables listen along a routeIndoor for people with low to no vision?	smell cues, sound cues, tactile cues, visual cues
What enables touch along a routeIndoor for people with low to no vision?	tactile sign, floor type, slope change, door count, Braille, detectable path, surface material
What enables look along a routeIndoor for people with low to no vision?	visual sign
What enables perceiveObstacle along a routeIndoor for people with low to no vision?	contrast, tactileWarning, audibleWarning
What enables smell along a routeOutdoor for people with low to no vision?	restaurants, bakeries, snack bars

What enables listen along a routeOutdoor for people with low to no vision?	traffic, audible signals, echos, pedestrian noise, awnings, open spaces, manhole, stores, restaurants
What enables touch along a routeOutdoor for people with low to no vision?	curb, surface type, thresholds, sun, poles, bus shelters, signs, bin, stairs, fences, balustrades, surface changes
What enables look along a routeOutdoor for people with low to no vision?	buildings, statues, visual sign
What enables perceiveObstacle along a routeOutdoor for people with low to no vision?	pole barrier
What enables navigateCheckoutLine at a service for people with low to no vision?	detectable posts and railings
What enables seeDisplayedItems at a service for people with low to no vision?	good lighting
What enables accessService at a service for people with low to no vision?	accessible transit, good lighting
What enables readTactilely at signage for people with low to no vision?	rounded corners, below text, within reach, tactile signs, braille
What enables readVisually at signage for people with low to no vision?	glare-free, shadow free, contrasting color, appropriate height, large print
What enables hearAnnouncements at signage for people with low to no vision?	audio systems [voice activated messages audio channel]
What enables maintainBalance in a stairway for people with low to no vision?	closed risers, slip-resistant surface, minimal glare, handrail
What enables detectStepEdge in a stairway for people with low to no vision?	tonal contrast strips, distinguishable edging
What enables detectFlightStairs in a stairway for people with low to no vision?	tactile paving indicator
What enables graspHandrail in a stairway for people with low to no vision?	grip clearance, contrasting color
What enables hearAnnouncements at a transitStation for people with low to no vision?	acoustic cues
What enables readSigns at a transitStation for people with low to no vision?	tactile signs, large print, high contrast, non-glare, braille
What enables stopToPath at a transitStation for people with low to no vision?	access path, handrails
What enables findStop at a transitStop for people with low to no vision?	consistent stop location, tactile paving, good lighting, landmarks [shelters, benches, trash cans, newspaper boxes, grass shoulder]
What enables waitAtStop at a transitStop for people with low to no vision?	good lighting, weather protection, tactile paving
What enables hearAnnouncements at a transitStop for people with low to no vision?	acoustic cues
What enables recognizeVehicle at a transitStop for people with low to no vision?	consistent signage
What enables payFare at a transitVehicle for people with low to no vision?	good lighting, handrails
What enables takeSeatSecureChair at a transitVehicle for people with low to no	grab bars, handrails, close to front

vision?	
What enables boardVehicle at a transitVehicle for people with low to no vision?	grab bars, handrails, ground level lighting, adequate time
What enables deboardVehicle at a transitVehicle for people with low to no vision?	grab bars, handrails, ground level lighting
What enables moveThroughVehicle at a transitVehicle for people with low to no vision?	grab bars, handrails, good lighting, free of obstruction, access path
What enables makeStopRequest at a transitVehicle for people with low to no vision?	auditory and visual confirmation, contrasting color, announce destination points
What enables reachStopRequest at a transitVehicle for people with low to no vision?	within reach
What enables graspStopRequest at a transitVehicle for people with low to no vision?	one hand operation

Table 41 Pre-Glossary

Question Term	Count	Answer Term	Count	Objects	Actions
peoplewhotravelinwheelchairs	151	space	59	people who travel in wheelchairs	moveinspace
enables	127	door	39	people with low to no vision	changelevel
hinders	126	ramp	32	transit vehicle	findspace
peoplewithlowtonovision	109	lighting	29	pedestrian crossing	gettopath
transitvehicle	27	access	28	building	opendoor
pedestriancrossing	22	surface	22	ramp	passthroughdoorway
building	20	narrow	22	bathroom	pushbutton
ramp	18	wide	20	elevator	waitatstop
bathroom	17	handrails	18	entrance	approachdoorway
elevator	16	signs	18	service	grasphandrail
entranceexit	14	tactile	16	pedestrian path	hearannouncements
serviceindoor	12	steps	14	transit stop	listen
pedestrianpath	11	contrast	14	interior doorway	transferfromcar
service	11	good	14	parking structure	enterroadway
transitstop	10	high	14	stairway	entersidewalk
interiordoorway	9	visual	14	transit station	look
parkingstructure	9	aisle	14	parking lot	movealongpath
stairway	8	open	13	signage	parkingstreet
transitstation	8	path	13	route	passpeople
moveinspace	7	edge	12	street parking	pay

parkinglot	7	cues	12	steps	seedisplayeditems
signage	7	low	11	destination	stayonramp
changelevel	6	slope	11		takeseatsecurechair
findspace	6	non	10		touch
gettopath	6	sidewalk	10		turn180
opendoor	6	bars	10		accessservice
passthroughdoorway	6	elevator	10		approachentrance
pushbutton	6	signalized	10		ascendramp
routeoutdoor	6	slip	10		detectflightstairs
waitatstop	6	stairs	10		discernwhichelevatorarrived
approachdoorway	5	clear	10		enterelevator
grasphandrail	5	braille	9		enterstall
hearannouncements	5	level	9		findstop
listen	5	poor	9		interactwithemployees
routeindoor	5	automatic	8		locatedestination
transferfromcar	5	button	8		locateentrance
enterroadway	4	close	8		maintainbalance
entersidewalk	4	curb	8		makestoprequest
look	4	doorway	8		manipulatehardware
movealongpath	4	entrance	8		movedownhallway
parkingstreet	4	grab	8		movethroughvehicle
passpeople	4	lift	8		orient
pay	4	table	8		parkingstreetparking
seedisplayeditems	4	parking	8		readsign
stairssteps	4	indicator	7		readvisually
stayonramp	4	clearance	7		stoptopath
takeseatsecurechair	4	full	7		washhands
touch	4	grip	7		approachpasstable
turn180	4	lack	7		approachstairway
accessservice	3	protection	7		bathe
approachentrance	3	reach	7		boardbus
ascendramp	3	steep	7		boardvehicle
detectflightstairs	3	traffic	7		deboardvehicle
discernwhichelevatorarrived	3	within	7		descendramp
enterelevator	3	raised	6		graspstoprequest
enterstall	3	swing	6		hearsignal
findstop	3	obstructed	6		locatecrossing

interactwithemployees	3	operable	6		movedownaisle
locatedestination	3	seats	6		movethroughstructure
locateentrance	3	color	6		navigatecheckoutline
maintainbalance	3	cross	6		payfare
makestoprequest	3	free	6		perceiveobstacle
manipulatehardware	3	ground	6		rampoutdoor
movedownhallway	3	large	6		reachitems
movethroughvehicle	3	pedestrian	6		reachstoprequest
orient	3	weather	6		readtactilely
parkingstreetparking	3	adequate	5		recognizevehicle
readsign	3	audible	5		ridevehicle
readvisually	3	glare	5		sitattable
stoptopath	3	noise	5		stayincrosswalk
washhands	3	paving	5		stopatcurb
approachpasstable	2	signage	5		stoponramp
approachstairway	2	single	5		streettoramp
bathe	2	block	5		transfer
boardbus	2	car	5		tryonclothing
boardvehicle	2	used	5		turnonramp
deboardvehicle	2	announcements	5		aligntoramp
descendramp	2	boarding	5		aligntraveldirection
graspstoprequest	2	audio	4		approachelevator
hearsignal	2	counter	4		approachramp
locatecrossing	2	floor	4		beseen
movedownaisle	2	guide	4		boardtrain
movethroughstructure	2	hallway	4		closedoor
navigatecheckoutline	2	hand	4		communicatewithoperator
payfare	2	heavy	4		crossopenspace
perceiveobstacle	2	height	4		crossstreet
rampoutdoor	2	landing	4		deboardbus
reachitems	2	locating	4		detectstepedge
reachstoprequest	2	locked	4		entersite
readtactilely	2	obstacles	4		flushtoilet
recognizevehicle	2	resistant	4		goupstairs
ridevehicle	2	sharp	4		identifydoor
sitattable	2	sink	4		passperson

stayincrosswalk	2	small	4		reachbutton
stopatcurb	2	storage	4		recognize
stoponramp	2	street	4		recognizearrival
streettoramp	2	time	4		smell
transfer	2	toilet	4		usewheelchairspace
tryonclothing	2	transit	4		
turnonramp	2	vehicle	4		
aligntoramp	1	area	4		
aligntraveldirection	1	identified	4		
approachelevator	1	round	4		
approachramp	1	sound	4		
beseen	1	turning	4		
boardtrain	1	buildings	3		
closedoor	1	number	3		
communicatewithoperator	1	poles	3		
cross	1	posts	3		
crossopenspace	1	pushed	3		
crossstreet	1	railings	3		
deboardbus	1	risers	3		
detectstepedge	1	securement	3		
entersite	1	shelters	3		
flushtoilet	1	wheelchair	3		
goupstairs	1	auditory	3		
identifydoor	1	broken	3		
indoordestination	1	bus	3		
outdoordestination	1	cluttered	3		
passperson	1	conditions	3		
reachbutton	1	consistent	3		
recognize	1	construction	3		
recognizearrival	1	crowds	3		
smell	1	dedicated	3		
street	1	detectable	3		
usewheelchairspace	1	dog	3		
vehicle	1	dropped	3		
		far	3		
		hard	3		
		ice	3		

		ineligible	3		
		inelligible	3		
		items	3		
		machine	3		
		maintenance	3		
		parkers	3		
		passing	3		
		pathway	3		
		platform	3		
		policing	3		
		print	3		
		sill	3		
		smooth	3		
		snow	3		
		trash	3		
		uneven	3		
		wet	3		
		acoustic	2		
		activated	2		
		advertisement	2		
		appropriate	2		
		around	2		
		assist	2		
		available	2		
		bathroom	2		
		bench	2		
		bisecting	2		
		boxes	2		
		cane	2		
		change	2		
		channel	2		
		chord	2		
		closer	2		
		confirmation	2		
		directories	2		
		dispenser	2		
		display	2		

		domes	2		
		firm	2		
		fist	2		
		fitting	2		
		flat	2		
		flight	2		
		flush	2		
		front	2		
		furniture	2		
		grade	2		
		grass	2		
		gravel	2		
		handles	2		
		inclination	2		
		inward	2		
		lamp	2		
		lane	2		
		latches	2		
		length	2		
		loose	2		
		manhole	2		
		manual	2		
		name	2		
		newspaper	2		
		odd	2		
		one	2		
		overgrowth	2		
		pavement	2		
		points	2		
		position	2		
		pulls	2		
		restaurants	2		
		revolving	2		
		room	2		
		segregated	2		
		shadow	2		
		shorelining	2		

		short	2		
		shower	2		
		sides	2		
		sliding	2		
		slippery	2		
		slow	2		
		smell	2		
		stable	2		
		state	2		
		station	2		
		transfer	2		
		travel	2		
		tree	2		
		truncated	2		
		two	2		
		type	2		
		uniformly	2		
		visible	2		
		water	2		
		zebra	2		
		additional	1		
		adjacent	1		
		admit	1		
		aids	1		
		allow	1		
		angles	1		
		annunciator	1		
		approach	1		
		arrows	1		
		ashtray	1		
		audiblewarning	1		
		availablility	1		
		away	1		
		awnings	1		
		background	1		
		bad	1		
		bakeries	1		

		balustrades	1		
		bank	1		
		barrier	1		
		basement	1		
		bathtubs	1		
		bevel	1		
		bicycle	1		
		bin	1		
		bollards	1		
		booth	1		
		branches	1		
		break	1		
		camber	1		
		cans	1		
		carpet	1		
		case	1		
		chairs	1		
		characters	1		
		circle	1		
		clamps	1		
		commonly	1		
		constant	1		
		contact	1		
		controls	1		
		corners	1		
		count	1		
		cover	1		
		crosswalk	1		
		debris	1		
		decorations	1		
		deploy	1		
		destination	1		
		device	1		
		differences	1		
		differentiation	1		
		dim	1		
		dips	1		

		direction	1		
		distinguishable	1		
		drainage	1		
		drive	1		
		drivers	1		
		echos	1		
		effort	1		
		eligibility	1		
		empty	1		
		enough	1		
		entry	1		
		even	1		
		excessive	1		
		eye	1		
		fences	1		
		force	1		
		gap	1		
		gates	1		
		grates	1		
		guard	1		
		guiderail	1		
		hardware	1		
		held	1		
		helpful	1		
		hills	1		
		hop	1		
		hose	1		
		improperly	1		
		inaccessible	1		
		inadequate	1		
		incorrect	1		
		information	1		
		insulated	1		
		irregularities	1		
		jambs	1		
		knee	1		
		knob	1		

		know	1		
		landmarks	1		
		layout	1		
		leads	1		
		left	1		
		lettering	1		
		lip	1		
		lit	1		
		long	1		
		lowers	1		
		maneuvering	1		
		marked	1		
		matching	1		
		material	1		
		messages	1		
		minimal	1		
		mounted	1		
		movable	1		
		multi	1		
		must	1		
		near	1		
		objects	1		
		occupancy	1		
		oncoming	1		
		opposite	1		
		order	1		
		oriented	1		
		outside	1		
		outward	1		
		overhangs	1		
		overhead	1		
		paratransit	1		
		partition	1		
		partner	1		
		payment	1		
		personal	1		
		picnic	1		

		pipes	1		
		placed	1		
		planters	1		
		plastic	1		
		potholes	1		
		power	1		
		press	1		
		propped	1		
		protruding	1		
		proximity	1		
		public	1		
		quickly	1		
		radius	1		
		recessed	1		
		reverse	1		
		roll	1		
		scaffolding	1		
		see	1		
		separate	1		
		series	1		
		shape	1		
		shop	1		
		shoulder	1		
		snack	1		
		soft	1		
		source	1		
		squares	1		
		staff	1		
		statues	1		
		stop	1		
		stores	1		
		straps	1		
		strips	1		
		style	1		
		sun	1		
		sweep	1		
		symbols	1		

		systems	1		
		tactilewarning	1		
		tall	1		
		tap	1		
		telescopes	1		
		terrain	1		
		text	1		
		texture	1		
		thresholds	1		
		toe	1		
		together	1		
		tonal	1		
		tone	1		
		toward	1		
		train	1		
		transparent	1		
		turnstile	1		
		twist	1		
		unfamiliar	1		
		unmarked	1		
		verbal	1		
		via	1		
		vision	1		
		voice	1		
		waiting	1		
		weight	1		
		well	1		
		wheel	1		
		wider	1		
		width	1		
		work	1		
		wrong	1		

APPENDIX F

ONTOLOGICAL CONCEPTS AND RELATIONS

This Appendix includes two tables that compose the basis for the ontology. Table 42 defines the concepts and their basic relations. Table 43 defines the attributes of each concept and its enable and hinder relations.

Table 42 Concepts and basic relations

Entity	Super relations	Instances (is-a)	Components (has-component)	spatial relations
Building	is-a destination	transit station, parking structure	hallway, entrance, stairway, room, elevator, signage	@
Transit Station	is-a building	@	@	@
Hallway	component-of building	@	ramp, doorway	intersected by route
Stairway	component-of building	@	step, handrail, landing, doorway	@
Step	component-of stairway; component-of sidewalk; component-of doorway	@	@	@
Handrail	component-of stairway; component-of ramp	@	@	@
Elevator	component-of building	@	doorway, call button, call signal	@
Call button	component-of elevator	@	@	@
Call signal	component-of elevator	@	@	@
Room	is-a destination; component-of building	bathroom, fitting room	doorway, aisle, items, staff,	@

			counter	
Aisle	component-of room; component-of transit vehicle	@	@	@
Bathroom	is-a room	@	toilet, sink, dispenser, shower	@
Toilet	component-of bathroom	@	@	@
Sink	component-of bathroom	@	@	@
Dispenser	component-of bathroom	@	@	@
Shower	component-of bathroom	@	@	@
Items	component-of room	@	@	@
Staff	component-of room	@	@	@
Counter	component-of room	@	@	@
Fitting room	is-a room	@	@	@
Entrance	is-a doorway; component-of building	@	@	connects-to pedestrian walkway
Ramp	component-of hallway; component-of doorway	curb ramp	landing, handrail	@
Curb ramp	component-of sidewalk; component-of pedestrian crossing	@	@	@
Doorway	component-of stairway; component-of elevator; component-of room; component-of hallway; component-of transit vehicle	entrance	ramp, step, sill, door, door button	@
Sill	component-of doorway	@	@	@
Door	component-of doorway	@	hardware, signage, door button	@
Door button	component-of doorway	@	@	@
Hardware	component-of door	@	@	@
Signage	component-of door; component-of route	@	@	@
Pedestrian path	@	@	Trail, Bridge, Tunnel, Sidewalk, Pedestrian Walkway	intersected-by route

Sidewalk	component-of pedestrian crossing; component-of pedestrian path	@	curb, curb ramp, step	connects-to pedestrian walkway; connects-to street
Curb	component-of sidewalk	@	@	@
Obstacles	@	construction, snow, ice, overgrowth, advertisement boards, planters, newspaper boxes, street furniture, shop displays, lamp posts, parking blocks, open manhole cover, basement doors, stairs, trees, open squares, scaffolding, bollards, trash can	@	@
Pedestrian walkway	component-of pedestrian path	@	@	connects-to sidewalk; connects-to entrance
Street	@	@	street parking, parking lot, crosswalk	connects-to sidewalk
Crosswalk	component-of pedestrian crossing	@	@	@
Pedestrian crossing	@	@	curb ramp, sidewalk, crosswalk, signal button, crossing signal	@
Signal button	component-of pedestrian crossing	@	@	@
Crossing signal	component-of pedestrian crossing	@	@	@
Transit stop	@	@	@	connects-to sidewalk; connects-to transit vehicle
Transit vehicle	@	@	doorway, aisle	connects-to transit stop
Route	@	@	signage, destination	intersects pedestrian path; intersects hallway
Destination	component-of route	room, building	@	@
Landmarks	component-of route	visual landmark, audio landmark, olfactory landmark, tactile landmark	@	@
Audio landmark	is-a landmark	traffic, audible signal, echo, pedestrian noise	@	@
Olfactory	is-a landmark	bakery	@	@

landmark				
Tactile landmark	is-a landmark	curb, sun, surface changes, pole barrier	@	@
Visual landmark	is-a landmark	visual sign, statue	@	@

Table 43 Hinder and enable relations

Entity	Attributes	Group	Hinder relations	Enable relations
Building	elevator (yes, no); signage (yes, no); accessible bathroom (yes, no); open spaces (yes, no); lighting level (#bright, #dim); protruding objects (yes, no); protruding objects signalized (yes, no); level count (integer); ramp (yes, no); space condition (clear, cluttered); space width (#narrow, #wide); tactile guide path (yes, no)	ALL	presence of signage (no) hinders locate entrance	lighting level (bright #) <enables> move in space
Call signal	type (auditory, visual); audio differentiation (yes, no); announcement (yes, no)	ALL	NONE	indicator type (visual) <enables> discern which elevator arrived
Crossing signal	crossing time (#short, #long); volume (#high, #low); locator tone (yes, no); type (audible, visual)	ALL	minutes to cross (#short) hinders enter sidewalk	
Door	width (#narrow, #wide); swing (in, out); type (manual, automatic, revolving, weight based); weight (#heavy, #light); status (locked, unlocked, open); closing speed (#slow, #fast); opening force (#low, #high)	ALL	type (revolving) hinders pass through doorway weight (#heavy) hinders open door	type (automatic) <enables> pass through stall
Elevator	storage (yes, no); space width (#narrow, #wide); occupancy (full, empty); door closing speed (#slow, #fast); bank (yes, no); number of doors (1, 2); lighting level (#bright, #dim)	ALL	NONE	presence of elevator (yes) <enables> change floor lighting level (bright #) <enables> enter elevator
Hallway	width (#narrow, #wide); storage (yes, no); obstacles (yes, no); slip-resistant surface (yes, no); space condition (cluttered, clear)	ALL	obstacles (yes) hinders walk propel	slip-resistant surface (yes) <enables> move down hallway

Handrail	condition (slippery); posts along rail (yes, no); material (metal, wood, plastic); grip clearance (yes, no); edge type (round); edge surface (smooth, rough); contrast level (#high, #low)	ALL	NONE	grip clearance (#) <enables> grasp handrail edge surface (smooth) <enables> grasp handrail presence of handrail (yes) <enables> board vehicle presence of handrail (yes) <enables> deboard vehicle
Hardware	control type (grip, twist, closed fist, loose grip); knob type (round)	ALL	NONE	control type (closed fist) <enables> manipulate hardware control type (loose grip) <enables> manipulate hardware
Pedestrian crossing	crossing signal (yes, no); noise level (#high, #low); traffic light (yes, no); lighting level (#dim, #bright); contrast level (#low, #high); crossing time (#long, #short)	ALL	NONE	crossing time (#short) <enables> enter sidewalk contrast level (#high) <enables> locate crossing
Ramp	slope (#steep, #gentle); landing (yes, no); turning radius (#narrow, #wide); width (#narrow, #wide); handrails (yes, no); openings on ramp (yes, no); slip-resistant surface (yes, no); contrast level (#high, #low); guiderail (yes, no); edge protection (yes, no); landing (yes, no); ramp guard (yes, no)	ALL	openings on ramp (yes) hinders use ramp slope (#steep) hinders approach doorway	presence of ramp (yes) <enables> move in space
Room	carpet (yes, no); space width (#narrow, #wide); space condition (cluttered, clear); lighting level (#bright, #dim); slip-resistant surface (yes, no)	ALL	NONE	slip-resistant surface (yes, no) <enables> move in space
Route	noise level (#high, #low); traffic level (#heavy, #light); landmark type (visual, audio, olfactory, tactile landmark)	ALL		landmark type (visual) <enables> orient oneself

Sidewalk	curb ramp (yes, no); pedestrian crossing (yes, no); slope (#steep, #gentle); slope length (#long, #short); width (#narrow, #wide); openings on path (yes, no); surface condition (uneven, slippery, smooth); maintenance condition (poor, good); steps (yes, no); lighting level (#bright, #dim); overhanging objects (yes, no); curb (yes, no); space condition (cluttered, clear); passing space (yes, no); tactile paving (yes, no); beveled edge (yes, no); obstacles on path (yes, no)	ALL	pedestrian crossing (no) hinders cross street maintenance condition (poor) hinders move along path openings on path (yes) hinders move along path surface condition (uneven) hinders move along path slope (#steep) hinders move along path obstacles on path (yes) hinders move along path steps (yes) hinders change level	NONE
Signage	braille size (#large, #small); braille correct (yes, no); lighting level (#bright, #dim); print size (#large, #small); surface glare (yes, no); contrast level (#high, #low); type (tactile, braille, visual); height (#high, #low); status (visible, hidden); character legibility (legible, illegible)	ALL	NONE	surface glare (no) <enables> read visually
Sill	type (raised, flush)	ALL	sill type (raised) hinders pass through doorway	sill type (flush) <enables> pass through doorway
Step	step height (#high, #low); step count (integer); riser type (open, closed); signalized (yes, no); slip-resistant surface (yes, no); beveled edge (yes, no); tonal contrast strips (yes, no)	ALL	step count (>1) hinders approach doorway	NONE
Transit stop	weather protection (yes, no); obstacle in boarding area (yes, no); uniform location (yes, no); uniform marking (yes, no); shelter visibility (transparent, opaque); noise level (#high, #low); lighting level (#bright, #dim); landmarks (yes, no)	ALL	weather protection (no) hinders wait at stop	weather protection (yes) <enables> wait at stop
Visual landmark	category (statue, contrasting materials, visual sign)	ALL	NONE	presence of visual sign (yes) <enables> look
Aisle	width (#narrow, #wide); space condition (cluttered, clear)	LNV	NONE	space condition (clear) <enables> move in space

Audio landmark	category (audio indicator, traffic, audible signal, echo, pedestrian noise)	LNV	NONE	presence of audio indicator (yes) <enables> perceive obstacle presence of traffic (yes) <enables> listen presence of audible signal (yes) <enables> listen presence of echo (yes) <enables> listen presence of pedestrian noise (yes) enables listen
Bathroom	space width (#narrow, #wide); space shape (square, non-square); storage (yes, no); space condition (cluttered, clear); occupancy (single, multiple); grab bar (yes, no); turning radius (#narrow, #wide)	LNV	space condition (cluttered) hinders walk propel	NONE
Building	elevator (yes, no); signage (yes, no); accessible bathroom (yes, no); open spaces (yes, no); lighting level (#bright, #dim); protruding objects (yes, no); protruding objects signalized (yes, no); level count (integer); ramp (yes, no); space condition (clear, cluttered); space width (#narrow, #wide); tactile guide path (yes, no)	LNV	lighting level (#dim) hinders orient oneself presence of protruding objects (yes) hinders walk propel protruding objects signalized (no) hinders walk propel lighting level (#dim) hinders locate entrance presence of open spaces (yes) hinders locate entrance presence of open spaces (yes) hinders orient oneself	presence of tactile guide path <enables> move in space space condition (clear) <enables> move in space
Call signal	type (auditory, visual); audio differentiation (yes, no); announcement (yes, no)	LNV	NONE	indicator type (audio) <enables> discern which elevator arrived indicator type (audio differentiation) (yes) <enables> discern which elevator arrived presence of audible announcements (yes) <enables> hear announcements
Crossing signal	crossing time (#short, #long); volume (#high, #low); locator tone (yes, no); type (audible, visual)	LNV	volume (#low) hinders hear signal	type (audible) <enables> enter roadway presence of locator tone (yes) <enables> locate crossing
Crosswalk	potholes (yes, no); zebra crossing (yes, no); zebra maintenance (poor, good)	LNV	zebra maintenance (poor) hinders enter roadway zebra crossing (no) hinders stay in crosswalk	presence of zebra crossing (yes) <enables> enter roadway presence of traffic light (yes) <enables> enter roadway

				presence of tactile paving (yes) <enables> stop at curb
Door	width (#narrow, #wide); swing (in, out); type (manual, automatic, revolving, weight based); weight (#heavy, #light); status (locked, unlocked, open); closing speed (#slow, #fast); opening force (#low, #high)	LNV	NONE	type (automatic) <enables> enter elevator type (weight based) <enables> open door swing (out) <enables> pass through stall
Doorway	parking distance (#far, #near); steps (yes, no); width (#narrow, #wide); lift (yes, no); traffic level (#high, #low); height (#tall, #short); ramp (yes, no)	LNV	traffic level (#high) hinders read sign	NONE
Elevator	storage (yes, no); space width (#narrow, #wide); occupancy (full, empty); door closing speed (#slow, #fast); bank (yes, no); number of doors (1, 2); lighting level (#bright, #dim)	LNV	bank of elevators (yes) hinders discern which elevator arrived	NONE
Handrail	condition (slippery); posts along rail (yes, no); material (metal, wood, plastic); grip clearance (yes, no); edge type (round); edge surface (smooth, rough); contrast level (#high, #low)	LNV	NONE	color contrast level (#high) <enables> grasp handrail presence of handrail (yes) <enables> maintain balance presence of handrail (yes) <enables> take seat secure chair
Olfactory landmark	category (bakery)	LNV	NONE	presence of bakery (yes) <enables> smell
Pedestrian crossing	crossing signal (yes, no); noise level (#high, #low); traffic light (yes, no); lighting level (#dim, #bright); contrast level (#low, #high); crossing time (#long, #short)	LNV	crossing signal (no) hinders hear enter roadway noise level (#high) hinders hear signal traffic light (no) hinders cross street	NONE
Ramp	slope (#steep, #gentle); landing (yes, no); turning radius (#narrow, #wide); width (#narrow, #wide); handrails (yes, no); openings on ramp (yes, no); slip-resistant surface (yes, no); contrast level (#high, #low); guiderail (yes, no); edge protection (yes, no); landing (yes, no); ramp guard (yes, no)	LNV	slip-resistant surface (no) hinders board vehicle contrast level (#low) hinders board vehicle guiderail (yes) hinders stay on ramp	presence of guiderail (yes) <enables> stay on ramp presence of ramp guard (yes) <enables> stay on ramp presence of edge protection (yes) <enables> stay on ramp

Room	carpet (yes, no); space width (#narrow, #wide); space condition (cluttered, clear); lighting level (#bright, #dim); slip-resistant surface (yes, no)	LNV	lighting level (#dim) hinders see displayed items	lighting level (bright #) <enables> see displayed items
Route	noise level (#high, #low); traffic level (#heavy, #light); landmark type (visual, audio, olfactory, tactile landmark)	LNV	traffic level (#heavy) hinders orient oneself noise level (#high) hinders listen	landmark type (olfactory) <enables> orient oneself landmark type (tactile) <enables> orient oneself landmark type (audio) <enables> orient oneself landmark type (audio) <enables> listen
Sidewalk	curb ramp (yes, no); pedestrian crossing (yes, no); slope (#steep, #gentle); slope length (#long, #short); width (#narrow, #wide); openings on path (yes, no); surface condition (uneven, slippery, smooth); maintenance condition (poor, good); steps (yes, no); lighting level (#bright, #dim); overhanging objects (yes, no); curb (yes, no); space condition (cluttered, clear); passing space (yes, no); tactile paving (yes, no); beveled edge (yes, no); obstacles on path (yes, no)	LNV	curb ramp (yes) hinders enter roadway lighting level (#dim) hinders move along path overhanging objects (yes) hinders move along path obstaces on path (yes) hinders orient oneself surface condition (uneven) hinders deboard vehicle	presence of tactile paving (yes) <enables> move along the path lighting level (bright #) <enables> move along the path width (#wide) <enables> move along path
Signage	braille size (#large, #small); braille correct (yes, no); lighting level (#bright, #dim); print size (#large, #small); surface glare (yes, no); contrast level (#high, #low); type (tactile, braille, visual); height (#high, #low); status (visible, hidden); character legibility (legible, illegible)	LNV	braille size (#small) hinders read sign braile correct (no) hinders read sign lighting level (#dim) hinders read visually print size (#small) hinders read visually surface glare (yes) hinders read visually contrast level (#low) hinders read visually	type (visual) <enables> push call button type (tactile) <enables> read tactilely type (tactile) <enables> identify door type (tactile) <enables> push call button type (braille) <enables> identify door type (braille) <enables> push call button
Signal button	reach distance (within#); button size (#large, #small); push force (#low, #high); indicator (tactile, visual)	LNV	NONE	indicator (tactile) <enables> push signal button
Sink	height (#high, #low); clearance (yes, no); sink pipe coverage (insulated, non-insulated); tap type (automatic, manual)	LNV	NONE	tap type (automatic) <enables> wash hands
Stairway	signalized (yes, no); number of handrails (1, 2); handrail (yes, no); lift (yes, no)	LNV	signalized (no) hinders change level signalized (no) hinders detect stairs number of handrails (1) hinders maintain balance	NONE

Step	step height (#high, #low); step count (integer); riser type (open, closed); signalized (yes, no); slip-resistant surface (yes, no); beveled edge (yes, no); tonal contrast strips (yes, no)	LNV	slip-resistant surface (no) hinders maintain balance slip-resistant surface (no) hinders board vehicle riser type (open) hinders board vehicle riser type (open) hinders maintain balance	signalized (yes) <enables> detect flight of stairs tonal contrast strips (yes) <enables> detect step edge riser type (closed) <enables> maintain balance
Tactile landmark	category (tactile indicator, tactile sign, tactile guide path, braille sign, curb edge, sun, surface change, pole barrier)	LNV	NONE	presence of tactile indicator (yes) <enables> perceive obstacle presence of tactile sign (yes) <enables> touch presence of tactile guide path <enables> touch presence of braille signs (yes) <enables> touch presence of curb (yes) <enables> touch presence of the sun (yes) <enables> touch presence of surface changes <enables> touch presence of pole barrier (yes) <enables> perceive obstacle
Toilet	height (#high, #low); size (#large, #small); flush type (automatic, manual)	LNV	NONE	flush type (automatic) <enables> flush toilet
Transit stop	weather protection (yes, no); obstacle in boarding area (yes, no); uniform location (yes, no); uniform marking (yes, no); shelter visibility (transparent, opaque); noise level (#high, #low); lighting level (#bright, #dim); landmarks (yes, no)	LNV	uniform location (no) hinders find stop uniform marking (no) hinders find stop shelter visability (transparent) hinders wait at stop noise level (#high) hinders recognize vehicle	lighting level (bright #) <enables> find stop presence of landmarks (yes) <enables> find stop
Visual landmark	category (statue, contrasting materials, visual sign)	LNV	NONE	presence of statues (yes) <enables> look color contrast level (high) <enables> perceive obstacle
Aisle	width (#narrow, #wide); space condition (cluttered, clear)	WCU	aisle width (#narrow) hinders navigate checkout line aisle width (#narrow) hinders walk propel space condition (cluttered) hinders reach items space condition (cluttered) hinders walk propel	aisle width (#wide) <enables> move down aisle

Bathroom	space width (#narrow, #wide); space shape (square, non-square); storage (yes, no); space condition (cluttered, clear); occupancy (single, multiple); grab bar (yes, no); turning radius (#narrow, #wide)	WCU	space width (#narrow) hinders move in space space width (#narrow) hinders sit transfer space width (#narrow) hinders turn180 space shape (non-square) hinders turn 180 storage (yes) hinders move in space grab bar (no) hinders sit transfer	space width (#wide) <enables> move in space space turning radius (#wide) <enables> turn 180 bathroom occupancy (single) <enables> move in space presence of bathroom (yes) <enables> access service
Building	elevator (yes, no); signage (yes, no); accessible bathroom (yes, no); open spaces (yes, no); lighting level (#bright, #dim); protruding objects (yes, no); protruding objects signalized (yes, no); level count (integer); ramp (yes, no); space condition (clear, cluttered); space width (#narrow, #wide); tactile guide path (yes, no)	WCU	presence of elevator (no) hinders change floors presence of accessible bathroom (no) hinders access service	level count (1) <enables> move in space level count (1) <enables> access service space width (#wide) <enables> move in space space width (#wide) <enables> turn 180
Call button	height (#high, #low); decorations (yes, no); press force (#high, #low); raised (yes, no)	WCU	call button height (#high) hinders reach button decorations (yes) hinders reach button call button raised (yes) hinders push call button call button press force (#high) hinders push call button	NONE
Counter	height (#high, #low); clearance (yes, no)	WCU	height (#high) hinders interact with employees	height (#low) <enables> interact with employees clearance (yes) <enables> interact with employees
Crosswalk	potholes (yes, no); zebra crossing (yes, no); zebra maintenance (poor, good)	WCU	potholes (yes) hinders stay in crosswalk	NONE
Curb ramp	ramp status (obstructed, clear); maintenance condition (poor, good); ramp orientation (crosswalk, street); matching curb ramp (yes, no); weather condition (snow, ice); tactile paving (yes, no); grade break type (flush); drainage grate (yes, no)	WCU	ramp status (obstructed) hinders enter roadway maintenance condition (poor) hinders enter roadway matching curb ramp (no) hinders enter sidewalk weather condition (snow) hinders use ramp	orientation (to crosswalk) <enables> align to direction of travel grade break type (flush #) <enables> street to ramp grade break type (flush #) <enables> enter roadway presence of drainage grate <enables> approach ramp

			weather condition (ice) hinders use ramp	presence of edge protection (yes) <enables> stay on ramp presence of curb ramp (no) <enables> stop at curb
Dispenser	height (#high, #low); reach distance (within#)	WCU	height (#high) hinders wash hands	reach distance (within#) <enables> wash hands
Door	width (#narrow, #wide); swing (in, out); type (manual, automatic, revolving, weight based); weight (#heavy, #light); status (locked, unlocked, open); closing speed (#slow, #fast); opening force (#low, #high)	WCU	type (manual) hinders open door status (locked) hinders open door width (#narrow) hinders pass through stall width (#narrow) hinders pass through doorway swing (out) hinders pass through doorway swing (in) hinders pass through stall	opening force (low #) <enables> open door swing (in) <enables> pass through doorway closing speed (#slow) <enables> pass through doorway status (open) <enables> pass through doorway type (automatic) <enables> deboard vehicle type (automatic) <enables> open door
Door button	reach distance (within#); status (visible, hidden)	WCU	NONE FOUND	reach distance (within #) <enables> open door status (visible) <enables> open door
Doorway	parking distance (#far, #near); steps (yes, no); width (#narrow, #wide); lift (yes, no); traffic level (#high, #low); height (#tall, #short); ramp (yes, no)	WCU	parking distance (#far) hinders approach doorway presence of steps (yes) hinders approach doorway width (#narrow) hinders approach doorway lift (no) hinders approach doorway	width (#wide) <enables> pass through stall width (#wide) <enables> enter elevator width (#wide) <enables> pass people width (#wide) <enables> pass through doorway height (#tall) <enables> board vehicle
Elevator	storage (yes, no); space width (#narrow, #wide); occupancy (full, empty); door closing speed (#slow, #fast); bank (yes, no); number of doors (1, 2); lighting level (#bright, #dim)	WCU	storage (yes) hinders enter elevator door closing speed (#fast) hinders enter elevator occupancy (full) hinders enter elevator space width (#narrow) hinders turn 180	space width (#wide) <enables> turn 180 number of doors (2) <enables> ride elevator presence of elevator (yes) <enables> wait at stop
Entrance	type (main, side, rear); space condition (clear, cluttered)	WCU	entrance type (rear) hinders approach doorway entrance type (side) hinders approach doorway	space condition (clear) <enables> pass through doorway
Fitting room	space width (#narrow, #wide); grab bar (yes, no); storage (yes, no)	WCU	space width (#narrow) hinders try on clothing grab bar (no) hinders try on clothing	space width (#wide) <enables> try on clothing

			storage (yes) hinders try on clothing	
Hallway	width (#narrow, #wide); storage (yes, no); obstacles (yes, no); slip-resistant surface (yes, no); space condition (cluttered, clear)	WCU	width (#narrow) hinders walk propel storage (yes) hinders walk propel	width (#wide) <enables> move down hallway space condition (clear) <enables> move down hallway
Handrail	condition (slippery); posts along rail (yes, no); material (metal, wood, plastic); grip clearance (yes, no); edge type (round); edge surface (smooth, rough); contrast level (#high, #low)	WCU	condition (slippery) hinders grasp handrail posts along rail (yes) hinders grasp handrail	edge type (round) <enables> grasp handrail presence of handrail (yes) <enables> bathe presence of handrail (yes) <enables> transfer presence of handrail (yes) <enables> use ramp
Hardware	control type (grip, twist, closed fist, loose grip); knob type (round)	WCU	control type (grip) hinders manipulate hardware control type (twist) hinders manipulate hardware knob type (round) hinders open door	NONE
Items	height (#high, #low); reach distance (within#)	WCU	height (#high) hinders reach items height (#high) hinders see displayed items	height (#low) <enables> see displayed items reach distance (#) <enables> reach items
Pedestrian crossing	crossing signal (yes, no); noise level (#high, #low); traffic light (yes, no); lighting level (#dim, #bright); contrast level (#low, #high); crossing time (#long, #short)	WCU	NONE	lighting level (bright #) <enables> enter roadway

Ramp	slope (#steep, #gentle); landing (yes, no); turning radius (#narrow, #wide); width (#narrow, #wide); handrails (yes, no); openings on ramp (yes, no); slip-resistant surface (yes, no); contrast level (#high, #low); guiderail (yes, no); edge protection (yes, no); landing (yes, no); ramp guard (yes, no)	WCU	presence of landing (no) hinders stop on ramp turning radius (#narrow) hinders turn on ramp width (#narrow) hinders stay on ramp handrails (no) hinders use ramp slope (#steep) hinders use ramp	turning radius (#wide) <enables> turn on ramp presence of ramp (yes) <enables> change floor presence of ramp (yes) <enables> enter roadway presence of ramp (yes) <enables> enter sidewalk presence of ramp (yes) <enables> approach doorway presence of ramp (yes) <enables> approach doorway presence of ramp (yes) <enables> board vehicle width (#wide) <enables> board vehicle width (#wide) <enables> stay on ramp slope (gentle #) <enables> board vehicle slope (gentle #) <enables> use ramp slope (gentle #) <enables> approach doorway ramp edge contrast (#high) <enables> board vehicle presence of landing (yes) <enables> stop on ramp slip-resistant surface (yes) <enables> board vehicle
Room	carpet (yes, no); space width (#narrow, #wide); space condition (cluttered, clear); lighting level (#bright, #dim); slip-resistant surface (yes, no)	WCU	carpet (yes) hinders move in space space width (#narrow) hinders move in space space condition (cluttered) hinders move in space space condition (cluttered) hinders enter building	NONE
Route	noise level (#high, #low); traffic level (#heavy, #light); landmark type (visual, audio, olfactory, tactile landmark)	WCU	NONE	landmark type (visual) <enables> look
Shower	door type (sliding, curtain); bathtub (yes, no); type (roll in); bench (yes, no); nosel type (hand held)	WCU	bathtub (yes) hinders bathe door type (sliding) hinders bathe	type (roll-in) <enables> bathe presence of shower bench (yes) <enables> bathe nosel type (hand held) <enables> bathe

Sidewalk	curb ramp (yes, no); pedestrian crossing (yes, no); slope (#steep, #gentle); slope length (#long, #short); width (#narrow, #wide); openings on path (yes, no); surface condition (uneven, slippery, smooth); maintenance condition (poor, good); steps (yes, no); lighting level (#bright, #dim); overhanging objects (yes, no); curb (yes, no); space condition (cluttered, clear); passing space (yes, no); tactile paving (yes, no); beveled edge (yes, no); obstacles on path (yes, no)	WCU	curb ramp (no) hinders enter roadway slope length (#long) hinders move along path surface condition (slippery) hinders move along path width (#narrow) hinders move along path width (#narrow) hinders pass people	presence of sidewalk (yes) <enables> move along path presence of sidewalk (yes) <enables> access service presence of curb (yes) <enables> board vehicle presence of beveled edge <enables> change level path slope (#gentle) <enables> move along path surface condition (smooth) <enables> move along path space condition (clear) <enables> move along path width (#wide) <enables> pass people width (#wide) <enables> move along path presence of passing space <enables> pass people
Signage	braille size (#large, #small); braille correct (yes, no); lighting level (#bright, #dim); print size (#large, #small); surface glare (yes, no); contrast level (#high, #low); type (tactile, braille, visual); height (#high, #low); status (visible, hidden); character legibility (legible, illegible)	WCU	NONE	contrast level (high) <enables> read visually height (#) <enables> read visually status (visible) <enables> recognize vehicle character legibility (legible) <enables> see displayed items
Signal button	reach distance (within#); button size (#large, #small); push force (#low, #high); indicator (tactile, visual)	WCU	NONE	reach distance (within #) <enables> push signal button size (large #) <enables> push signal button push force (low#) <enables> push signal button
Sink	height (#high, #low); clearance (yes, no); sink pipe coverage (insulated, non-insulated); tap type (automatic, manual)	WCU	height (#high) hinders wash hands clearance (no) hinders wash hands	height (#) <enables> wash hands clearance (#) <enables> wash hands pipe coverage (insulated) <enables> wash hands
Staff	NONE	WCU	NONE	presence of staff assistance (yes) <enables> interact with employees
Stairway	signalized (yes, no); number of handrails (1, 2); handrail (yes, no); lift (yes, no)	WCU	NONE	presence of stair lift (yes) <enables> change floor

Step	step height (#high, #low); step count (integer); riser type (open, closed); signalized (yes, no); slip-resistant surface (yes, no); beveled edge (yes, no); tonal contrast strips (yes, no)	WCU	step height (#high) hinders approach doorway	step count (0) <enables> move in space step count (0) <enables> approach doorway step count (0) <enables> pass through doorway step count (0) <enables> stop to path
Street	sidewalk (yes, no)	WCU	sidewalk (no) hinders move along path	NONE
Toilet	height (#high, #low); size (#large, #small); flush type (automatic, manual)	WCU	NONE	height (>#) <enables> transfer size (large) <enables> transfer
Transit Station	elevator (yes, no); turnstile (yes, no); gate width (#narrow, #wide)	WCU	elevator (no) hinders stop to path elevator (no) hinders wait at stop turnstile (yes) hinders wait at stop	gate width (#) <enables> wait at stop
Transit stop	weather protection (yes, no); obstacle in boarding area (yes, no); uniform location (yes, no); uniform marking (yes, no); shelter visibility (transparent, opaque); noise level (#high, #low); lighting level (#bright, #dim); landmarks (yes, no)	WCU	obstacle in boarding area (yes) hinders board vehicle	lighting level (bright #) <enables> wait at stop lighting level (bright #) <enables> pay fare
Transit vehicle	securement points (yes, no); wheehchair space (yes, no); occupancy (full, empty); ramp (yes, no); boarding time (#fast, #slow); grab bar (yes, no); lift (yes, no); passing space (yes, no); priority seating (yes, no); lifting device (yes, no); seat location (front, middle, rear)	WCU	securement points (no) hinders take seat secure chair wheelchair space (no) hinders take seat secure chair occupancy (full) hinders board vehicle ramp (no) hinders board vehicle	presence of grab bar (yes) <enables> board vehicle presence of grab bar (yes) <enables> deboard vehicle presence of lifting device <enables> board vehicle seat location (front) <enables> take seat secure chair presence of securement points (yes) <enables> take seat secure chair presence of wheelchair space (yes) <enables> take seat secure chair

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