DETERMINANTS OF THE ASSIMILATION OF INFORMATION TECHNOLOGIES IN HUMAN RESOURCE SERVICE DELIVERY IN CANADA AND THE UNITED STATES OF AMERICA

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The use of Information Technology (IT) in the delivery of Human Resource (HR) services –a traditionally laborious, paper-intensive operation—is spearheading a revolution in the way personnel services are delivered. Based on a thorough review of practitioner and academic research literatures, this dissertation studies the determinants of assimilation for the following HR Information Technologies (HRITs): (1) HR functional applications; (2) Integrated HR software suites; (3) Interactive (or Automated) Voice Response systems; (4) HR intranets; (5) Employee Self-Service applications; (6) Manager Self-Service applications; (7) HR extranets; and (8) HR portals. The assimilation of HRITs is operationalized through a multidimensional variable, HR Technology Intensity (HRTI), that includes information on the assimilation stage of the technologies used in the firm, as well as on the penetration with which they are being used. Using a Diffusion of Innovations perspective, four sets of factors are hypothesized to influence HRTI: Environmental Factors (more specifically, Environmental Turbulence), Organizational Factors (Top Management Support and Uniqueness of HR Practices), User Department Factors (HR Innovation Climate, HR IT-Absorptive Capacity and HR-Technology Champion), and IS Department Factors (HR IS Resource Availability and HR-IS Relationship). The latter are theorized to mediate the relationship between the User Department factors and HRTI when the Locus of Responsibility for HR-Technology includes at least partially the IS function –a

moderated mediation functional form (James & Brett, 1984). Data from 155 HR Executives from firms in Canada and the United States were collected using an Internet–based survey, yielding a response rate of 21.3%. No consequential differences were found among country sub-samples. Hierarchical regression analyses offered support for the hypotheses concerning the relationship between HRTI and Top Management Support (an Organizational Factor), and HR Innovation Climate (a User Department Factor). Moderated mediation analyses also substantiated the hypothesis linking HR Innovation Climate and HRTI by way of HR-IS Relationship when the Locus of Responsibility for HR-Technology includes the IS function. Finally, an alternate dependent variable (the Sum of Percentage Penetration of IT for HR) offers converging support for the analyses linking predictor and independent variables. Implications, limitations of this investigation, and suggestions for future research conclude this dissertation.

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FOREWORD

To You, my Father, my Lord, my Creator, my Divine Model, my Destiny…

Thanks to You I live, I breathe, I am who I am. Like J. S. Bach, I hope to put this work before Your throne the day you call me. I did nothing without Your help, Your inspiration and Your "angels." Thank you, Abba! Use me abundantly!

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May Our Creator bless all of you that made this quest possible.

I. INFUSION OF INFORMATION TECHNOLOGY IN HUMAN RESOURCES

A. INTRODUCTION

The use of Information Technology (IT) in the delivery of Human Resource (HR) services promises an unprecedented revolution in the effectiveness and the efficiency with which personnel services can be provided in today's firms. The Human Resource function has traditionally been laden with laborious, paper-intensive operations, on its quest to serve the firm and its internal and external stakeholders. Automating such operations was not an easy task during the 20th Century, when the computational demands were substantial, as also were prices and customization needs of hardware and software required for HR tasks. Yet, technologies that have emerged during the past five to seven years seem to finally have reached the point in which their characteristics make their use desirable –if not indispensable—for HR departments. Recent reports from influential organizations such as The Conference Board (Palframan, 2002), and from the Society for Human Resource Management (SHRM) Thought Leader's Forum have emphasized the increasing importance of technology for the HR function. Participating in a talk on Information Technology for the HR function, Prof. Edward Lawler, III, from the University of Southern California's Center for Effective Organizations, went as far as to say that:

"In five years HR will be part of the IT function;" that

"eHR will obliterate the HR function," and that

"eHR will free up HR to be a strategic partner,"

as potential scenarios for the HR function (Bates, 2001; SHRM, 2002).

Radical as these remarks might seem, they highlight the fact that Information Technology is finally reaching a point in which roles and tasks that traditionally had been handled by means of paper forms can be substituted by electronic forms and automated data flows that could fundamentally transform the way the HR function works. One can infer the blooming importance of this segment of the IT industry by the size of its 1999 annual worldwide revenues, calculated around $2.6 billion, and expected to reach $3.7 billion by 2004 (Goloboy, Byron, & Wilson, 2000). In addition, survey research suggests that HR intranets have already become the primary means of delivering HR services in large American companies (Watson Wyatt, 2000). Myriad vendors offering modular and integrated applications exist. Not only are large software vendors present in this market (e.g., PeopleSoft, SAP, Oracle), but also smaller firms offering their products to automate a variety of HR services, including recruiting, training, career planning, benefits administration, performance management, etc. These facts suggest that scholarly attention about the determinants for acquisition and deployment of eHR is needed to better understand what drives the use of IT in the HR function, as well as the extent to which it is used.

From an academic standpoint, it is surprising that this issue has not been given more consideration. While some scholarly attention has been dedicated to the use of Information Systems (IS) by personnel or HR departments (Cascio & Awad, 1981; Kossek, Young, Gash, & Nichol, 1994; Walker, 1982), the use of Human Resource Information Technologies ("HRITs," also referred to with the labels "virtual HR," "B2E" –business-to-employees applications—or "eHR")[1] is still largely ignored by management researchers, in spite of the possibilities these

[1] Currently, there is a lack of consensus in naming this phenomenon, perhaps as a symptom of its novelty. While Osigweh (1989) and Latham, Millman & Karambayya (1997) have warned about construct confusion in the management and related sciences, attempting to unify the nomenclature of the construct is beyond the scope of this dissertation.

technologies offer to the HR function and to its customers. Three core research issues warrant serious attention:

A. Who is actually using HRIT's?
B. How much technology (i.e., intensity of use) is being utilized by HRIT adopters? and
C. What stimulates some firms to infuse much higher levels of IT in their HR operations than do others?

This topic is important to study for both economic and academic reasons. Economic motivations to study ITs for the HR function include the blooming market this industry segment comprises, with a number of important players and the expectation that major stakeholders of user firms are being positively effected. Table I.1 shows a list of recent reports authored or sponsored by consulting firms on this area. Academic motivations include the impact these technologies may have for an important functional unit in the firm (HR) and for businesses in general. Information technologies are being touted as one of the crucial tools in transforming HR from a compliance-oriented, costly staff function into a "strategic partner" and a "change agent," to use Ulrich's (1997) future-focused roles for the HR function. As automation releases HR staff from "paper-pushing," low value-added activities –the argument suggests—more important activities such as finding smarter ways to compensate, train, or upgrade employees' capabilities should become not only the first priority but the one in which the HR function would actually spend more time.

The effects of HRITs are expected to extend beyond the focal department, to the company at large. Expectations raised by technology vendors include: lower personnel operation costs and turnaround time for the delivery of its services, better HR ratios, higher employee satisfaction, greater efficiency in the delivery of services, a decreased probability of making mistakes, and overall, the prospect of increasing the ways in which talent is managed in the firm (Watson Wyatt 2002a; 2002b; Oracle 2001). In sum, the potential that HRITs have to improve the contribution that the HR function offers to the firm deserves scholarly attention.

Table I.1 Recent Reports on the Use of Human Resource Information Technologies [1]

Investigation	Technology Focus	Topic of Study	Respondents	Mode of Analysis	Key Finding(s)
Brewster & Hegewisch (1994)	Computer usage by HR departments [2]	• Prevalence of computer use by HR departments	HR executives & managers (n=15,231)	• Non-statistical (percentages)	• At least 50% reported using computers in 3 HR activities • Less than 40% used fully integrated computer systems • Irish & UK firms were less likely to use computers in HR than were companies based elsewhere
Cedar (1999)	Self-service applications	• Prevalence of this HRIT category • Growth prospects for this HRIT category	Executives & managers (IHRIM members) [4] (n=328)	• Non-statistical (percentages)	• At least 25% had deployed some form of ESS capability • Fewer than 20% had implemented any MSS capabilities • Less than 10% had extended self-service to overseas units • Widespread plans to introduce ESS & MSS capabilities
Cedar (2000)	Self-service applications & portals	• Prevalence of both HRIT categories • Growth prospects for both HRIT categories	Executives & managers (HR primarily) [5] (n=342)	• Non-statistical (percentages)	• Moderate increase in the incidence of ESS capabilities relative to the 1999 survey • Little net growth in the incidence of MSS capabilities • Widespread plans to introduce ESS & MSS capabilities • 40% reported having a portal strategy; 80% of these strategies incorporated HR functionality

Table I.1 (continued)

Investigation	Technology Focus	Topic of Study	Respondents	Mode of Analysis	Key Finding(s)
Cedar (2001)	Self-service applications & portals	• Prevalence of both HRIT categories • Growth prospects for both HRIT categories	Executives & managers (HR primarily) (n=304)	• Non-statistical (percentages)	• Sizable growth in the incidence of ESS & MSS capabilities among North American firms • European companies were less likely than North American firms to have implemented ESS & MSS • Widespread plans to introduce ESS & MSS capabilities across regions • Sizable increase in the number of North American firms with portal strategies • European firms were more likely than North American firms to have a portal strategy and to incorporate HR functionality
Cedar (2002)	Self-service applications & portals	• Prevalence of both HRIT categories • Growth prospects for this HRIT category	Executives & managers (HR primarily) (n=299)	• Non-statistical (percentages)	• Modest growth in ESS &MSS capabilities across regions • HR functionality increasingly is incorporated in corporate portal strategies across regions
Plumtree Software (2002)	Portals	• Growth prospects for this HRIT category	Vendor's customers (other characteristics not reported) (n=110)	• Non-statistical (percentages)	• HR departments display the highest level of interest in deploying portal communities (i.e., group portal pages) among internal business groups
Robinson, Heyday & Edward (1999)	HR functional applications & integrated HR suites	• Prevalence of this HRIT category	HR executives & managers[3] (n=552)	• Non-statistical (percentages)	• At least 50% reported using apps in 6 HR activities • HR intranets were not widely used, and those that were in place tended to be limited to online publishing & internal job postings

Table I.1 (continued)

Investigation	Technology Focus	Topic of Study	Respondents	Mode of Analysis	Key Finding(s)
Towers Perrin/IBM (1992)	HRIT generally	• Relative importance of HRIT for future competitive advantage • Impediments to the realization of HRIT's full future potential	Executives (HR primarily), consultants & faculty (n=2,961)	• Non-statistical (percentages)	• Over 50% projected HRITs would be a high-priority HR activity by 2000 • Less than 60% cited unavailability of HR applications or insufficient executive commitment as a major inhibitor of the future potential of HRITs • Fewer than 20% cited inability to move to new systems or lack of HRIT strategy as a major inhibitor of the future potential of HRITs • Canadian companies were less likely than US & UK firms to classify HRITs as a high priority • UK companies were less likely than US & Canadian firms to cite insufficient executive support & the ability to move to new systems as inhibitors • US companies were less likely than Canadian & UK firms to cite application availability as an inhibitor
Towers Perrin (2001)	Self-service applications	• Prevalence of this HRIT category • Growth prospects for this HRIT category	Executives & managers (majority in HR) (n >200)	• Non-statistical (percentages)	• Over 90% reported utilizing web-based HRITs in service delivery • 40% provided at least limited self-service capabilities • Approximately two-thirds projected increasing their investments in HRITs over the next 3 years
Towers Perrin (2002)	Self-service applications & portals	• Prevalence of both HRIT categories • Growth prospects for both HRIT categories	Characteristics not specified (n>125)	• Non-statistical (percentages)	• A majority of firms have implemented at least some ESS & MSS capabilities • 42% had HR portals; another 31% planned to by 2003 • Over 90% of employees had access to an HR intranet

Table I.1 (continued)

Investigation	Technology Focus	Topic of Study	Respondents	Mode of Analysis	Key Finding(s)
Watson Wyatt (2000)	HRIT Infrastructure	• Prevalence of diverse HRIT categories	Executives (HR primarily) (n=295 firms)	• Non-statistical (percentages)	• Over 40% had extended the functionality of their integrated suites with self-service applications • 77% used IVR & HR intranets as service delivery modes
Watson Wyatt (2002a)	HRIT Infrastructure	• Prevalence of diverse HRIT categories • Growth prospects for HRITs generally	Characteristics not specified (n=173)	• Non-statistical (percentages)	• Over 70% had implemented HRITs with static capabilities (e.g., online data reviews) • One-third to one-half had implemented HRITs with at least some interactive capabilities (e.g., self-service) • More than 60% reported having HR intranets, while less than 10% used IVR as a service delivery mode • 75% projected making HRIT upgrades within 2 years, and another 17% within 5 years

[1] Adapted from Florkowski & Olivas-Luján (2003); sorted alphabetically (by copyright holder or author's family name), then chronologically.

[2] While the labeling is ambiguous, tables 2.15 & 2.15a appear to document the prevalence of HR functional applications and integrated HR suites.

[3] Assumed from the fact that the study was co-sponsored by the Institute of Personnel and Development.

[4] The International Association for Human Resource Information Management (IHRIM) is a leading organization promoting IT use in HRM.

[5] Inferred from the statement on page 2 that respondents in 2000 were not different from those who had participated in 1999.

B. THE EVOLVING USE OF ITS IN HR

This section describes the HRITs that have been found most influential in recent years from an evolutionary perspective. Table I.2 describes selected characteristics of the eight HR Information Technologies (HRITs) studied in this dissertation: (1) HR functional applications; (2) Integrated HR software suites; (3) Interactive (or Automated) Voice Response (IVR/AVR) systems; (4) HR intranets; (5) Employee Self-Service applications (ESS); (6) Manager Self-Service applications (MSS); (7) HR extranets; and (8) HR portals. Now follows a short narrative about the evolution of automation within the HR function, including a description of each of the HRITs above.

1. HRITs in this Research

Most sources identify payroll administration as the first area automated within the HR function, in some large companies, since the 1950s, but mostly for basic compensation operations (DeSanctis, 1986; Walker, 1991). Regulations imposed by the Equal Employment Opportunity Commission (EEOC) in the late 1960s are credited for having substantial impact on the information needs for HR, thus increasing the need for automation, simply to comply with record-keeping requirements. Unfortunately, at that point in time, prices of hardware and software made HRIS unaffordable for but the largest firms. Other regulations that continued to increase the need for HRIS include the Occupational Safety and Health Act (OSHA), the Employment Retirement Income Security Act (ERISA) –from the 1970s—, the Consolidated Omnibus Budget Reconciliation Act (COBRA), the Tax Equalization and Finance Readjustment Act (TEFRA), the Age Discrimination in Employment Act (ADEA) –1980s—, the American with Disabilities Act (ADA) and the Family and Medical Leave Act (FMLA) –enacted in the 1990s.

Table I.2 Overview of Human Resource Information Technologies (HRITs) [1]

HRIT Innovation	Descriptions/Purpose	Features[2]	Typical Activities Facilitated for End-Users
HR Functional Applications	Software-enabled automation of discrete tasks & responsibilities assigned to the HR function	• Available before the other HRITs • Absence of unifying standards across software products	• Talent management (e.g., posting, testing, applicant tracking, career planning, HR forecasting, scheduling) • Performance Management (e.g., performance appraisal, needs assessment, e-Learning, pay structure design & maintenance, incentives administration) • Stakeholder Management (e.g., compliance reporting, grievance administration)
Integrated HR Software Suites	Collection of HR functional applications sold as a unit	• Ability to share data among applications • Each functional application is full-featured & can stand alone	
Interactive Voice Response (IVR) Systems	Phone based, software-enabled tree or menu structure that allows callers to access work-related information and/or input data via voice or telephone-keypad commands	• Electronic voice mail • Data-entry capabilities to facilitate select HR activities or to respond to company surveys	• Accessing company announcements • Benefit-plan enrollment • Training registration • Applicant testing & rudimentary biodata collection • Employment/income verification by authorized external parties
HR Intranets	Private computer network that provides employees with direct access to linked internal databases and/or a seamless interface with the Internet	• Based on TCP/IP standards[3] • Online publishing of policies, handbooks & forms • Online postings of job vacancies	• Reviewing personal information in HR databases • Online tracking of retirement-plan performance • Online investigations of potential health care providers for benefit plan elections • Researching job availability as a precursor to applying
Employee Self-Service Applications (ESS)	Software-enabled set of HR transactions that can be initiated and completed by company employees, without direct involvement by HR staff	• Highly configurable regarding the range of automated HR transactions • Role -constrained access to specific HR transactions	• Directly updating personal information in HR databases • Online competency testing and training registration
Manager Self-Service Applications (MSS)	Software-enabled set of HR transactions that can be initiated and completed by company managers, without direct involvement by HR staff	• Highly configurable regarding the range of automated HR transactions • Role -constrained access to specific HR transactions	• Creating, tracking, & managing open job requisitions • Granting base-salary increases and tracking decisions against approved budget

Table I.2 (continued)

HRIT Innovation	Descriptions/Purpose	Features[2]	Typical Activities Facilitated for End-Users
HR Extranets	Private computer network that links the information systems of client-firms to external vendors delivering co-sourced or outsourced HR services	• Based on TCP/IP standards[3] • Firewalls restricting external access to 'shared' HR data • May incorporate available HR-XML protocols	• Updating personal information changes in databases administered by external vendors • Online oversight of health benefits, pensions, etc.
HR Portals	Web-based interface that offers a personalized, unified access-point to all information sources, tools, and systems individuals need to effectively consume or deliver HR services	• Based on TCP/IP standards[3] • Role-constrained access to data stores, applications & systems • Pagelets that group related activities, information & applications	• Accessing channel-based web resources to identify information, tools and vendor listings addressing particular life needs • Online shopping for discounted offerings from a pre-configured network of external product & service vendors

[1] Adapted from Florkowski & Olivas-Luján (2003).

[2] Aside from IVR systems, HRITs generally call for desktop, laptop or kiosk access-points for end-users.

[3] Transmission Control Protocol (TCP) / Internet Protocol (IP) is the suite of electronic communications protocols underpinning the Internet.

Auspiciously, as the information needs within the HR function grew, so did the availability and affordability of computer information systems. Before the 1980s, when the personal computer (PC) was invented, large, multi-user computers such as mainframes (or, depending on size and computing capability, computers, minicomputers, etc) were characterized by high prices, customized software development, and batch (as opposed to online or interactive) processing. HR Functional Applications, mostly for compensation purposes (e.g., payroll, benefits), running on those computing facilities, were the first of the HRITs to appear in the market –and the first HRIT category that appears on Table I.2. DeSanctis (1986: 16) reports that "[b]y 1971,… approximately 60 % of the nation's 150 largest banks, life insurance and retailing companies had operational computer systems for human resources. And 40 % of all Fortune 500 firms had implemented such systems." In fact, her research, –conducted in the mid-1980s—shows that the HRIS at that time were housed on larger computer hardware: 82.3 % of the firms that answered her survey used mainframes for the HRIS, 9.9 % used microcomputers, and only 7.8 % had started using microcomputers. She also reports that the average non-hardware installation cost for HRIS was $411,000, and the average annual budget approximately $271,000 (p. 19).

Technological progress in all computing areas during the 1980s and 1990s brought about an enlargement in capabilities for the mainframe-based systems on one hand, and in pervasiveness and availability of microcomputers or PCs on the other. The former can be considered a substantial enabler of the development of the second HRIT on Table I.2: Integrated HR Software Suites, while the latter could be identified as an important driving force for the last five: HR Intranets, Employee Self-Service applications, Manager Self-Service applications, HR Extranets, and HR Portals.

Integrated HR Software Suites are portrayed as integral solutions for the HR function. Housed frequently on corporate or central computers, these systems provide access to larger databases through a variety of modules that automate the different HR sub-functions. In

addition, there might be interaction between the HR suite and other components (e.g., production scheduling, financial company management), as in the case in which the HR suite is part of an ERP (Enterprise Resource Planner) system such as SAP ®, PeopleSoft ®, or JD Edwards ®. Both HR Functional Applications and Integrated HR Suites –the first and second HRITs in Table I.2—share the fact that they are standardized solutions for HR tasks, but the size and scope of the latter are much more ambitious than the former's. The industry for separate HR Applications is consequently more diverse and fragmented than the group of competitors for Integrated HR Software Suites.

On the other hand, the pervasiveness of personal or microcomputers enabled less expensive and more widespread development of HR applications. Increased availability of computers, plus the use of telecommunications based on the TCP/IP (Transmission Control Protocol/ Internet Protocol) protocols suite created the ability to have computers interacting through Local or Wide Area Networks (LANs/ WANs). Another important force enabling the use of technologies for HR purposes –and many others—was the generalized use of hypertext markup language (HTML), the computer language that allows communications using the hypertext transfer protocol (HTTP), the basis for the explosive growth of the Internet or the World Wide Web. In the late 1990s, companies witnessed an increased availability of Intranets (HTTP-based communications constrained within the firm network), through which the HR department was able to publish policy information such as handbooks, job postings, etc. This use of the company Intranet for HR purposes has been labeled "HR Intranets," the fourth technology described on Table I.2.

Progress in computer hardware and software also brought the ability to interact with computers in other ways, such as via telephone. Interactive (also known as Automated) Voice Response systems (IVR or AVR) –the third technology on the table—, which were originally designed to channel phone calls automatically by pressing dial buttons, also reached the HR department in the delivery of various services such as benefit plan enrollment, training

registration, company announcements, phone surveys, etc. These systems are currently capable of taking voice commands, in addition to reacting to dial tones. They have also allowed external organizations (such as banks or bonding agencies) to verify employees' status or income levels by calling the appropriate numbers.

The fifth and sixth technologies on Table I.2 are closely related. Employee Self Service (referred to as ESS) and Manager Self Service (MSS) applications technically became a possibility when –originally static—HTML applications started communicating with databases. At that point, company internal customers of the HR function (employees or managers) no longer needed to interact with HR personnel to update their individual records, registering online for training, managing job openings or recording performance evaluations. The use of web-based self-service applications for HR purposes has been hailed as a solution to one of the oldest criticisms of the HR function: the fact that many of its services have created a mound of paperwork, when not red tape. The need for HR employees to act upon each and every transaction that involved its domain has been drastically reduced by the use of ESS and MSS applications. Of course, there are always exceptions and special cases that need direct intervention from HR personnel, but many HR processes that created no- or low-value added for the organization have been streamlined through the use of these technologies. The consulting group Cedar (1999, 2000, 2001, 2002), which has been documenting the use of these self-service applications, has consistently reported increases in the use of ESS, and ambitious plans to introduce both ESS and MSS systems.

HR Extranets, the seventh technology on Table I.2, involves links between organizations' HR departments and external entities, such as pension providers, health benefit administrators, etc. This technology enables direct contact between the HR department (in some cases also non-HR employees) and those service providers.

Finally, HR Portals offer a personalized, web-based single access point to all information sources, tools and systems needed to effectively use the HR services offered by the company

via the Internet. Depending on the roles, privileges and responsibilities that employees have, they can access a variety of HR services such as the ones described above, or even external products and services such as online shopping, discounts, etc. HR Portals are highly configurable through code modules (also called “pagelets” or “applets”) that can be added to or taken from the entry page that employees would see after logging into the system. Those modules offer links to the HR services provided by the firm. Again, the Cedar group has documented both real and planned growth for this HRIT during the past four years, as also have reported Towers Perrin (2002) and Plumtree Software (2002) for the past year.

2. Sourcing Approaches

An important issue that is related to the use of the HRITs described above deals with the approaches for making them available (i.e., sourcing them) to the firm. The decision as to whether “make or buy” a computer system has been compounded in recent years by the emergence of Application Service Providers (ASPs), or firms that attempt to offer integral technological solutions on a variety of needs (IOMA, 2001; Kimball, 2001; Kimball, 2001-2002). Thus, HR departments interested in using technology may source it by (a) making it in-house, (b1) buying a pre-packaged solution, or (b2) hiring an ASP company. As a large number of HR sub-functions are currently available through ASPs, Lepak & Snell (1998) have used transaction cost economics and the resource-based view of the firm to form a model to understand the use of ASPs for HR purposes, a phenomenon they have called “Virtual HR.”

3. Interfacing with the IS Function

Another relevant matter on the use of HRITs deals with the relationship between the IS and the HR functions. Just like not all HR functions are always a responsibility of the HR department (e.g., payroll is in many companies a responsibility of the accounting or finance area), the IS function may or may not have a central role in the administration of HRITs

(Roberts, 1999). These technologies may be within the domain of the HR function, the IS function, or of both functions. For example, Hoffman and Hoffman (1998) reported univariate statistics of HR technology usage of 24 large firms, the size of their HRIS subunits, their reporting relationships, ratios on HR, IS and related issues, showing wide differences in the way those firms run their HRIS. The MIS literature venue on IT governance (cf. Brown & Magill, 1994; Sambamurthy & Zmud, 1999), which offers some frameworks useful for understanding this phenomenon and its implications, will be used in the next sections to build the model that drives this dissertation.

C. IT IN HR –AN ADMINISTRATIVE INNOVATION FOR THE ORGANIZATION

In spite of all the potential benefits, not all firms are equally likely to adopt these HRITs or to do it with the same enthusiasm. A crucial step in better understanding the presence of technologies for the HR function of the firm, should be given toward analyzing what organizations are more likely to assimilate those HRITs in their day-to-day operation, as well as the extent to which they adopt such technologies. The literature on Diffusion of Innovations (DOI, Rogers 2003), particularly as applied to Information Systems (Attewell, 1992; Fichman & Kemerer, 1993a; Fichman & Kemerer, 1993b; Fichman & Kemerer, 1999; Kwon & Zmud, 1987; Swanson, 1994), offers some guidance for understanding the predictors of eHR use. Studies on diffusion of innovations are germane to this topic, as DOI theory has developed useful paradigms to understand adoption and diffusion of HRITs.

One helpful distinction that was advanced by Daft (1978) is whether the innovation is of technical or administrative type. Technical innovations are those that help in the company's productive process, while administrative innovations have an impact on the way the organization is managed. Clearly, HRITs have a direct impact on the way the organization is handled, but not so much on the production process.

Swanson (1994) and Prescott & Conger (1995) offered extensions to this classification. Swanson's tri-core theory of IS innovations classifies these innovations as a function of the organizational units that adopt them. Type I innovations are those that are adopted and used by the IS function only; Type II innovations support the administration of the business and Type III innovations assist the production technologies in the firm. Clearly, HRITs should be classified as Type II innovations, using Swanson's typology.

On the other hand, Prescott & Conger (1995) offered an alternative typology that classifies innovations by their locus of impact: the IS unit, the focal organization (labeled intra-organizational innovations) or the focal and other organizations (labeled inter-organizational). According to this typology, most HRITs included in this research could be classified as **intra-organizational** IS innovations, as they affect not only the IS function, but also the HR and several other organizational units. Some IVR applications, HR Extranets and some HR Portals, however, could be catalogued as **inter-organizational** innovations, as they affect not only the adopting organization, but also the service provider.

These typologies are useful in that they help identify the factors that could be relevant to answer the first research question in this project: what characterizes the organizations that utilize HRITs more. Based on a review of the DOI literature, this dissertation tests several correlates of eHR technologies within organizations.

D. CONCLUSION

This chapter had three main purposes. First, I have attempted to show that the use of ITs in the HR department is a topic worth researching, giving the economic importance it has as an industry and the potential impact on the HR function and the company at large. Second, I have briefly depicted the evolution of information technologies for the HR function, with an emphasis on describing those HRITs that have emerged in the past seven to ten years –the focal technologies for this research. Finally, I have included arguments to show that the use of

HRITs can be construed as an administrative innovation (Daft, 1978), of the second type in Swanson's (1994) typology, and with intra-organizational or inter-organizational loci of impact, as defined by Prescott & Conger (1995); these classifications help position this investigation within the Diffusion of Innovations literature (Rogers, 2003), within the MIS, and the HR innovations literature. In the following chapter, I review the major works found relevant for this topic.

II. REVIEW OF THE RELEVANT LITERATURE STREAMS

Perhaps one of the greatest challenges for this project was joining research streams that seldom coincide: Human Resources and Management Information Systems. In the classical corporation, both the HR and the MIS functions are support or staff departments, a fact that frequently translates into lower status and power, relative to other departments or divisions that generate revenue for the firm directly. Compounding this situation is the fact that these departments frequently have antagonistic—instead of cooperative—roles (DeSanctis, 1986; Roberts, 1999). In addition, since the decade of the 1990s, a large number of activities from both the IS and the HR departments are being outsourced (King, 2001; Lepak & Snell, 1998). Finally, the disciplines that nourish these fields also seem to be quite distant: HR gets many of its analytical tools and perspectives from Psychology, Sociology, and other so-called "soft sciences," while MIS draws more from Operations Research, Statistics, and related applied, engineering, more mathematically-inclined or "hard" sciences. This is not to say that they have nothing in common. The fact that both departments are housed within Schools of Business in most US universities sends a strong signal about the social stakeholders they serve. Both the MIS and the HR field use similar statistical tools (e.g., regression, structural equation modeling, correlational studies), and have a high regard for Management research outlets such as the Academy of Management, its journals, and related forums. In addition, there is a search for relevance and pragmatism that has found resonance in both academic fields (Benbasat & Zmud, 1999; Rynes, Bartunek, & Daft, 2001). Given the current compartmentalization of Business schools, however, there appears to be a bias toward isolation of these fields, rather

than cross-fertilization –resembling the industrial scenario. Joining literature streams from these two disciplines could be considered one of the contributions of this dissertation.

More specifically, an argument can be developed to suggest that, when studying HR information technologies, an MIS perspective on innovations, within the context of the HR literature is most adequate. Evidently, the specific tasks, objectives, critical situations and key stakeholders –such as end users or management support—on which HRIT usage will depend, must be provided for by the HR management literature. But the research framework, analytical style, and several key constructs have been developed more intensely by the MIS innovations literature, as will be shown below. Finally, connections between these two departments also must be included, to build a complete picture of HRIT assimilation.

This chapter is organized as follows: next comes a review of extant academically oriented publications on Human Resource Information Systems (HRIS), the predecessor for the HR Information Technologies that are the topic of this study. The next section deals with the Innovations literature, first in general terms; second, specifically dealing with innovations in Management Information Systems; and third, on HR Innovations. These literature streams are used to form the model that is presented in Chapter III and subsequently tested.

A. HRIS STUDIES

The earliest studies on Information Systems for the HR function that were found in the research literatures date from the 1980s (e.g., DeSanctis, 1986; Guinan, 1989). As Table II.1 suggests, academic work in the area has been frequently descriptive or pragmatic in nature; that is, more decidedly focused toward practitioners than toward the academic research community (Cedar 1999; 2000; 2001; 2002; Ceriello & Freeman 1991; Forrer, Leibowitz & Shore 1991; Kavanagh, Guetal & Tannenbaum 1990; Palframan 2002; Plumtree Software 2002; Towers Perrin 2002; Walker 1993; 2001). A few studies have offered limited theoretical frameworks, most of them with prescriptions on how automation of the HR function should fit

with the strategic thrust of the firm (Broderick & Boudreau 1992; Guinan 1989; Hannon, Jelf & Brandes 1996). Given the complexity of social and technical phenomena entailed in the implementation of Information Technology for the HR function, as well as the embryonic state of research dealing with the HR-IS interface, qualitative methodologies have been predominant. In fact, several articles are based on in-depth case studies of one or a very small number of firms (Broderick & Boudreau, 1991; Hannon, Jelf, & Brandes, 1996; Kossek et al., 1994; Palframan, 2002; Rodger, Pendharkar, Paper, & Molnar, 1998; Tansley, Newell, & Williams, 2001).

The few studies that embrace more generalizable methodologies (i.e., used larger samples and statistical analyses with conventional significance levels) inform our understanding of the phenomenon by (1) identifying the areas where HRIS have been historically used, (2) describing some correlations between the use of HRIT and HR functional areas (e.g., Ball, 2001; DeSanctis, 1986; Haines & Petit, 1997), and –in one case—(3) informing about the use of HRIS in other countries (Martinsons, 1994).

It also becomes readily apparent that current work in the area has utilized a very broad definition of HRIS, without more concretely identifying the types of HRITs that are used. In other words, there are no studies depicting the complexity of the HRITs being used in the firms in the sample (for example, whether web-based systems, or integrated HR suites or IVR systems are used, vs. the more traditional HR application)[2]. Our understanding will be enhanced by including and differentiating organizations with respect to the sophistication of their HRIS, both in terms of the technologies in use, and the ways in which they are utilized.

Transcending methodologies, a recurring topic is the lack of IT savvy in the HR department (DeSanctis, 1986; Hannon, Jelf & Brandes 1996; Kinnie & Arthurs 1996). Several authors go into detail on the missed opportunities that HR's lack of awareness or ability of IT brings about (e.g., Ball 2001; Kossek, Young, Gash & Nichol 1994; Legge 1989; Rodger,

[2] Although a recurrent topic in the literature from the 1980s and early 1990s was the use of mainframe computers vs. the increasing use of microcomputers (cf. DeSanctis, 1986; Ceriello and Freeman, 1991).

Pendharkar, Paper & Molnar 1998; Tansley, Newell & Williams 2001), such as the possibility to make the HR function more of a business contributor than it historically has been. Automation, the argument goes, should provide a way not to reduce HR headcount, but a way to upgrade the roles and tasks that the HR function performs to make a stronger contribution to the firm's bottom line and to the interests of the employees; problem is, this is not occurring.

Potential explanations for impediments to more sophisticated use of IT in HR vary. Tansley and her colleagues (2001) suggest the potential displacement of HR staff as one of the reasons why some HR managers would not embrace automation more eagerly. Kossek et al (1994) observed that sometimes "Information Brokers" develop within the corporation; that is, users that become true believers in the system and extract advantages by interacting with less technologically able users. They also noticed that a few knowledgeable or intense users of the HRIS in some departments become categorized as "Computer Jocks" and are isolated by the rest of the HRIS users who interact with the system through these intense users. Others report that there is little dialog between the IS and the HR functions in firms (DeSanctis 1986; Kavanaugh, Gueutal & Tannenbaum 1990). This lack of communication between the two functions has been denounced as one important reason toward the sub-optimization of IT in HR departments. These are some of the issues that apparently affect more negatively the use and capitalization of ITs in the HR department. Yet, the *expectation* that IT will liberate HR from its traditional, bureaucratic, "paper-pushing" tasks and enable it to become a true strategic partner is increasingly evident (e.g., Broderick & Boudreau, 1992; Forrer, Leibowitz, & Shore, 1991; Palframan, 2002; Ulrich, 2000).

Most striking is the fact that none of the extant studies on HRIS have attempted to differentiate firms that would use IT more than their counterparts do. Nor have investigators documented the extent to which the HR function actually has been automated, or the degree to which those HRITs are assimilated. While surveys usually report the percentage of *firms* that use HRIS for the various HR sub-functions (e.g., payroll, training, etc.), a gap exists in the

literature to understand the proportion of such functional transactions that are automated, and its correlates.

The following sections of this chapter review the relevant literature on innovations, as it has been applied in the organizational, IT and HR fields, with the aim of building a model that will help understand the presence and use of HRITs in the organization. As stated in Chapter I, conceptualizing HRITs as innovations provides a rich epistemological venue to further understanding acquisition and subsequent assimilation of IT in the HR function. The next section will identify the most influential or recent studies on organizational, IT and HR innovations, as well as the results that might be usefully extended to this particular set of technologies.

Table II.1 Research on Human Resource Information Technologies [1]

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Ball (2001)	HR functional applications and HR suites	• Prevalence of these HRIT categories	Executives & managers –most in HR (n=115)	• Means testing • Correlation analysis	• At least 50% reported using apps in 9 HR activities • Firm size was associated with the presence and functional configuration of these kinds of applications ($p<.05$)
Beckers & Bsat (2002)	HRIS and strategy	• Conditions for the company's HRIS to offer a competitive advantage	Not applicable (N/A)	• Non-statistical (percentages)	• Offers a framework linking the company's strategy with the HRIS as a Decision Support System • Identifies some criteria to evaluate whether the HRIS provides a competitive advantage to the organization
Broderick & Boudreau (1991)	HRIS in large firms	• Evolutionary stages of HRIS	Executives of Fortune 500 firms with leading HR use of computers (n=10)	• In-depth interviews	• Three stages of growth in computer use: threshold, growth, and consolidation/strategic expansion • Differences among firms appeared closely related to the choice of technology and the centralization of key HR decision makers
Broderick & Boudreau (1992)	HRIS and strategy	• Fit between the company's strategy and types of HRIS	N/A	• N/A	• Cost leadership objectives, best supported by transaction processing/ reporting/tracking systems • Quality/satisfaction strategy, best supported by expert system applications • Innovation strategies best supported by decision support systems.
Ceriello & Freeman (1991)	Comprehensive review of HR Management Systems	• No research questions; a guide to all aspects of an HRMS	N/A	• N/A	• A comprehensive guide to HRIS before the industry "exploded"

Table II.1 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
DeSanctis (1986)	HR Information Systems	• Status of HRIS in firms • Governance (MIS vs. HR), technological base, HRIS usage, planning modes, satisfaction predictors	HRIS Managers & others within personnel, compensation and benefits (n=171)	• Univariate • Correlational • Means testing	• Most HRIS at the time were based on mainframes (82.3%) • The HRIS as a subunit reported to HR or related areas –no longer to the IS function • In addition to compensation/benefits, other sub-areas using HRIS included compliance, planning, recruiting, and training • Satisfaction with HRIS correlated positively with the number of HRIS applications, time to develop the HRIS, HRIS responsibilities, HR involvement during development, and integration with corporate area ($p<.05$)
Forrer, Leibowiz & Shore (1991)	Edited book on the state of the art of HR Information Systems	• Chapters focus on several issues related to the automation of HR sub-functions	N/A	• N/A	• Prescriptions for practitioners are included at the end of most chapters • The closing chapter includes results of a study of 47 interviews to representatives of Fortune 500 firms, describing the status of their HRIS
Guinan (1989)	Model of strategic fit between company objectives, HR effectiveness re: its constituencies, and outcomes	• Modeling the way in which HRIS should support the firm's HR strategic needs and how that fit should impact HR's effectiveness and overall functional variables	N/A	• N/A	• Not applicable, as this is a theoretical, not empirical piece
Haines & Petit (1997)	HRIS success	• Antecedents for HRIS "success" • HRIS Success conceptualized as User satisfaction and System usage	HRIS user members of the Canadian Association of HR Systems Professionals (n=152)	• Means testing • Correlation • Stepwise regression analysis	• User satisfaction and System usage, uncorrelated • User satisfaction negatively predicted by education level and work experience, and positively related to the Presence of an HRIS unit, In-house training, Documentation quality, On-line applications running, Ease of use, Usefulness, Flexibility, and Perception of increments in personal productivity

Table II.1 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Hannon, Jelf & Brandes (1996)	HRIS for MNCs	• Status of HRIS in eleven US-based multinationals	Executives in charge of the HRIS (n=11)	• Survey, frequencies reported	• Three international approaches to HRIS emerged: integrated, blended and ad hoc • Executive support for the HRIS is necessary • Various HRIS stakeholders must be considered, particularly HR professionals, as they are frequently lacking in skills for HRIS
Hoffmann & Hoffmann (1998)	HRIS functions	• Characteristics of HRIS sub-functions	Very large, multinational firms (n=24)	• Univariate (percentages, ratios, etc.)	• HRIS responsible for most IT responsibility in HR; IT only supports hardware and systems to a larger extent • IVR prevalent in those firms, but moving toward web-based ITs • Large dependence on mainframes
Kavanagh, Gueutal & Tannenbaum (1990)	Review of HRIS	• No research questions; a guide to all aspects of an HRMS	N/A	• N/A	• A good description of the HRIS of the early 1990s
Kinnie & Arthurs (1996)	HR functional applications & integrated HR suites	• Prevalence of this HRIT category	HR executives (n=231)	• Univariate (percentages, case studies)	• At least 50% reported using apps in 8 HR activities • IT skills and knowledge of HR specialists partially explain under-utilization of IT

Table II.1 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Kossek, Young, Gash, and Nichol (1994)	Implementation of a corporate-wide HRIS	• How users respond to the implementation of an HRIS	Key employee groups' responses to HRIS (n=150) From corporate and field locations, across levels and areas of one specific firm	• Inductive, longitudinal case study • Surveys and interviews • Analyses of company documents	• Varying degrees of resistance and ambivalence found in implementing an HRIS • Face-to-face seminars better influenced favorable intentions to use the HRIS • Typology of four HRIS reactions: (a) Computer Jock Phobia, (b) Gradual Automators, (c) Corporate HRIS Resisters, and (d) Information Brokers • The HRIS symbolized HR's attempt to become more strategic • HRIS expected to enhance the roles played by HR • The HRIS changes power dynamics and communications • HR managers would not use the HRIS directly
Legge (1989)	HRIS	• Potential impact of IT on personnel-related functions	N/A	• N/A	• The increasing presence of microelectronic technology in organizations raises issues including job design, organizational design, employment, careers, and training • Personnel's involvement is often late, peripheral, and reactive • The gap between the importance of ITs to personnel management and its characteristic involvement is examined
Martinsons (1994)	Computerized HR information systems	• Prevalence of this HRIT category • Growth prospects for this HRIT category	HR executives & managers (n=479)	• Univariate (percentages) •	• 84% of Canadian firms reported using computerized HR information systems, compared to 67% in Hong Kong • 15% of the firms in Hong Kong projected having a computerized HR information system within 3 years, compared to an additional 9% for those in Canada

Table II.1 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Palframan (2002)	HR Technology, broadly defined	• HR Technology plans, strategies, trends, and challenges, as seen by members of the publishing organization (The Conf. Board)	Campbell Soup, Cemex, Electricity Supply Board, Heineken, Manpower, and Pricewaterhouse Coopers (n=6)	• Apparently, in-depth interviews with key decision makers in each firm	• Considers HR technology plans and strategies of some major organizations represented on The Conference Board's North American and European Working Groups on Technology for Human Resources
Rodger, Pendharkar, Paper & Molnar (1998)	Implementation of a corporate-wide HRIS	• Re-engineering the HR function by means of an HRIS	HRIS users (n=69) and company executives (n=10)	• Interviews, surveys • Analyses of annual reports	• More improvements to the reengineering process needed • Users found several features not user friendly • Users generally satisfied with content and frequency of reports • Directors felt "a very real need" for users to become aware of potential uses of the HRIS
Tansley, Newell & Williams (2001)	Implementation of a corporate-wide HRIS	• Extent to which an HR module of an enterprise system is a "philosophical break with the past"	HRIS project team members	• Attendance at meetings • Process mapping workshops • Interviews (16) • Company documentation	• The HR system was not implemented at its full potential • The HRIS was for most participants a simple automation of the current process, instead of changing the process to capitalize on the advantages offered by the system • Lack of support from senior management discouraged the HR implementation team
Ulrich (2000)	Web-based HRIS	• No research questions; suggests ways in which HR can transform through technology to become a "strategic partner"	N/A	• N/A	• Customer intimacy implies getting very familiar with details of the individual customer's needs • Moving from value chain to value networks of suppliers will enhance marketers' capabilities
Walker (1993)	Review of HRIS	• No research questions; a guide to several aspects of an HRIS	N/A	• N/A	• Fine description of the HRIS of the early 1990s; included reengineering concepts, and a focus on cost-justification
Walker (2001)	Measurement of HRIS effectiveness	• Proposing the "balance scorecard" to measure HRIS effectiveness	N/A	• N/A	• Proposes the "balance scorecard" to measure HRIS effectiveness

[1] Extended from Florkowski & Olivas-Luján (2003); sorted alphabetically (by copyright holder or author's family name), then chronologically.

B. INNOVATION STUDIES

1. Organizational Innovation Studies

No research project on innovations can neglect the contributions made by Daft (1978), Damanpour (1988, 1991), Rogers (2003), and their respective collaborators. Their work has influenced a large number of researchers interested in exploring the phenomena of acquisition and assimilation of innovations in a variety of contexts. For example, Klein and colleague's theoretical work (Klein & Sorra, 1996; Tornatzky & Klein, 1982) offers a well-recognized perspective on the different types of factors that should be considered when analyzing organizational phenomena. Tornatzky & Klein's (1982) meta-analysis of the characteristics that innovations have, has been extended to other areas, such as the environmental factors (Klein & Sorra, 1996), organizational, and user factors (Kwon & Zmud, 1987), among the most frequently stated. For this dissertation, three types of predictors of innovation (environmental, organizational and departmental factors) are offered to further our knowledge of this area.

Damanpour and Daft have also furthered the field in several ways. For example, Damanpour and his colleagues have theoretically and empirically advanced the differentiation between technical and administrative innovations (Damanpour & Evan, 1984), and between product and process innovations (Damanpour & Gopalakrishnan, 2001). Daft's dual-core model of organizational innovation, which classifies innovations as *technical* vs. *administrative*, has been widely cited and tested. In addition, this classification has inspired extensions that have had great impact by themselves in other fields of knowledge (e.g., Swanson's 1994 tri-core model of innovation, explained in more detail in the following section).

Conceptualizing HRITs as innovations does not fit these classifications squarely. It was stated at the conclusion of Chapter I that HRITs are mainly *administrative* innovations, since they are helpful to run the firm, not so much to change the way the organization produces its

goods or services. However, a case may also be made that several HRITs are more *technical* in nature than administrative; they might introduce or capitalize on equipment (e.g., computers, telephones, company Intranet, etc.) that are clearly technology-based. Similarly, it could also be stated that several of the HRITs in this study are accompanied by changes in *processes* (e.g., instead of having to request income tax classifications personally or by telephone, employee self-service technologies enable direct changes by the employee with minimal intervention by the HR staff). Anyway, the contributions made by Damanpour and by Daft are significant enough that they should be mentioned in any innovation research.

But Rogers' work is definitely the most influential inquiry on the topic of innovations (Rogers 2003). His massive compilations of innovation studies bridge a variety of fields, including agriculture, communications, social development, epidemiology, human behavior, and, of course, technology in a wide variety of types.[3] While his contributions are many, his treatment of innovations as a product, process or technology that was not used in the past by the adopting entity—irrespective of whether the innovation has been around for a short or long while—has been accepted as a standard in the field. This project joins this tradition in that some of the innovations under study (e.g., HR functional applications) were commercialized for several years before the organizations decided to adopt them. Another concept in Rogers' work is that most innovations are not assimilated spontaneously, but that there exist *stages* of adoption through which most adopters go by, more or less sequentially (e.g., acquisition, adoption, customization, routinization, institutionalization, abandonment). Conceptualization of the specific stages, both in content and number, depends to some extent on the innovation at

[3] In a similar way to other highly influential scholars, Rogers' work has been under scrutiny and criticism; for example, his classification of innovation adopters as innovators, early adopters, early majority, late majority and laggards has been challenged by other scientists that posit that innovation adoptions are not normally distributed, but that there might be other models that better explain the adoption of innovations (e.g., Bass, 1969; Mahajan, Muller & Bass, 1990). For an application of innovation modeling, see Florkowski & Olivas-Luján (2003).

hand. Meyer & Goes (1988), for example, offered a nine-stage assimilation process, based on their work on over three-hundred adoptions of medical technologies. In the next section the model with respect to stages that will be used in this investigation will be delineated, as it appears to be most suitable, since it has been developed within the IT innovations literature.

2. IT Innovations

Table II.2 contains a summary of the most influential publications on IT Innovations found for this review. Several of them are comprehensive reviews that have steered the field by summarizing recent research in the area, showing patterns, and issuing recommendations so that future research can proceed more efficiently from previous work (e.g., Kwon & Zmud, 1987; Prescott & Conger, 1995; Swanson 1994). The remainder are applications of theory–sometimes including extensions or challenges to existing theories of IS innovation—or empirical tests of more generic innovation theories adapted to MIS themes.

Reviews by Kwon & Zmud (1987), and Prescott & Conger (1995) have strongly influenced recent research. The former identified five types of factors that strongly influence systems implementation (environmental, organizational, user, task-related and characteristics of the system itself), using a Diffusion of Innovations perspective, while the latter developed a typology of IT innovations, based on the locus of their impact –the IS unit (i.e., innovations that only affect the IS function, such as Object-Oriented Programming), intra-organizational impact (these innovations affect not only the IS unit but also the organization at large; e.g., self-service HR applications), and inter-organizational impact (IT innovations that affect other organizations, not just the adopting one; e.g., automated inventory reorder systems). Both utilized a stage assimilation process that includes adoption, implementation, and routinization.

Returning to the types of innovation, Prescott & Conger's classification seems rivaled in impact by the tri-core model forwarded by Swanson (1994). His typology classifies IT innovations in the following three main categories: Type I innovations are those that are

reserved for IS tasks (e.g., software maintenance tools); Type II innovations support the administration of the business (e.g., an HRIS or accounting systems) and Type III innovations assist production technologies of the firm (e.g., an ERP or enterprise resource planning system).

Several patterns emerge from the listing of studies in Table II.2. First, a majority of these studies deal with empirical, large-scale tests of IT adoption (both acquisition or implementation), using surveys of key informants (typically the IS executive in the firm) as the preferred data collection method (Chau & Tam 1997; Cooper & Zmud 1990; Drury & Farhoomand 1999; Fichman & Kemerer 1993a; 1997; 1999; Flanagin 2000; Grover 1997; Grover, Fiedler & Teng 1997; Lai & Guynes 1997; Png, Tan & Wee 2001; Premkumar & Roberts 1999; Rai & Bajwa 1997; Ravichandran 1999; 2000; Ravichandran & Rai 2000; Ryan & Harrison 2000; Teng, Fiedler & Grover 1998; Thong 1999; Wierenga & Ophius 1997). Alongside, regression and correlation are the most frequently used statistical analyses, although some models require the use of path analyses (by means of Partial Least Squares or Structural Equations modeling) or Discriminant or Survival analyses –in agreement with the type of theoretical question, of course. A study that stands out due to the large number of individuals surveyed (over 1,200 employees, albeit in 39 organizations) is Klein, Conn & Sorra's (2001), which highlights the importance of an innovation climate and resource availability in the implementation of an MRP (Manufacturing Resource Planning). The remaining large-scale survey studies use a single-respondent per organization strategy, perhaps in an effort to economize resources, and with the benefit of inquiring about a very visible phenomenon –

Information Technologies—which is not as prone to perceptual differences as other organizational phenomena might be[4].

Qualitatively-oriented methodologies are not frequently used, although Lee & Kim (1998), Pichault (1995), and Zmud & Apple (1992) used case studies to better understand issues related to the infusion or acceptance of the technologies, such as the pace and scope (Lee & Kim, 1998), politics and power dynamics (Pichault, 1995), and routinization (Zmud & Apple, 1992). While these topics are of critical importance to the ultimate success or contribution of any IT innovation within the firm, they are less connected to this dissertation because of their emphasis on more advanced stages of innovation assimilation.

Another interesting pattern is the fact that most technological innovations in the table have IS as its predominant locus of impact (e.g., Object Oriented programming, Relational Database Management systems, Integrated Services Digital Networks, software reuse, Total Quality Management in software development, Business Process Reengineering). Much less popular is the study of innovations with an *intra*-organizational locus of impact (e.g., Executive Information Systems, Marketing Decision Support Systems, electronic scanners in supermarkets) or with an *inter*-organizational locus of impact (Material Requirements Planning, Electronic Data Interchange, organizational websites). Only Grover, Fiedler and Teng's (1997) research included innovations with different loci of impact. This point is relevant to the study in that HRITs have different loci of impact too, as explained in Chapter I. When offering this typology, Prescott & Conger (1995) suggested that Diffusion of Innovations (DOI) theory is particularly useful to understand those with an intra-organizational locus of impact, but they did not discourage the use of the framework on innovations with different loci. The studies

[4] This point is particularly important, given the debate that has recently taken place between Gerhart, Wright & Mcmahan (2000), Gerhart, Wright, Mcmahan & Snell (2000), Huselid & Becker (2000), and Wright, Gardner, Moynihan, Park, Gerhart & Delery (2001), who take different positions on how perceptual errors on HR practices might bias the conclusions regarding these practices' effect on organizational performance. Thanks are due to Dr. F. Pil for bringing up this issue.

summarized on Table II.2 support the use of the DOI framework on other innovations, as will be shown in the following chapters.

To conclude this subsection, and to summarize on the topic of assimilation stages, this investigation follows the four-stage assimilation model suggested by Fichman & Kemerer (1997). The stages for that model are: (1) evaluation or trial use; (2) acquisition –but not yet deployment; (3) limited deployment (less than 25 % of expected use); and (4) generalized deployment (more than 25 % of expected use already in place). This assimilation stage model seems most appropriate for HRITs for the following reasons. While most HRITs are not simple to assimilate, they do not seem to be as complex as, for example, medical innovations like the ones studied by Meyer & Goes (1988; they proposed a nine-stage assimilation model that seems excessively detailed for the case of HRITs). In addition, Fichman & Kemerer (1999) have also studied assimilation gaps –the fact that many organizational or IT innovations frequently are not deployed to a reasonable degree but until a long time after acquisition—their work thus showing greater development of the notion of assimilation stages than it is found in other studies. They in fact utilized two assimilation stage models (as reported in Fichman, 2001), ultimately using the four-stage model described above.

Table II.2 Research on IT /IS Innovations

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Allen (2000)	Framing IS as Innovations	• Limitations of the pro-innovation bias	N/A	• Theoretical piece	• Innovations are social processes, subject to cycles, adaptations, and conflict
Chau & Tam (1997)	Open Systems	• Factors affecting adoption of open systems in organizations	Senior IT executives (n=89)	• In-depth interviews	• Organizations look at their "ability to adopt" an innovation, rather than at the benefits they could accrue from adoption • Adoption of open systems appears more "reactive" than "proactive"
Cole & McCain (1985)	OCLC software	• Adaptations to library transactions processing software	Library representatives (n=25)	• Interviews to a stratified sample from a previous survey study	• OCLC library systems are adapted by a large percentage of organizations in the sample • Users tend to utilize systems in ways that satisfy their local information processing needs
Cooper & Zmud (1990)	Materials Requirements Planning software (MRP)	• Application of Kwon & Zmud's (1988) framework to the context of MRP software	Manufacturers across the USA (n=52)	• Survey to a random sample of US manufacturers	• Matching task with technology compatibility is a major factor in MRP adoption • MRP infusion, however, seems to be determined by political and learning factors
Drury & Farhoomand (1999)	Electronic Data Interchange (EDI)	• Technological push v. Demand-side pull	Firms in a variety of industries (n=152)	• Survey • Comparison of scale means	• Technological-push and demand-pull forces are found to produce different external, internal, and cost-related benefits • Technological-push requires user accessibility and support • Benefits are more clearly identifiable with demand-pull • Internal demand-pull results in the highest levels of benefits but is infrequently the major source of impetus
Fichman & Kemerer (1993b)	IS Innovation in general	• Effects of Increasing returns and knowledge barriers on Software Process Innovations	N/A	• Theory-building	• The fact that software process innovations (SPIs) are characterized by (1) increasing returns and (2) knowledge barriers to adoption suggests that studying adoption and diffusion of SPIs across IT units requires new explanatory variables and knowledge of new patterns of diffusion

Table II.2 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Fichman & Kemerer (1997)	Software process innovations (SPIs)	• Effects of Increasing returns and knowledge barriers on Object Oriented Languages	IT managers in medium to large companies in the US (n=608)	• Partial least squares (PLS) path modeling	• Organizations are more likely to use SPIs when they have a greater scale of activities to spread costs • More extensive knowledge over innovation increases likelihood of adoption • Diversity of technical knowledge and activities increases adoption propensity
Fichman & Kemerer (1999)	Relational databases (RDBs), 4th generation programming languages (4GL) and CASE tools	• Introducing the concept of "Assimilation gaps"	IT managers in medium to large companies in the US (n=608)	• Differences between adopters and non-adopters • Survival analyses and related tests	• A very pronounced gap was found for CASE development tools • Moderate, yet significant, gaps were found for RDBs and 4GLs
Flanagin (2000)	Organizational Websites	• Influence of social pressures beyond organizational and technology factors	Orgs in a regional U. S. chamber of commerce (n=288)	• Discriminant and Regression analyses	• Organizational social pressures, the most significant discriminators of adopters and non-adopters, though not particularly important in predicting the likelihood of future adoption for organizations currently without websites • This suggests that social pressures may have their strongest effect during the early phases of innovation diffusion • Organizational features and perceived benefits, also reasonable discriminators of adopters and non-adopters as well as effective predictors of the likelihood of adoption for non-adopters

Table II.2 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Grover, Fiedler & Teng (1997)	Ten ITC innovations: IS outsourcing, CASE tools, OOP, large-scale RDBs, teleconferencing, expert systems, email, CAD/CAM, EDI	• Test of Swanson's (1994) tri-core model of IS innovation	IS executives from large firms in the US (n=313)	• Comparison of adopting vs. non-adopting samples based on survival analysis	• Empirical support is found for Swanson's (1994) typology and implications for innovations studies • Depending on the type of innovation, some contextual variables facilitate its adoption better than others
Hahn & Schoch (1997)	Electronic publishing	• Use of DOI theory and concepts in electronic publishing	N/A	• Application of DOI definitions to the electronic publishing phenomenon	• The "Innovation cluster" for electronic publishing is defined • DOI theory offers a foundation to better understand the use of electronic publishing ventures
Klein, Conn & Sorra (2001)	MRP Implementation	• Differences between successful and failing implementations of computerized technologies	Employees at various levels (n=1,219) in computerized manufacturing plants (n=39)	• Correlations • Regression • Path analyses	• Financial resource availability and management support for implementation stimulate high-quality implementation policies and practices and a strong climate for implementation • Innovation climate fosters effectiveness in use
Kwon & Zmud (1987)	Systems implementation	• Applying DOI to implementation of information systems	N/A	• Compilation of studies on IS implementation	• Five types of factors appear as most influential: environmental, organizational, user, task-related and characteristics of the system itself
Lai & Guynes (1997)	Integrated Services Digital Networks (ISDN)	• Drivers of ISDN adoption in the US	Business Week 1000 firms (n=161)	• Discriminant analysis	• Firms more prone to adopting ISDN are larger, less open, have more slack resources, more "technology expansion" actions, and fewer "technology restriction" actions
Lee & Kim (1998)	Information Technologies	• Test of framework classifying innovation objects and processes in IT	Korean Banks (two) and manufacturers (two)	• Comparative case studies	• Pace and scope of innovations are theoretically posited to relate to the type of innovation (objects vs. processes)

Table II.2 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Pichault (1995)	Politics under IT changes	• Effects of introducing computer based Information systems	A chain store, a bank, a teaching hospital, & a news agency in Belgium	• Comparative case studies	• Orgs. with power concentration tended to perpetuate existing structures • More political management styles promoted personal commitment to the changes
Png, Tan & Wee (2001)	Frame relays	• Effects of national culture on IT adoption	Large firms from 24 countries with presence in the Asia-Pacific region (n=153)	• Logit discrete choice regression model	• A one-point increase in Hofstede's uncertainty avoidance index for the country of incorporation associated with a 3% lower likelihood of adopting frame relay • Power distance was not significantly correlated with adoption of frame relay
Premkumar & Roberts (1999)	Communication technologies and software	• Innovation, organizational and environmental predictors of adoption of new ITs	Rural small businesses (n=78)	• Discriminant Analysis on interview / survey data	• Relative advantage, top management support, organizational size, external pressure and competitive pressure are the best predictors of adoption of ITs in this context
Prescott & Conger (1995)	IT innovations	• Classifying IT innovation studies	N/A	• Review of recent research on IT innovations (70 articles)	• IT innovations can be classified by the locus of impact (IS unit, intra- and inter-organizational) • DOI theory appears to be most applicable to ITs with an intra-organizational locus of impact • ITs with the IS unit as locus of impact appear to require less organizational support, and their implementation appears to be related to nontraditional innovation characteristics such as functionality and efficiency • Innovations with an inter-organizational locus of impact seem to be affected mostly by contextual and environmental variables

Table II.2 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Rai & Bajwa (1997)	Executive Information Systems (EIS)	• Determinants of adoption and adoption levels of EIS for collaboration (EISc) and for decision support (EISd)	IS managers from companies in 42 states (US) and across industries (n=210)	• Regression	• Environmental Uncertainty (E-Unc) related to adoption of both EISc and EISd • Size of IS unit, related to EISd adoption only • Top management support is a strong predictor of level of adoption for both EISc and EISd • E-Unc and IS support, related to adoption levels for EISd only
Ravichandran (2000)	Total Quality Management (TQM) practice in software development	• Determinants of swiftness and intensity of adoption of an administrative innovation	IS Executives from Fortune 1000 firms (n=123)	• Survival and hazard analyses and related tests • Regression	• Adoption of TQM is influenced by the organization's quality orientation and the IS department's support for quality, having a quality assurance function, and the structural complexity of the IS unit
Ravichandran & Rai (2000)	TQM in IS	• Development of a theory of software quality management, including socio-behavioral, organizational and professional issues	IS Executives in Fortune 1000 firms (n=123)	• Partial Least Squares path analysis	• Software quality, best attained when top management promotes improvements in process design and encourages its evolution on stakeholders • All elements of the organizational system need to be developed to attain quality goals • Piecemeal adoption of select quality practices is unlikely to be effective
Ryan & Harrison (2000)	Social changes brought about by IT innovations	• Uncover costs and benefits of changes to social subsystems brought about by new IT in organizations	IT decision-makers (n=50)	• Interviews • Content analyses with open coding and axial coding techniques	• Social subsystems costs and benefits accrue with IT implementation should be incorporated in investment decisions • The more potentially disruptive the technology, the greater the evaluation IT decision makers should make of social costs and benefits

Table II.2 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Swanson (1994)	Types of IT Innovation	• Extending Daft's (1978) dual core of organizational innovations	N/A	• Review of innovation studies and illustrative examples	• IT innovations can be usefully classified as follows: Ia: IS administrative process; Ib: IS technological process; II: Product and business administrative process; IIIa: IS product and business technology process innovations; IIIb: IS Product and business process; IIIc: IS Product and business integral innovation
Tam & Hui (1999)	Computers' price elasticity	• Elasticity of computer prices 1955-1984	N/A	• Historical data on computer prices, modeled with respect to three models	• Models show an initial decline in elasticity (meaning that computer spending was less price sensitive in the first two decades) • Elasticity appears to increase after the 1970s
Teng, Fiedler & Grover (1998)	Business Process Reengineering (BPR) & IS	• Organizational, technological and strategic elements for radical process change to take place and succeed	IS executives across various industries in the US (n=313)	• Means comparison (t-tests) on various scales	• Factors related to IT maturity and influence may facilitate the decision to reengineer, but are not critical in the later stages of the initiative • Factors having significant relationships beyond the initial decision include variables pertaining to innovative capacity of the organization and strategy-IS interface • Technical IT competence appears to be a necessary but not sufficient enabler for reengineering success
Thong (1999)	IS in small businesses	• Use of IS in Singaporean small businesses	CEOs from firms in Singapore's Association for Small and Medium Enterprises	• Discriminant analysis • PLS path modeling	• CEO characteristics, IS characteristics, and organizational characteristics predict adoption of IS in these small businesses • Mostly organizational characteristics (size, employees' knowledge, information intensity) relate to the *extent* of IS adoption

Table II.2 (continued)

Investigation	Technology Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Wierenga & Ophius (1997)	Marketing Decision Support Systems (DSS)	• Factors predicting adoption of Marketing DSS	Marketing executives in US firms (n=575)	• Regression	• User involvement, sophistication, system adaptability, direct interaction are the main predictors of Marketing DSS adoption • Main use is to obtain information, not to upgrade current information
Zmud & Apple (1992)	Electronic scanners in supermarkets	• Comparing routinization and infusion of innovations	Supermarket chains' data compiled by the Food Marketing Institute and by IBM's Scanner Division, then surveys, then interviews of sub-samples (n=8)	• Correlations between market chains and a Guttmann-type infusion scale created for this purpose	• The Guttmann scale for infusion offered in this study seems to successfully discriminate chains according to their use of scanners • Governance system changes (i.e., routinization) appeared more rapidly in place than high infusion of the technology

3. HR Innovation Studies

Logically, an influential research stream such as diffusion of innovations would not go unnoticed by HR researchers. For reasons that are not readily apparent, however, the innovations paradigm has not been widely embraced by HR researchers. It might be less intuitively appealing to conceptualize HR policy or practice as an innovation, than other more novelties that are embodied in visible tools or equipment. Table II.3 summarizes the six HR Innovation studies found in preparation for this dissertation.

As it is evident from the table, Kossek has been more prolific in this area than other HR researchers (Kossek, 1989a; 1989b; Kossek, Young, Gash & Nicol, 1994). Her early works (1989a, 1989b) focused on the acceptance of eight HR innovations within a financial services company.[5] Executives and managers were found to be more accepting of these innovations than were lower level employees. More recently, Kossek et al. (1994) investigated workforce reactions to an HR information system at a large energy company. Their study offered a typology of four observed reactions toward the HRIS that has been cited by other HRIS researchers (e.g., Ball, 2001; see Table II.1, above, for more details)[6]. Yet, the research design was somewhat more qualitatively-oriented than it is typical of the innovations literature. For example, varying degrees of resistance and ambivalence were found in implementing the HRIS; face-to-face seminars better influenced favorable intentions to use the HRIS; the HRIS symbolized HR's attempt to become more strategic; the HRIS changed power dynamics and communications, and HR managers would not use the HRIS directly.

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[5] The innovations were: quality circles, job posting, flex-time, a fitness program, flexible benefits, case rewards, an employee newsletter and a peer award.

[6] It should be clarified that this typology is not germane for the current study, as the typology focuses on *individual*'s acceptance of the HRIS, not on *firm*-level determinants of HRIT assimilation.

Another influential research that looks at HR practices as innovations was offered by Pil & MacDuffie (1996). Their article offers longitudinal evidence to the effect that HR management systems work best when they are used as "bundles" of complementary practices, rather than in isolation. Pil & MacDuffie also found that flexible work organization (e.g. use of teams, job rotation, etc.) is frequently followed by flexible automation, but not the opposite. In other words, assembly factories that automate their processes first are less likely to introduce flexible or high-performance HR practices later in their production process. This study also used a research methodology (structured interviews at forty-three automobile assembly plants worldwide) that allows the researchers to get rich, in-depth information about the phenomenon and the contextual variables; a very strong methodological approach not frequently used in the innovations literature.

Tannenbaum & DuPuree-Bruno's (1994) study appears to be more in line with methodologies in the tradition of the diffusion of innovations literature. They surveyed forty government agencies in the state of New York, to find out the extent to which contextual variables (e.g., size, climate, organizational structure, external conditions, and workforce variables) relate to a large number of HR innovations (one of them an HRIS, but the report does not offer separate results on this or any other innovation). Their investigation found that formalization, centralization, and HR department climate demonstrated somewhat weaker linear effects with HR innovation, and that external favorability exhibited a nonlinear relationship with HR innovation.

Finally, Johnson, Baldwin & Diverty (1996) offer a macroeconomic perspective from Canada about HR strategies and practices and the use of labor technologies, using statistics from the national bureau (Statistics Canada). Their study suggests that technology-adopting firms appear to have superior performance than their less technologically-inclined counterparts.

Table II.3 Research on HR / Personnel Innovations

Investigation	Innovation Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Johnson, Baldwin & Diverty (1996)	IT adoption and labor training	• Links between strategy, training and technology	Canadian firms, participants in various surveys by Statistics Canada	• Percentages • Longitudinal comparisons	• Technology-adopting firms appear to have superior performance • Technology adoption and training are also linked
Kossek (1989a)	HR innovations	• Factors predicting acceptance of six HR innovations in a large financial firm	Managers & employees at an insurance company (n=2,018)	• Surveys and interviews	• Significant differences in the acceptance of these programs were found for the following background variables: program experience, hierarchical level, seniority, and organizational unit
Kossek (1989b)	HR innovations	• Adoption, implementation and acceptance of HR innovations	Managers & employees at an insurance company (n=2,018)	• Surveys and interviews	• Executives and managers were more accepting of these innovations than were lower level employees
Kossek, Young, Gash, and Nichol (1994)	Implementation of a corporate-wide HRIS	• Issues related to the implementation of an HRIS	Key employee groups' responses to HRIS (n=150) From corporate and field locations, across levels and areas of one large energy firm	• Inductive, longitudinal case study • Surveys and interviews • Analyses of company documents	• Varying degrees of resistance and ambivalence found in implementing an HRIS • Face-to-face seminars better influenced favorable intentions to use the HRIS • Typology of four HRIS reactions: (a) Computer Jock Phobia, (b) Gradual Automators, (c) Corporate HRIS Resisters, and (d) Information Brokers • The HRIS symbolized HR's attempt to become more strategic • The HRIS was expected to enhance the roles played by HR • The HRIS changes power dynamics and communications • HR managers would not use the HRIS directly

Table II.3 (continued)

Investigation	Innovation Focus	Research Question(s)	Respondents	Mode of Analysis	Key Finding(s)
Pil & MacDuffie (1996)	High involvement HR practices	• Effects and correlates of high-involvement work practices' adoption	Automobile assembly plants worldwide (n=53)	• Structured interviews • Longitudinal comparisons	• HRM systems appear to work better as 'bundles' of complementary practices • Flexible work organization (e.g. teams, job rotation) is frequently followed by flexible automation, but not the other way around
Tannenbaum & DuPuree-Bruno (1994)	HR innovations in state public agencies	• Extent to which size, climate, organizational structure, external conditions, and workforce variables relate to seventy-two HR innovations	NY State public agencies (n=40)	• Correlations • Comparisons of means for organizational characteristics and agency innovativeness	• Formalization, centralization, and HR department climate demonstrated somewhat weaker linear effects • External favorability exhibited a nonlinear relationship with HR innovation

Technology adoption and training are also observed to be related, although there seem to be differences across industries. Training seems to be strongly related to the nature of the innovation: manufacturing firms exhibit more training related to technology-based innovation strategies, whereas the services sector appears to have more quality-based and human resource-based innovation strategies (p. 118). Although this study is not as strongly related to the topic of this dissertation, it has been included in this review due to its focus on HR innovations –a somewhat rare occurrence in the HR literature.

From the sections above, it can be safely stated that the Diffusion of Innovations approach, which has been so fruitful in the MIS literature, is not easy to find in the HR area. Given the salience that IT innovations are attaining for the HR function, the time seems ripe to use this approach to advance the state of the art on HRIT innovations.

C. CONCLUSION

The main purpose of this chapter was to identify and review the literature streams that more directly aid our understanding of the use of HRITs as innovations. First, I reviewed the extant research studies on HR Information Systems (HRIS), none of which focus on the determinants of HRIT assimilation, or on the intensity with which firms utilize those technologies. Then, I identified innovation studies from three research streams –MIS, HR, and general organizational innovations—that appear to best address the research questions driving this dissertation. In the next chapter, I describe the model that guides the empirical tests in this dissertation.

III. RESEARCH MODEL AND HYPOTHESES

Two fundamental research questions guide this section of the investigation:

(1) How should the presence of information technology in HR processes be operationalized?

(2) What environmental, organizational, and departmental factors influence firm-level assimilation of HR information technologies?

A research model was developed to address these issues, utilizing the research streams outlined in Chapter II (see Figure III.1). The model will be used to develop hypotheses that will be tested in this investigation.

A. MAIN DEPENDENT VARIABLE – HR TECHNOLOGY INTENSITY

The main dependent variable is HR Technology Intensity (HRTI), an aggregate measure of the information technologies deployed in the organization, with HR purposes. As it has been suggested in the previous chapter, in order to understand the intensity or "strength" with which an organization makes use of HRITs, three different but related dimensions must be combined. First, it is necessary to measure the organizations' set of HRITs, in regards to the number of technologies utilized. Second, the assimilation stage (Fichman & Kemerer, 1997) in which each of the HRITs is present in the organization should be captured by the dependent variable, lest the measure become a simple count of technologies without truly describing the extent to which the technologies have been incorporated. Third, the HR sub-functions that are automated with each of those technologies–that is, the *penetration* of each of those HRITs—should be included

to quantify how much each of those HRITs is helping the HR function achieve its operational objectives. This final dimension is necessary to differentiate organizations that might have a large proportion of their work automated vs. those whose automation is minimal, even though the number of and assimilation stage of their HRITs might be similar. Together, these three dimensions provide a technology-intensity index (HRTI) that signifies how many HRITs are being used in the firm, to what extent these technologies are being used, and in which HR sub-areas. Having only two or one of the dimensions would provide a very limited vision of the intensity with which the HRITs are deployed in the firm. For example, including only the HR sub-areas and the number of HRITs would miss critical information in regards to the level of assimilation achieved: an organization that has only recently acquired many technologies with several HR purposes in mind should not have the same score as an organization that has implemented the same number of technologies with a similar penetration level, but that is "over the hump" in the organizational learning curve. An aggregated strategy has been chosen to represent these three dimensions for the reasons that will be explained next. The specific operationalization will be described in Chapter IV, in the corresponding subsection, including some obvious limitations, which are expected not to overpower its benefits.

Fichman (2001) identified six conditions that favor the aggregation of technologies when studying IT innovations. When these conditions are present, innovation findings can be considered more robust and generalizable, and a stronger predictive validity may be expected from the investigation. The six conditions, in the context of this research, are:

1) the main interest is in a model that generalizes to the HRIT innovations class, as opposed to a specific HRIT innovation;
2) antecedents are posited to have effects in the same direction in all assimilation stages;
3) characteristics of organizations can be treated as constant across the HRIT innovations in the study;

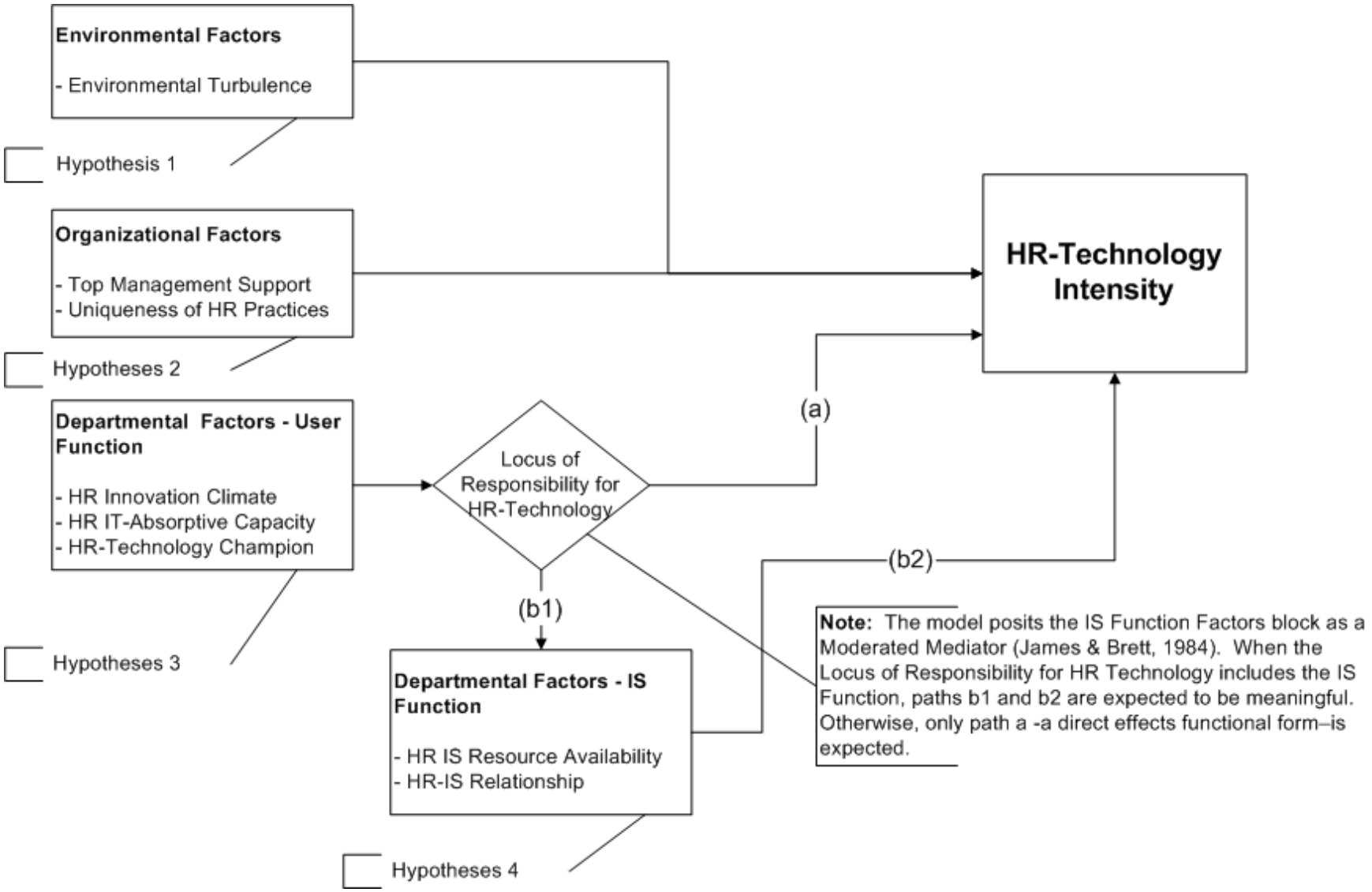

Figure III.1 Theoretical Model

4) HRIT innovation characteristics cannot be treated as constant across organizations, as is the case in comparing IVR technologies with web-based employee self-service (ESS), for example; IVR technologies are delivered through the telephone line –a well-extended means for communications—, while web-based ESS requires the presence of the intranet in the organization;
5) the set of innovations includes substitutes or moderate complements (e.g., a firm might choose to offer only a web-based delivery of compensation benefits, but another might offer both a web-based and a telephony-based alternatives), and
6) sources of noise in the measurement of the innovations (e.g., respondent effects) may be present.

This measurement approach is also well legitimated within both the HR (cf. Fiorito, Jarley, & Delaney, 2000; Huselid, 1995; Koch & McGrath, 1996; Macduffie, 1995; Youndt, Snell, Dean, & Lepak, 1996) and MIS (cf. Fichman & Kemerer, 1997; Grover, Fiedler, & Teng, 1997; Ravichandran, 2000) literatures, where researchers have used aggregation when operationalizing such constructs as IT innovation by labor unions, technology diversity, intensity of TQM adoption, and HR sophistication. These various aggregated measures also aid in understanding complex, multidimensional phenomena that cannot be understood with simpler measurement approaches. It is by analogy with these variables that HRTI, the dependent variable, has been designed is expected to aid our understanding of the use of HRITs in the organization, just like Fiorito et al's (2000) IT innovation in labor unions, or Ravichandran's (2000) aggregated measure of intensity of TQM adoption.

B. PREDICTOR VARIABLES – ANTECEDENT FACTORS FOR INNOVATION

Studying the *factors* that predict innovation is a well-established modality within the DOI literature, and particularly in MIS (Cooper & Zmud, 1990; Kwon & Zmud, 1987; Prescott & Conger, 1995; Tornatzky & Klein, 1982). Kwon & Zmud (1987) identified five broad types of

factors as predictors of innovations: (1) environment, (2) organization, (3) user, (4) task, and (5) technology characteristics. This research focuses on the first three types of factors, following on work by Fichman (2001) and by Ravichandran (2000). Technology characteristics are not the explicit focus of this study, with the purpose of following Fichman's (2001) aggregation research design in order to increase the generalizability of the findings. Ravichandran (2000), in his study of adoption of total quality management practices in IS units, also excluded technology and user characteristics but included those that pertain to the environment, the organization, and the task context, as he found them most relevant for his organizational-level study. The type of IT innovation in this study—HR Information Technologies—, however, requires the inclusion of characteristics of the most relevant unit in the organization for IT, the Information Systems (IS) function. Both practitioner and academic literature suggest the inclusion of this factor. For example, Hoffman & Hoffman (1998), in addition to SHRM/BNA's Bulletin to Management survey on HR activities, budgets and staff (2001) report that a sizable proportion of firms have shared governance or responsibility for HRITs, falling on the HR and the IS functions. A moderated mediation functional form (James & Brett, 1984) is hypothesized to be in place, as described graphically by the diamond shape and accompanying labels on Figure III.1. Further detail will be provided below, under the IS Function Factors heading.

1. Environmental Factors

The environmental characteristic that appears to be most relevant for this study is Turbulence (Jones, Rockmore, & Smith, 1996). Environmental Turbulence has recently been referred to as the "degree of change and unpredictability of a market environment" (Li & Atuahene-Gima, 2001; p. 1125). Certain or predictable environments score high in munificence, high in stability and low in complexity (O'Neill, Pouder, & Buchholtz, 1998; p. 102). Under such circumstances, information technologies that help reduce unpredictability will not be deemed as valuable to the firm, thus reducing the likelihood that financial resources will be allocated to

acquire them. On the other hand, when munificence and stability are low and complexity high – i.e., turbulence is high—managers, in their attempt to remain in control, will be keen to explore solutions with the potential to help them reduce uncertainty and unpredictability.[7]

For these reasons, highly turbulent environments create a structural situation in which the potential benefits of, and demand for technology should be robust. Many factors may influence the level of environmental uncertainty confronting a given firm's HR function. Geographic location has been identified as one of these factors because it impacts the quality and availability of talent within the proximate labor market (Schneider & Bowen, 1999). Others include regulation, customer and supplier relations, and even technological developments (Jones et al., 1996). Regulations, for example, might differ not only as a function of geography (states may have enacted different laws governing the relationship between the firm and its labor market), but also industry (some industries' labor practices are more heavily regulated than others). Customer or supplier relations might accentuate the need to hire, retain, train, or let go portions of the workforce depending on the bargaining power that those stakeholders have over the firm. For example, an important customer might require a focal firm to train its employees on the use of an EDI (electronic data interchange) system to automate orders in the implementation of a just-in-time system. These are but a few examples on how changes in the environment might affect the pressure that different firms will feel in the form of environmental turbulence; whether those pressures might correlate positively with the intensity of HR technology in the firm (HRTI), as suggested in the paragraph above, is an empirical question worth being examined. Accordingly, the formal hypothesis may be stated as follows:

> **Hypothesis 1:** Environmental Turbulence is positively related to HR Technology Intensity.

[7] A very similar construct is Environmental Uncertainty (cf. Waldman, Ramírez, House, & Puranam, 2001; p. 137).

2. Organizational Factors

Two company-level variables have been identified as important in predicting HR Technology Intensity within the assimilating organization: Top Management Support and the Uniqueness of HR Practices.

a) Top Management Support

This construct is a well-documented predictor of innovation in DOI studies (Kossek, 1989; Meyer & Goes, 1988). While several researchers have advanced the notion that managers have little impact in the actions of organizations (e.g., Lieberson & O'Connor, 1972; Pfeffer, 1981; Tornatzky et al., 1983), the prevailing view seems to credit them with a significant role in the adoption process. For example, Rogers (Kossek, 1989; p. 380) highlights the importance of the leader of the organization. In their influential study of high-tech medical innovations, Meyer & Goes (1988) found that CEOs could have "substantial impact" (p. 918) when they personally support specific innovations. Similarly, in the context of Executive Information Systems (EIS) adoption, Bajwa, Rai, & Brennan (1998) found that top management creates a "supportive context" that may indirectly influence EIS success through a favorable context for vendor/consultant interactions with client firms. Hence, it is posited that Top Management Support will be related to increments in the dependent variable, HR Technology Intensity. For example, firms where top management seriously considers and gives an important priority to the HR department's requests for automation, or where the workforce needs to have an HR function that uses modern technology are given precedence over other organizational concerns, should result in higher levels of HRTI.

b) Uniqueness of HR Practices

The second construct, Uniqueness of HR Practices, has been linked to at least one major HR innovation: HR outsourcing (Klaas, McClendon, & Gainey, 2001). Klaas and his colleagues found that firms with idiosyncratic HR practices are less likely to outsource their HR services. By analogy, the more unique the human resource practices of the firm, the lower the probability that ready-made or "off-the-shelf" HR solutions will be available. Whether performed by IT staff or external vendors, extensive customization of existing HR applications, or the development of new company-specific software, should increase costs to the point where it becomes difficult to make a business case for automating HR activities. In sum, there will be less certainty that investments in HRITs will pay off when the firm's practices are idiosyncratic. These considerations form the basis for the following:

Hypothesis 2a: Top Management Support is positively related to HR Technology Intensity

Hypothesis 2b: Uniqueness of HR Practices is negatively related to HR Technology Intensity.

3. User Factors –the HR Function

A third type of factor that is relevant for studies of firm-level innovations has usually been labeled "Individual factors" (Kwon & Zmud, 1987; p. 233) or "Individual characteristics" (Prescott & Conger, 1995; p. 22). Cooper & Zmud (1990), however, prefer the term "User" (p. 125) which is more appropriate for this research, as it lends itself better to denote the fact that HRITs (and other similar technologies) are not adopted by individuals themselves; they are adopted by the *department* or *function* whose work is being automated within the organization. End users can

be HR staff or their internal customers, but the majority of the benefits that may be generated by these service innovations are vested with the HR function.

Three constructs in this category are included for empirical testing: (a) the HR Department's Innovation Climate; (b) IT Absorptive Capacity of the HR department; and (c) the presence of an HR Technology Champion. As in the preceding sections, hypotheses will be presented after the supporting arguments are made.

a) HR Department's Innovation Climate

Following a longstanding tradition in the organizational climate literature (Schneider 1972; 1975; 1987), Schneider & Bowen (1985) define climate as "the message employees get about what is important in the organization" (p. 239). Siegel & Kammerer (1978) were among the first who found that organizational climate can influence the rate of technological innovation. In the context of computer technology innovations, Klein, Conn, & Sorra (2001) found that a strong climate for implementation was related to manufacturing resource planning (MRP) implementation effectiveness. "Implementation climate" was characterized not only by employees' perception of the innovation being a priority for the firm, but also by observations and experiences indicating that the organizational policies and practices actually support the innovation.

Other academics have called for more contextualized climate constructs (e.g., Rousseau, 1988; Schneider & Reichers, 1983). Recent research indicates that organizational or intra-organizational sub-climates may be an independent driver of innovation. In one study, support for innovation within *teams* emerged as the main predictor of hospital innovations (Anderson & West, 1998). Similar effects have been documented at the *department* level. Consistent with the work of Nicholson, Rees, and Brooks-Rooney (1990), Tannenbaum & DuPuree-Bruno (1994) found that "a supportive [departmental] climate led to role innovations"

within the HR function (p. 189). [8] Given these findings, it is expected that HR departments with a strong innovation climate will encourage the introduction and utilization of Information Technologies across HR activities. As discussed earlier, HRITs often are touted as means of strengthening HR's "administrative expert" and "business partner" roles.

b) IT Absorptive Capacity of the HR Department

The second factor, IT Absorptive Capacity of the HR Department, is derived from two IT studies based on Cohen & Levinthal's (1990) construct of absorptive capacity. As Sambamurthy & Zmud (1999) express it: "*absorptive capacity*, […] refers to the ability of a firm's employees to develop relevant knowledge bases, recognize valuable external information, make appropriate decisions, and implement effective work processes and structures…" (p. 267). They suggest that a firm's "IT-related absorptive capacity" is reflected in line managers' IT management experience, which grows over time, via interactions with IT employees and participation in IS initiatives. Similarly, Boynton, Zmud & Jacobs (1994) apply absorptive capacity theory to support the notion that a firm's ability to effectively apply IT is dependent "on the development of a mosaic of IT-related knowledge and processes that bind together the firm's IT managers and line managers" (p. 300). In their study, managerial IT knowledge predicted high levels of IT use. By analogy, there is an expectation that the HR function's IT Absorptive Capacity will be an effective predictor of the presence and use of HRITs in the firm.

c) Presence of an HR Technology Champion

The third factor in this block, an active HR Technology Champion, is well anchored in the DOI literature (Rogers, 2003; p. 414). Beatty's (1992) rich, ethnographic, and longitudinal work

[8] Interestingly, three (of the 72) HR innovations in Tannenbaum & DuPuree-Bruno's (1994) study reflect IT-enhanced HR tasks: automated job selection (applicant tracking, computerized testing and legal compliance analysis), computer-assisted training, and HR information systems (with a focus on database management). Unfortunately, separate analyses of these items (or kinds thereof) were not reported.

indicated that the absence of a champion was an almost insurmountable barrier to the implementation of advanced manufacturing technologies (i.e., computer aided design and/or manufacturing: CAD/CAM). Using more generalizable methodologies, Howell & Shea (2001) reported that champion behaviors appear to be related to environmental scanning. [9] Champion behaviors, in turn, were positively related to project performance at the time of implementation and one year afterward. While it may be possible that HR Technology Champions do not "reside" within the HR function (i.e., the HR Technology Champion is not necessarily an employee of the HR function), this construct has been placed on this block of factors for theoretical parsimony and the lack of studies indicating that it would be better placed elsewhere in the model. Accordingly:

Hypothesis 3a: HR Innovation Climate is positively related to HR Technology Intensity.

Hypothesis 3b: IT Absorptive Capacity of the HR department is positively related to HR Technology Intensity.

Hypothesis 3c: The presence of an HR Technology Champion is positively related to HR Technology Intensity.

4. IS Function Factors

As stated earlier, there are both intuitive and academic arguments that support including characteristics of the IS function as a distinct set of factors. This category matters most when the HR function is at least partially dependent on the IS function for the automation of its

[9] An internal locus of control was found positively related to framing innovations as opportunities, while framing the innovations as threats was negatively related to champion behavior.

services. [10] In firms where the locus of responsibility rests on the IS function –a "centralized" IT governance mode—, IS function factors are likely to mediate (at least partially) the influence of the HR function factors. It follows that a "federal mode" (to use Sambamurthy and Zmud's, 1999 term for the shared responsibility for IT governance mode) should make characteristics of both the IS and the HR units relevant for variations in HR Technology Intensity. When the locus of responsibility for the management of HR Technology and its use rests entirely on the HR department –a "decentralized" IT governance mode (Brown & Magill, 1994; Sambamurthy & Zmud, 1999)—, the IS function factors are not expected to predict a significant amount of the variance in HR Technology Intensity.

Locus of Responsibility for the management and use of HR Technology then is a variable that triggers factors from the IS function as a mediator between the HR function factors and HR-Technology Intensity. James & Brett (1984), in their discussion of moderators, mediators and related tests call the functional form between these constructs a "moderated mediation" (p. 310). Two main constructs pertinent to the IS function factors are included in this

[10] With the advent of outsourcing and the emergence of Application Service Providers (ASPs), firms in an extreme case might have both the HR and IS functions outsourced. Less extreme, yet "ideal" (i.e., not necessarily existing in the most pure form) cases which make more sense from a practical viewpoint include: HR outsourced, IS "in-sourced"; HR in-sourced, IS outsourced; and both HR and IS in-sourced. Other possibilities might include the use of partnerships or strategic alliances and of "Internal markets" (King, 2001), but this study will not contemplate those cases to keep its scope manageable. It is important to recall that, even in the extreme case in which both functions are outsourced as much as possible, firms need to retain some level of control and responsibility over some of their HR- or IS-related tasks. In other words, a firm might outsource some HR tasks such as recruiting or training or some IS tasks such as code-generation or infrastructure maintenance, but many other tasks will remain under internal control. It is in those HR tasks that remain local that the firm will have an incentive to operate it as efficiently as possible, in many cases through automation, possibly in collaboration with the IS function. For the model that guides this study to be relevant, then, a firm should have at least some HR functions under its control (i.e., HR should not be totally outsourced), but whether the IS function is a relevant predictor or not, depends upon the way the HR-IS responsibilities are organized: in centralized, decentralized or federal governance modes.

research: IS Capacity and IS Relationship with the HR function. These two constructs are designed to capture the "ability" and the "willingness" of the IS function to service the HR department.

a) HR IS Resource Availability

HR IS Resource Availability is defined as the extent to which the IS function has resources available to service the user department –HR in this case. In the MIS-Innovations literature, Teng, Fiedler & Grover (1998) found that technical IT competences were an important (although not sufficient) predictor for success of a process innovation –business process redesign (BPR). Similarly, Klein, Conn & Sorra (2001) reported that financial resource availability was strongly correlated with implementation policies and practices for Manufacturing Resource Planning (MRP). MRP is an innovation that is similar to HR technologies in that most departments of the firm are affected by it –an intra-organizational innovation, in Prescott & Conger's (1995) terms. [11] Thus, the "ability" to service the HR function, as represented by technical IT competences and general availability of resources is expected to be strongly related to the use of HRITs in firms where the IS function has a relevant role in its use.

b) IS Relationship with the HR Function

As stated above, this construct is intended to capture the "willingness" of the IS function in servicing the HR department. In their reviews of the factors related to IT implementation, Cooper & Zmud (1990) and Kwon & Zmud (1987) include "appropriate user-designer interaction and understanding" as imperatives to IT implementation effectiveness (Cooper & Zmud, 1990; pp. 123-124). Cooperation between the user and the IS function is also stressed by Ang and

[11] Prescott & Conger (1995) conducted a review of about ten years of DOI research in IT, and found it useful to classify the studies in three major categories, by their locus of impact: the IS unit, intra-organizational, and inter-organizational. DOI theory appeared more adequate for innovations with an intra-organizational locus of impact than for the other types.

colleagues (1999) in the context of IT planning, the process that, at least in the best-case scenario, should determine technology investment decisions. Similarly, Applegate, McFarlan, McKenney & Cash (1996) and Teo & King (1997) have "emphasized that close relationships between business and IS staff are necessary to ensure that IS plans support business strategies" (Ang et al., 1999; p. 538). Thus, the intuitive idea that the relationship between the IS and user function impacts various stages of the IT systems life cycle has received support from the research community. For this dissertation, the idea that a favorable IS-HR relationship impacts the level of HR Technology Intensity will be empirically tested.

c) Locus of Responsibility for HR Technology

Figure 1 posits that the two IS factors will mediate the relationship between User factors and HR Technology Intensity ***when*** the Locus of Responsibility for HR Technology is either "centralized" with the IS function (a full mediation form is expected) or shared among the IS and the HR functions in a "federal" mode (a partial mediation is expected). In the event that the IS function does not have any responsibility on HR Technology (a "decentralized" IS governance mode), these factors are not expected to mediate the effect of the HR function factors on HR Technology Intensity. In more formal terms:

> **Hypothesis 4a:** HR IS Resource Availability mediates the relationship between *User Factors* and HR Technology Intensity, provided that the Locus of Responsibility for HR Technology rests, at least partially, upon the IS function.
>
> **Hypothesis 4b:** IS Relationship with the HR function mediates the relationship between *User Factors* and HR Technology Intensity, provided that the Locus of Responsibility for HR Technology rests, at least partially, upon the IS function.

C. CHAPTER CONCLUSION

Based on the literature review from Chapter II, I describe in this chapter the variable and the model designed to address the research questions steering this research: (1) how should the presence of information technology in HR processes be operationalized? and, (2) what environmental, organizational, and departmental factors influence firm-level assimilation of HR information technologies?

I define a three-dimensional dependent variable inspired by the IS and HR literatures to deal with the first question, and build a model rooted in the diffusion of innovations literature, in an attempt to capitalize on the success that the IS innovations literature has shown for understanding IT assimilations. In this attempt, I take into consideration the lessons from the general innovations and from the HR innovations literatures to offer as complete and informed as possible a model to test empirically in the following chapters.

A final point worth underscoring is the fact that a moderated mediation functional form – not a functional form frequently posited in organizational research—is hypothesized for the IS function factors. The Locus of Responsibility for HR Technology variable has been contemplated as moderating the contribution that the IS Function Factors may have in influencing the dependent variable.

IV. METHODOLOGY

A web-based survey research was designed to test the hypotheses developed in Chapter III. This chapter discusses the sample, contact protocol used to elicit responses, web-based survey design and implementation, and operationalization of constructs and types of statistical analyses that will be used in the ensuing data tests.

A. SAMPLE

Selected demographics for the firms and the respondents are shown on Table IV-1. Organizations with more than five hundred employees, located within Canada and the United States, were targeted for this study; smaller firms were deemed less likely to have the scale or the need for deploying HRITs. The majority of potential respondents were identified by accessing databases available to subscribers of the *Canadian HR Reporter*, to members of the International Human Resource Information Management (www.ihrim.org) association, and to members of the Society for Human Resource Management (www.shrm.org). A pilot subset (24 of the final 155 or 15.5 %) of regional respondents –South Western Pennsylvania—with the same profile as the larger sample was included after logistic regression analyses did not reveal systematic differences with the larger sample, except for having, on average, more advanced assimilation of IVR technologies, F (1, 125) = 6.03, $p < .05$; the other eight technologies and the descriptive characteristics for firms –company size, industry and HR technologies—or for survey respondents –tenure, hierarchical level, functional area—were not significantly different. Both the fact that there was only one difference between this subset of respondents and the larger subset, and the fact that Fichman's (2001) aggregation strategy is being used in this study are

expected to offset any potential biases—recall that Fichman's sixth condition arguing for aggregation of technologies when studying IT innovations deals with the potential presence of sources of noise in the measurement of the innovations. This small sample's added inclination for IVR technology might be one such potential source of noise to offset with the use of aggregation.

Given the nature of the information requested, Vice-Presidents of Human Resources were addressed in the communications, but in many cases –as sanctioned in the survey's instructions—they delegated the responsibility for answering to a different person. Several addressees sent the researcher e-mail "courtesy copies" of their messages asking other people to respond, showing evidence of their interest in the study and their conscious attempts to locate the best respondents within their firm. Table IV-1 shows demographic information about the respondents and their organizations.

Table IV.1 Select Characteristics of Organizations and Respondents

Organizations				**Respondents**		
	N	**%**			**N**	**%**
Industry				**Area**		
- Manufacturing	32	23.5		- HR	116	97.5
- Non-manufacturing	104	76.5		- IS	3	2.5
Size				**Hierarchical level**		
- Less than 2,500	49	35.8		- Top executive in area	36	30.3
- 2,500 – 9,999	51	37.2		- Senior manager	32	26.9
- 10,000 or more	37	27.0		- Middle manager	39	32.8
				- Generalist	9	7.6
Country				- Other	3	2.5
- Canada	47	34.8				
- USA	88	65.2		**Tenure**		
				- Less than 3 years	26	22.4
HR Ratios				- Between 3 and 10	40	34.5
- Less than .9	74	55.6		- More than 10	50	43.1
- Between .9 and 1.1	11	8.3				
- Above 1.1	48	36.1				

1. Response Rate and Non-Response Bias

Using the contact protocol described below, 767 organizations in a wide variety of industries were contacted for the study –244 in Canada, 523 in the USA. Charities and governmental organizations were not included in the sample. Thirty-two addressees were discarded because the firm did not have enough ITs in the view of potential respondents, the individuals were no longer working in the firm –a postal return or a letter from the organization was received—, or the firm no longer existed. Six addressees declined to answer because of high workload, inappropriate timing, or similar reasons.

One hundred and fifty-five valid responses were recorded in the web-survey database (85 from the USA, 49 from Canada and 21 did not leave this information), which yields a response rate of 21.3 %. [12] This response rate compares very favorably with similar large-scale, international studies: in Harzing's (2000) review of response rates in cross-national organizational studies, response rates varied between 6 % and 16 %. Her own study reached a 20 % response rate with a 56-question survey (less than one-third of the 185 items in the current survey, although that study included twenty-two countries). Even domestic mail surveys with organizational respondents from the HR function have had to settle with low response rates; for example, SHRM-BNA's Human Resource Activities, Budgets, and Staffs Survey for 2001 had a response rate of nine percent (SRHM-BNA, 2001, p. 9). Jackson, Schuler and Rivero's study (1989) also had a 20 % response rate. In the Innovations area, Ravichandran and Rai's (2000) study obtained a 17.32 % rate. In sum, although the response rate is not as high as it was originally desired, it seems to be in the higher end for a study of VPs of HR, and on average for an Innovations research.

[12] Most of the firms are headquartered in the USA (88, or 61.1 %), followed by Canada (45, or 31.3 %), the United Kingdom (5, or 3.5 %), Germany (2, or 1.4 %), and then Switzerland, Japan, The Netherlands, and Sweden (1 company from each of these countries, or 0.7 %); remaining firms did not leave this information.

Nevertheless, non-response bias is a potential source of error if prospective respondents that do not answer the study may differ from those that do, in characteristics that are germane to the research (cf. Dillman, 2000). To assess the seriousness of this problem, country and industry distributions were compared between firms that responded to the online survey and those that abstained from participating. Response rates by country were 16.7 % for the USA and 21.83 % for Canada, which implies that conclusions from this report might be slightly biased toward relationships that can be found more easily in Canadian than in US American firms. Of 400 randomly selected firms in the database of prospective respondents whose industry was identifiable, manufacturing firms accounted for 16.25 %, whereas non-manufacturing ones comprised 83.75 %. Comparing these percentages with those in Table IV.1 reveals that a larger percentage of manufacturing firms answered the survey relative to those that were originally contacted. The implication is that results from this report might slightly overstate relationships that are idiosyncratic to manufacturing companies. A more precise calculation of the non-response bias was not viable because of the way that the sample was composed (i.e., mailing lists from two sources did not include the industry for their firms), in addition to the fact that most of these firms do not have their demographic descriptors (e.g., size, characteristics of their HR units, etc.) available in an economically feasible manner. The following pages describe the group of respondents that recorded their answers in the web-based survey.

2. Organizational Demographics

Participating firms are from a wide variety of industries, most of which are non-manufacturing, or service-oriented (104, or 76.5 %). Other cross-sectional IS Innovation studies report similar diversity of industries and between 20 % and 25 % of their respondents in manufacturing (e.g., Ravichandran and Rai, 2000; Grover, Fiedler and Teng, 1997). Multi-industry studies as these ones usually claim a higher degree of generalizability for their findings

than single-industry or single-organization studies, the latter being more typical in the Innovations literature (cf. Tornatzky and Klein, 1982).

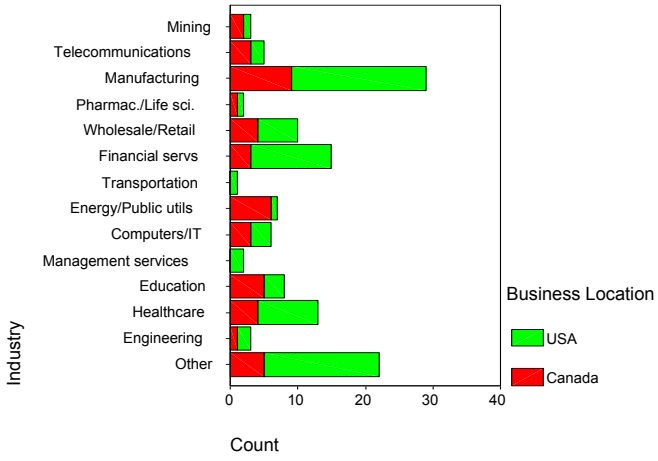

Figure IV.1 Industries Represented in the Sample, by Country of Origin

The majority of these organizations is large-sized, a likely result of the selection process. Only 20.4 % reported having less than one thousand employees. Forty-nine firms (35.8 %) informed having less than 2500; fifty-one of them (27 %) had between 2,500 and 9,999; and the remaining thirty-seven (27.0 %) reported more than ten thousand. The mean value for this variable is 16,326 (S.D. = 48,064.44), with a minimum of 85 and a maximum of 360,000. These large figures imply that the sample in this study should not be considered as representative of the larger population of organizations (cf. Jackson, Schuler and Rivero, 1989). Comparing this distribution with the 1997 Economic Census (US Census Bureau, 2001) also suggests that respondents to this study are located in the higher end of the distribution.

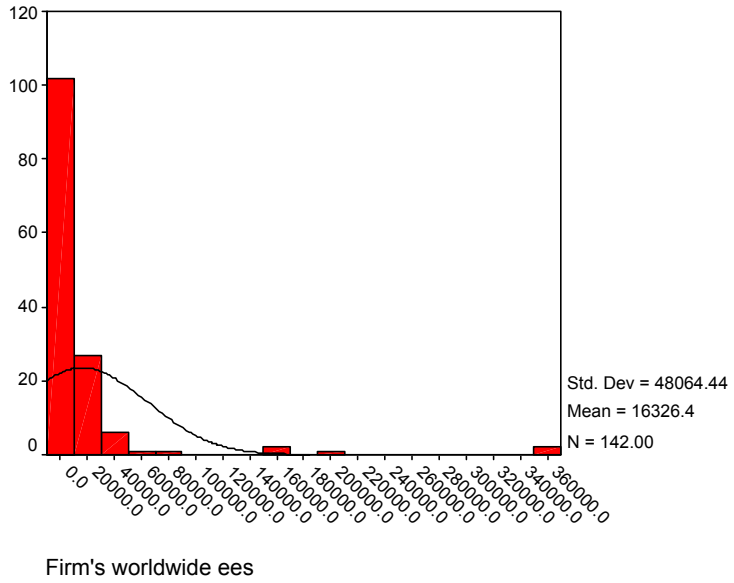

Figure IV.2 Size of Organizations in the Study

These firms have on average a typical HR ratio of HR staff per hundred company employees: 1.16 (S.D. = 1.29). To compare, SHRM/BNA's Bulletin to Management has consistently shown a median range between .9 and 1.1. Seventy-four of the firms in this study (55.6 %) showed a lower ratio than .9, eleven (8.3 %) scored within that range, and forty-eight companies (36.1 %) were calculated to have over 1.1 HR staff per hundred employees. [13]

[13] Given the cross-sectional nature of this project, it is not possible to determine whether the use of HRITs lowered higher initial HR ratios because no data on HR ratios is available previous to the assimilation of HRITs. Additionally, while the data presented in this survey is not too far for comparability, it must be stated that SHRM does not collect information on HR technology.

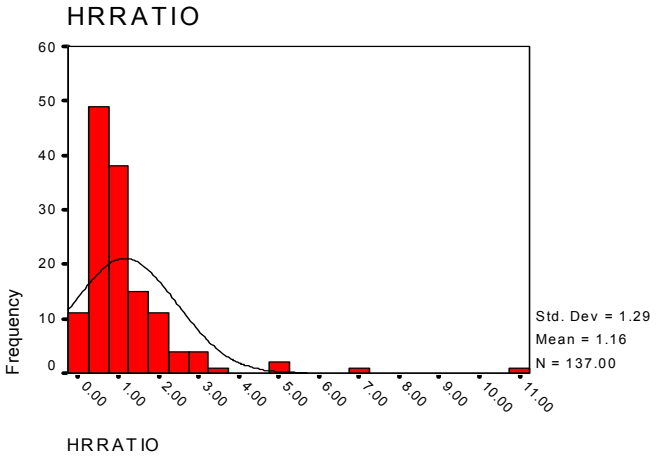

Figure IV.3 HR Ratios for Firms in the Sample

3. Respondents' Demographics

Most respondents had positions in the HR area (116, or 97.5 %; with the remaining 2.5 % from the IS area). Close to 60 % reported being at the top of their functional area or at senior management levels, as Figure IV-5 shows. As indicated above, the researcher received several "courtesy-copy" emails sent by addressees to other people in their firms. This suggests that a sizeable amount of responses (close to 40 %) were submitted not by the Vice President of HR but by a delegate from the IS, HRIS, or other units.

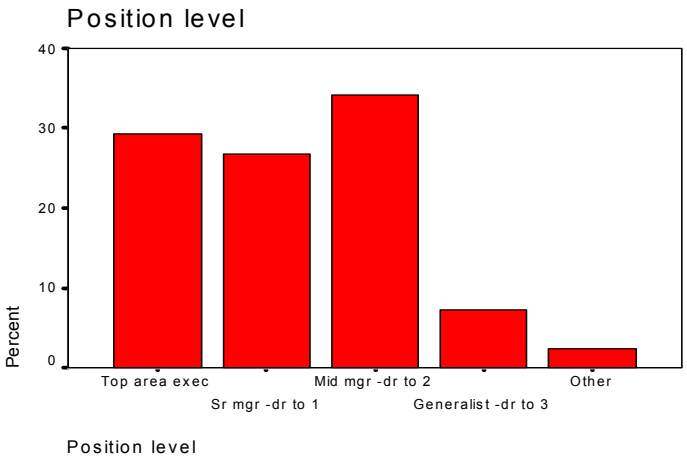

Figure IV.4 Respondents' Hierarchical Level

Finally, long tenure in respondents' positions –average: 10.5 years; S.D.: 8.11— suggests that they know their firms well and should be located in compelling positions to inform on the topic of the study. Only twenty-six respondents (22.4 %) had less than 3 years in their firms; forty of them (34.5 %) between 3 and 10 years of experience, and fifty respondents (43.1 %) reported 10 or more years working for their firms.

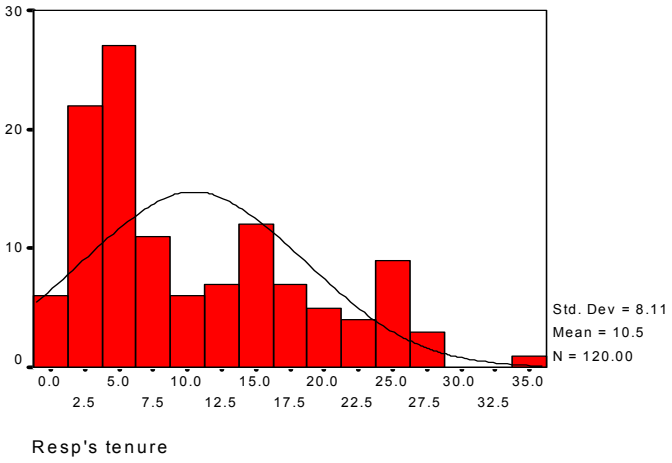

Figure IV.5 Respondents' Tenure Distribution

The decision to use a mixed communication contact protocol had several motives. To begin with, using only email (the least expensive alternative) was deemed undesirable because no tangible, yet inexpensive incentive –such as the bookmark—could be sent via email. In addition, unsolicited email is currently considered annoying ("spam"), particularly when the respondent has no connection or interest on its subject matter. Sending the bookmark via regular mail enabled having a physical reminder in participants' hands, as well as giving potential respondents an opportunity to request being deleted from the database, before an email was sent. Additionally, it was found that sending notices or reminders via email to potential respondents frequently coincides with the peek days in which responses are received on web surveys (Batagelj, Lozar, & Vehovar, 1998), an experience that was replicated in this study. Almost twice as many response records were received the day after the email reminder was sent –compared to the second best response day—, and the largest number of email messages from respondents was received by the researcher on the day after the email was sent. The convenience of clicking on a hyperlink (or cutting and pasting an Internet address from an email program into a web browser) makes the use of email extremely compatible with web surveys. Finally, the third reminder was sent via regular mail to provide a last prompt about the study and its importance, a reminder that would be more tangible, formal, and "business looking" than an email message. [14]

2. Web-based Survey

Essentially, the web-based survey was designed as a data repository, implemented by means of an interrelated set of pages written in "hyper-text markup language" (html, the basic machine language for the Internet). The questionnaire was very complex: it had 185 questions

[14] About 233 email messages and 3 letters were received from potential study participants throughout the weeks collecting data. Care was taken to reply each of those communications promptly, sometimes thanking them for taking the time to inform that they would not participate, other times to answer questions about deadlines or confirm receipt of their communications.

and ten skip patterns, most of which are due to the contingent nature of the items about the nine HRITs in the study. Programming allowed dynamic branching or skipping of unnecessary sections, in such a way that those respondents who only had one HRIT (e.g., only HR functional applications) would answer 140 questions; on the other hand, respondents whose companies had all nine HRITs in the study, were presented with all 185 questions. Because of the large number of computer variables –some questions needed several of them to comply with the research-based suggestions described below—and to comply with confidentiality requirements, a relational database with four tables was used to store visitors' responses. Education versions of a commercial web-development suite (Macromedia Studio MX ®) were used to automate the development of the website, using html tags interpretable by the most popular web browsers (Netscape ®, Explorer ® and Opera ®), to maximize brand independence. A description of the structure of the web survey now follows.

a) Navigation Flow –the "Front-End"

As shown on Figure IV.1, the questionnaire proper was divided in three sections, each of which was presented on a web page –screenshots for all pages can be found in Appendix C. Adding an entry and a final page constitutes the backbone of the survey, presented as the central sequence in the figure. The entry page was originally designed to conform to IRB regulations regarding informed consent for protection of human respondents: confidentiality of responses was assured, an estimate of the time needed to answer the survey (25-40 min) was presented, an offer to send respondents a summary of the data, and contact information for the researcher and the Dissertation Chairman were displayed. Responses to questions about the use of HRITs on the first survey page determined the sections to be included on the final page (the contingent or dynamic section). A last page, thanking respondents for their time was shown upon submission of the final survey page. Contact information for the researcher was displayed in all pages, to allow participants to report any problems.

B. DATA COLLECTION

Next comes a description of the contact protocol used to communicate with the potential respondents, and of the web-based survey that collected their answers. The research protocol was reviewed and approved by the Institutional Review Board of the University of Pittsburgh (IRB # 020586). The following pages detail some of the issues that, based on an extensive review of the pertinent literature, were considered most relevant in its design and implementation. Views of the survey and samples of the letters sent are included in the appendices.

1. Contact Protocol

A three-contact protocol was authorized by the University of Pittsburgh's IRB for communicating with potential respondents. Drawing from research summarized by Dillman (2000) and from studies published by Simsek and Veiga (2001), by Schaefer and Dillman (1998), and by Cook, Heath, and Thompson (2000), the following sequence of communications was used (sample letters are included in Appendix B):

1. A first-class, personalized mail "Invitation to participate in the study" was sent to the potential respondents. As incentives, the letter also included a Katz School of Business bookmark as a token of appreciation for the answers, and an assurance to send a summary of data to survey respondents.

2. A personalized e-mail reminder was sent about 1 week after, to potential respondents that had not responded yet, and whose email address was available –about 87 %. Personalized first-class letters were sent to the remaining 13 % whose email was not available.

3. A final, first-class, personalized "Final reminder" letter was mailed about two weeks after the email reminder, to the remaining potential respondents.

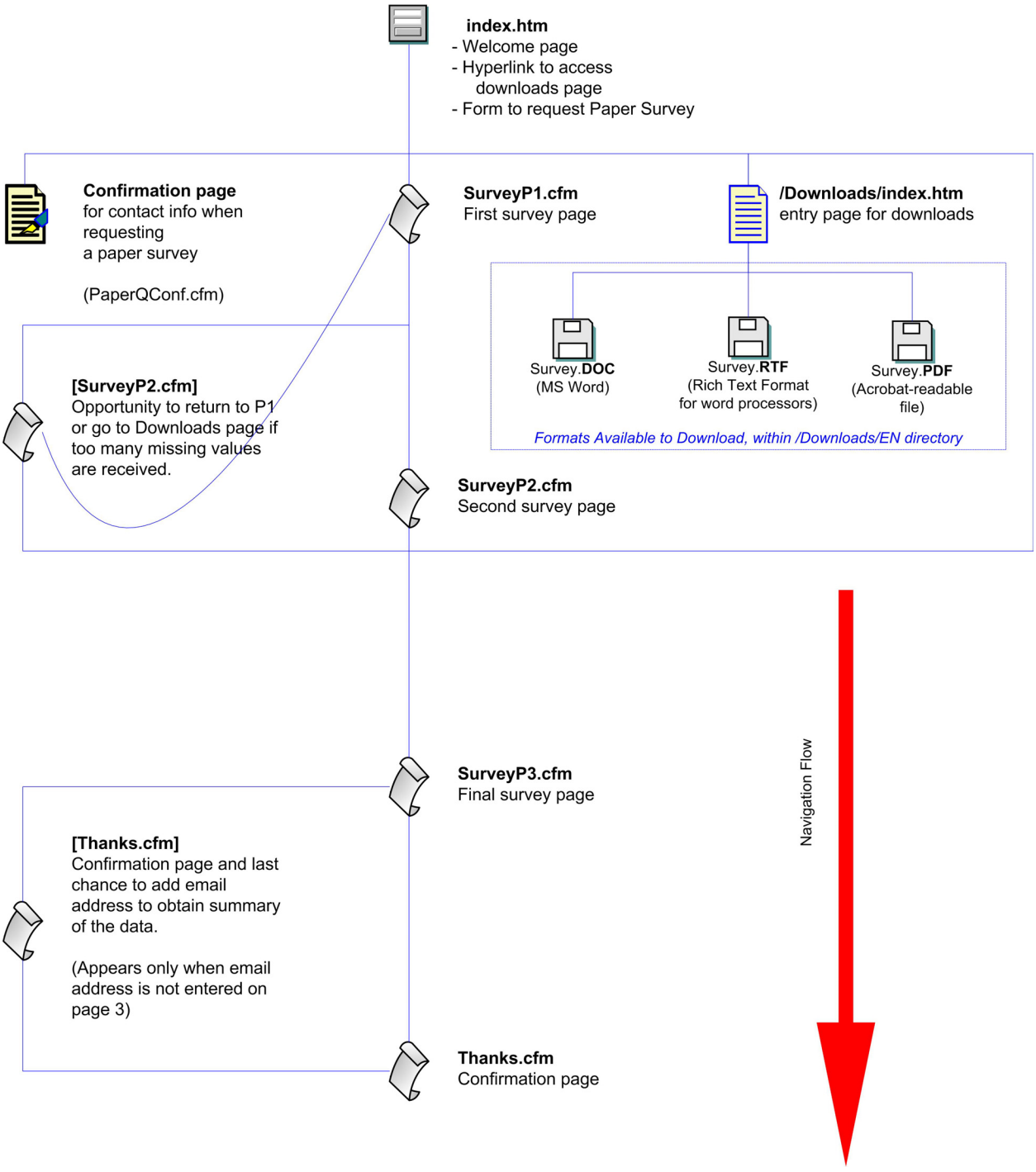

Figure IV.6 Structure of the Internet-based Survey

Suggestions from the dissertation committee members[15] prompted the inclusion of two ancillary pages in an effort to facilitate responses from potential respondents. First, the entry page presented visitors with a space to submit their contact information so they would receive by mail a paper-and-pencil version of the survey and a postage-paid envelope addressed to the researcher. Second, visitors to the website were also offered a link to a "downloads" page from which they could access the full survey in three of the most popular electronic formats for text documents: Microsoft Word ®, rich text format (RTF) and portable data file (PDF). The researcher's contact information (phone, fax, email and regular mail addresses) was included in the paper version, so that visitors who downloaded the survey could submit their responses in the most convenient way for them. Appendix D contains a reduced view of the full downloadable questionnaire.

An effort was made to display the two versions of the survey as similar to each other as possible. The same font was used in both versions and the same sequence of questions was presented to respondents. Studies by Stanton (1998) and by Couper & Burt (1994) were reassuring in that they found similar covariance structures in comparisons of web-based vs. paper responses. In fact, Stanton's study also found that the Internet-based survey had fewer missing values than the paper version, an experience that was also observed in this study, and will be described below.

Two noteworthy differences between the online and the paper versions were the use of a hyperlink for skipping four questions on the first webpage, and the omission of irrelevant questions depending on the HRIT's that the firm had at least purchased. The first difference was that the paper version had no automated way to pass over the unnecessary questions like the web-based version hyperlink, but the instructions were prominent and used a reverse background color for the number of the question where the respondent should continue

[15] I am indebted to Dr. Dennis Galletta and to Dr. Frits Pil for their suggestions on this matter.

(Dillman, 2000). The second difference proved much more substantial, as there were nine sections that dynamically might or might not appear, depending on the assimilation stage in which the firm had the nine different technologies in the study. Fortunately, only two respondents chose to use the paper-and-pencil version of the survey, but both neglected to answer sections that they were supposed to answer because they had the technologies in their firm. This fact suggests that the use of a web-based survey should be preferred over a traditional paper-and-pencil version when the skipping patterns are complex, as was the case in this study.

A couple of pages were also programmed to interact with respondents to the survey a few days after the data collection was launched. First, to prevent visitors from recording empty responses in the database, code was added to the second survey page to offer respondents an option to download the survey or return to the first survey page if they had not answer any of the HRIT questions or had left too many questions without answers. This is illustrated on Figure IV.1 as the square-bracketed version of the second survey page [SurveyP2]. Similarly, during the first days the survey was online, it was observed that some respondents would not write their email address on the last question of the survey, thus making it impossible for the researchers to send them the summary of the data. Since one of the underlying ethical research principles was the respondents' freedom to not reveal their identity, should they choose to do so, code was also added to the last page, reminding respondents that not leaving an email address (or leaving an invalid one) would preclude the researchers from sending them the summary of the data. Care was taken to also remind them that inclusion of their email address was never a requirement for taking the survey, and that the researchers were already thankful for taking the time to answer the questions until that point. This code is illustrated on the figure as the square-bracketed version of the last page (e.g., [Thanks]).

A final modification that took place during the starting days of the survey was the addition of three options to the questions on penetration of HRITs. It was observed that several

respondents were using a write-in field to add “Training and development” and “Regulatory compliance” items to the question about how HR applications are used in the firm and “Training” items to the question about the use of the fully integrated HR suite. A search on the most recent HR software online catalog (HR Press’: http://www.hrpress-software.com/) revealed that these categories were indeed commercially available; accordingly, they were added to the survey so that the next respondents did not have to type it in but they could simply select from a pull-down menu whether they used the technologies for such purposes or not.

Overall, these modifications to the survey illustrate the flexibility that the use of web-based surveys may offer researchers to control the stimuli that respondents are presented. This flexibility is simply impossible when using paper-and-pencil questionnaires. It should also be stressed that no major changes in the content of the survey were deemed necessary, only in the navigation flow and options available. Support for not making any additional changes in the content will be offered below, when describing the comments received from respondents. Depending on their nature and substance of the questions, changes in content could have mandated the exclusion of responses received before such changes were made, but this did not seem to be the case in this study.

b) Monitoring or Administrative Pages –the “Back-End”

A set of administrative web pages for monitoring progress on the survey process was also programmed. Given the internal nature of these pages, only the researcher and the Dissertation Chairman had knowledge of and access to these pages. The first page showed the answers left by respondents to the questions on the stages of adoption for the HRITs in the dependent variable. The second and the third administrative pages showed respondents’ comments left at the end of the answering pages. The fourth page was designed to easily download respondents’ email addresses so they would not receive reminders as described in the contact protocol above. The next page presented the contact information left by visitors who

requested the paper-and-pencil, mail version of the survey. Another option was a hyperlink to download the entire response database to a local file in the researcher's computer. Finally, using tracking capabilities provided by the web-hosting service provider, several counters were installed to monitor overall activity on the website. Now follow some considerations resulting from the use of these monitoring pages. [16]

As suggested by Simsek and Veiga (2001), no "cookies" (i.e., computer files to track website visitors' behavior) were used. On one hand, the use of cookies may be construed by some respondents as an invasion of their privacy, which would have required additional informed consent. On the other hand, some visitors might not even allow the use of cookies in their browsers, thus artificially and unnecessarily limiting the universe of potential respondents. Finally, the use of html's "hidden variables" (computer variables that are under programmer's control but need not be shown to the website visitor) allowed keeping track of the necessary steps to make the questionnaire more functional (cf. Birnbaum, 2001). This technique also enabled the researcher to avoid "session timeouts," a software limitation that other web-based instruments have reported.

c) Web-based Survey Literature

Albeit incipient, there is a useful body of literature that was examined during the development of the web-based questionnaire. To maximize the survey readability, several

[16] Some of the open comments left by respondents were very encouraging and even congratulatory (e.g., "Way to go with Pitt, I am a Pittsburgh native and a graduate of CMU. Please send the results of survey." "Please feel free to contact me with any questions or if you need any additional information. I think it's great that you are focusing on this area…."). Other comments were clarifying of responses (e.g., "Unable to provide much of financial information", "Labor union strength is not any factor in our industry."), and a few were moderately critical (e.g., "The questions on the dates of when technologies were implemented were difficult to remember...", "Many of the questions seemed repetitive"). Because no pattern was observed with respect to any specific questions or sets thereof, no additional actions were taken during the data collection period.

simple, yet distinguishable font styles were applied throughout the survey, following Dillman's (2000) design principles. Visual guides were used both online and in the paper versions to differentiate instructions, sections, questions and response options. Based on experimentally-based suggestions offered by Couper et al. (2001) visual cues telling respondents their progress status in taking the survey were also implemented (see Figure IV.7 for samples).

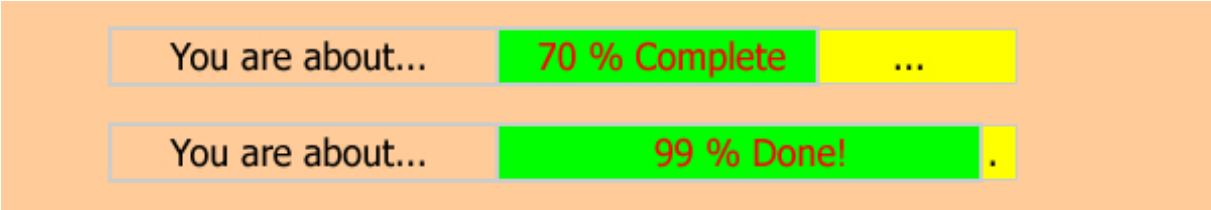

Figure IV.7 Sample Progress Status Bars Used in the Survey

Overall navigation was designed to be linear, as simplified as possible, in agreement with Norman, Friedman, Norman, and Stevenson (2001), who found advantages to the linear design of online surveys, even for computer-savvy respondents. Dillman (2000) also recommends the use of scroll-down pages over single-item screens, for both aesthetic and technical reasons –scrolling down pages makes responding the online survey more similar to responding on paper. Further, submitting multiple items to the server unnecessary inflates the time needed to take the survey, compared to submitting a few pages with multiple answers.

In addition to the general navigation flow, a number of recommendations were followed with respect to item design for the Internet. Response units (e.g. “years”, “%”, “US dollars”) were specified to minimize the possibility of obtaining inadequate answers (Dillman, 2000). As suggested by Dillman, (2000), default values for pull-down menus were programmed as "Please select" to avoid the possibility of receiving responses not selected by respondents. A similar logic was used in programming default values for radio buttons, as suggested by Birnbaum (2001 p. 50). Checkbox formats were not used, given the impossibility to distinguish a "No

answer" value from a "Default" value; this view is consistent with Couper et al's (2001) who also recommended avoiding checkboxes in academic web-based research.

Several references found in the literature review voiced concern with the possibility that some web-survey respondents might submit invalid or misleading answers (see for example, Stanton 1998; Stanton & Rogelberg 2001), suggesting the use of access controls, particularly in the form of passwords to filter out casual visitors to the survey. While such concerns appear to be very valid for publicized web-based surveys, this research did not use passwords for two reasons: as Stanton suggests, respondents having to type passwords have a reason to be more concerned with how identifiable their responses are. The other reason is that this survey was not promoted by any means other than the invitations sent to potential respondents. An additional precaution was taken to prevent accidental visitors: a command file instructing web crawlers (programs that index the Internet for search engines such as Yahoo ® or Google ®) **not** to index the site was added to the root directory of the survey. While it is not possible to guarantee that no respondent submitted a misleading response –as in all survey research efforts—; the fact that potential respondents were selected from membership lists of HR professionals, together with the incentive to send them a summary of the data, should reduce the possibility that such an event had occurred.

d) Web-Survey Statistics

Site statistics showed 1,280 hits on the "front-end" pages during the weeks the survey collected the data for this dissertation –see Table IV.2. While hits are a frequently used measure of activity on a website, it must be understood that a single visitor usually leaves multiple hits (a minimum of one hit per page visited, but often more than one if they press the "refresh" button on their web browser). For this reason, hits statistics can be interpreted in relative terms, but should not be construed as independent visits. Three hundred and forty-eight of those hits were targeted to the welcome page, though only 175 hits were registered on

the “Thank you” page. As it is in paper-and-pencil surveys, not all visitors left questionnaires fully answered. Six visitors entered the “Confirmation” page –for requesting a paper-and-pencil survey by mail—but only one left contact information. There were 133 downloads registered by the automated survey statistics; ninety-one downloads (68 %) were for the PDF format, thirty-three (25%) were for MS Word ®, and the remaining nine (7%) chose the “rich text format” version. The number of downloads suggests that many visitors wanted to see all questions before answering. Only one respondent chose to fax the paper survey, which suggests that “downloading respondents” ended up taking the online version but it is also possible that some of them might have not participated after all.

Table IV.2 Number of Hits on Web-Survey Pages

Pages	**Hits**
Welcome	348
SurveyP1	248
SurveyP2	196
SurveyP3	174
Thanks	175
Send paper survey	6
Download formats	
PDF	91
DOC	33
RTF	9
Total hits	**1,280**

Only one interruption was detected during the eleven weeks that the website gathered information: on October 21, 2002, a major Distributed Denial of Service (DDoS) attack was registered on the Internet's root servers (Federal Bureau of Investigation, 2002). One website visitor emailed the dissertation author, reporting problems taking the survey, a few days after the attacks. It is unclear whether this visitor or any others that might have been affected later succeeded in taking the survey online or not, but the fact that only one respondent wrote to report problems in accessing the online survey –and this report occurred after the DDoS attack—is reassuring.

3. Conclusion on the Data Collection Section

While it is impossible to isolate the reasons why this study fared relatively well in terms of its response rate, the subject matter –automation of the HR department—has been touted as "a major impetus for imminent change" for the HR function (Bates, 2002, p. 5). Professor Edward E. Lawler III, and other participants at the SHRM Foundation's "Thought Leaders" retreat have recently stated their expectations that IT is spearheading radical change for the HR department. To the degree that these prospects resonate among practitioners, it is possible that current interest in this topic made the survey more appealing than other studies of HR managers. There is also evidence to suggest that the use of a web-survey strategy was ideal for a questionnaire as long and complex as the one used for this study. Fichman and Kemerer (1997) who used a computer-based questionnaire with 104 questions (about 56 % of the instrument for this study) and 35 branch points make a similar statement. Finally, the conscious design and execution of the contact protocol might also have helped reach a respectable response rate.

C. OPERATIONALIZATION OF CONSTRUCTS

As a general guideline, measures published with satisfactory psychometric properties for the theoretical constructs in Chapter III were used in this research. In several cases, the measures were adapted to the context of the study (e.g., some scales that were designed for studying Manufacturing Resource Planning or MRP were reworded to study HRITs), and some of the scales were shortened to between three to seven items, in an attempt to balance questionnaire length with psychometric quality. Now follows a description of the measures used to operationalize the constructs and the psychometric properties that were attained in this research. While Appendix A contains descriptions of the variables with the items in detail, and Appendix C shows the survey as actually seen by respondents, the descriptions below should facilitate readers' understanding of operationalizations in this research.

1. Dependent Variable: Human Resource-Technology Intensity (HRTI)

The construct that this study attempts to explain was named Human Resource-Technology Intensity (HRTI). Consistent with Fichman's (2001) conditions for aggregation and in the same spirit as other innovation measures (cf. Fiorito, Jarley & Delaney 2000; Fichman and Kemerer 1997; Grover 1997; Huselid 1995; Koch and McGrath 1996; MacDuffie 1995; Ravichandran 2000), its operationalization is as follows:

$$\mathbf{HRTI} = \sum_{i=1}^{8} \mathbf{j}_i \mathbf{p}_i \quad \text{where:}$$

i : Varies with the following information technologies for HR services:

(1) Functional HR Applications; (2) Integrated HR Suite; (3) HR Integrated

–also known as Automated—Voice Response (IVR/AVR); (4) HR intranet; (5) Employee Self-Service (ESS); (6) Manager Self-Service (MSS); (7) HR extranet; and (8) HR portals

$\mathbf{j}_i$: Assimilation stage (cf. Fichman & Kemerer, 1997): 0 = not acquired; 1 = evaluation or trial use; 2 = purchased, not yet deployed; 3 = limited deployment (less than 25 %); 4 = generalized deployment (25 % or more)

$\mathbf{p}_i$: Penetration of functional HR areas where the corresponding i^{th} Information Technology will be or has been deployed

The first component of the variable ($\mathbf{j}_i$) was operationalized with the following question: "In the delivery of HR services, does your company use: " followed by the five assimilation stages described above, for each of the eight IT's (functional HR applications through HR portals). The second component ($\mathbf{p}_i$) was operationalized by the number of functional HR areas in which the IT had been or would be deployed, if it had already been purchased (third stage or higher in Fichman and Kemerer's 1997; assimilation model). Functional areas automated by HRITs were identified from a variety of sources, cross-checked with the HR Press' online software catalog [http://www.hrpress-software.com/]. As stated above, in the description of the "front-end" of the web survey, three areas were added during the first days the survey was online. Such areas were detected by monitoring responses to the "Other –please specify" option fields, and confirmed by crosschecking with the online catalog of HR software.

2. Independent Variables

a) Environmental Factor

Environmental Turbulence was operationalized by asking the extent to which ten factors have: (1) affected their organization's competitiveness, and (2) changed for the firm within the last three years. The ten factors were derived from Jones, Rockmore and Smith (1996). Specified on Appendix A, they deal with labor issues (e.g., availability and cost of hiring and retaining qualified employees), technology, management of collective knowledge, and stakeholders' influences (unions, customers, suppliers and regulations). Responses on the effect of these factors ranged from "no impact" (a value of 0 was assigned) to "extensive impact" (value of 4 assigned to this answer) in a 5-point scale. Answers about change for those factors in the recent past also were in a 5-point scale that was centered so that values would range from –2 for "very negative" impact to +2 for "very positive," with 0 as the middle value ("no perceptible impact"). For the sake of convenience and item simplicity for respondents, they were asked to answer on scales ranging 1-5; these values were then recoded as described above to create an index that would be compatible with the linear statistical methods used in the next chapter –correlation and regression. [17]

b) Organizational Factors

Top Management Support was operationalized by means of a six-item, seven-point Likert scale, ranging from "strongly disagree" to "strongly agree." Items, detailed on Appendix A, were adapted from Rai and Bajwa (1997). Sample items are "It is important for top management that our operations utilize IT" and "Top management provides constructive feedback on the use of IT in our HR operations." Cronbach's alpha for this scale: .87.

[17] Thanks are due to Jim Craft for the discussions that developed this elegant implementation.

Uniqueness of HR Practices was also operationalized by means of a seven-point Likert scale ranging from “strongly disagree” to “strongly agree.” Four items borrowed from Klaas, McClendon and Gainey (2001) composed the scale, but deletion of the first item (“Our HR practices are tailored to fit the nature of our business operations”) increased the reliability coefficient from .64 to an acceptable value of .73 (cf. Nunnally, 1978). Other sample items are: “Solving HR problems in this firm requires knowledge of our business strategy,” and “In this firm, you have to understand the history and culture before you can help solve HR problems.”

c) Departmental Factors

Similarly to the theoretical framework section, this segment is divided in three parts: (i) variables dealing with the user function (HR), (ii) variables about the technical function (IS), and (iii) variables about HRIT governance to examine the moderated mediator function in the model.

(i) The User Function –Human Resources

HR Department’s Innovation Climate was measured with a six-item scale in the Likert format described above. Four items were adapted from Tannenbaum & Dupuree-Bruno (1994) and the remaining two from Anderson & West (1998). Sample items: “In this company, HR recognizes and rewards new ideas from HR staff” and “HR and its staff display a willingness to take risks.” The alpha coefficient was assessed at .91.

HR’s IT Absorptive Capacity used a four-item scale derived from the work of Boynton, Zmud & Jacobs (1994), Cohen and Levinthal (1990), and Sambamurthy & Zmud (1999). Items included “Senior HR executives have a long history of interacting directly with the IS department in this firm” and “Collectively, HR professionals in this firm (including HRIS staff) have sufficient IT competencies to independently implement telephony- and web-based applications for the HR department.” Alpha coefficient was .81.

HR-Technology Champion used seven items, derived from Beatty (1992) and from Howell & Shea (2001). "The level of IT in our HR operation can be attributed to enthusiastic promotion by key person(s)" and "Problem-solving skills of key person(s) have increased our use of HR-IT's" are illustrative of the items used. Alpha coefficient: .93.

(ii) The Technical Function –Information Systems

IS HR-Technology Capacity was operationalized with four items, adapted from Klein, Conn & Sorra (2001)[18]. Sample items include: "The IS department lacks sufficient funds to purchase suitable HR technology applications" and "Adequate funds are available to fund this firm's HR applications implementation efforts." Alpha coefficient: .81.

HR-IS Relationship was measured using four items, derived from Boynton, Zmud & Jacobs (1994) and from Karimi, Gupta & Somers (1996). Sample items: "The IS team is well informed about the HR department's operations" and "The IT specialist-HR user relations in our firm are constructive." Reliability coefficient: .89.

(iii) HRIT Governance

Locus of Responsibility for HR-Technology was measured using six items to identify the organizational unit whose scope of responsibility included HRIT-related activities such as leading the development, implementation, standards setting, and planning of HRITs. Sample questions include: "Priorities for the development and implementation of HR-technologies are set by:" and "HR-Technology standards are set by." Response options included the IS function, the HR department, joint responsibility, business units, and so on. Coding for this variable was done in several steps: three variables were created, one for each of the IT governance modes (*centralized*, or located in the IS department; *decentralized*, when responsibility is in the HR unit;

[18] Thanks to Katherine Klein for her promptness and collegiality in sharing the measures used by her and her colleagues.

and *federal*, for shared responsibility). These variables were then assigned one point for each occasion in which the items indicated the governance mode for HRITs. The intermediate variable having the largest value was then utilized to assign each case to one of the three categories. Of twenty cases where two of the intermediate variables had the same value, eight were resolved by crosschecking with the response to the question of "Who participates in HRT planning in your firm?"

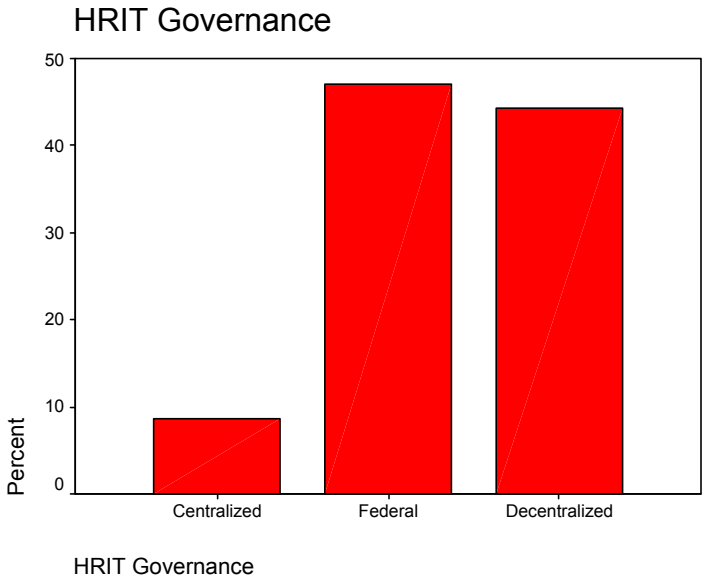

Figure IV.8 HRIT Governance Modes

As Figure IV-8 shows, only 7.9 % of the firms (12 cases) reported a centralized governance mode. In consequence, centralized and federal governance modes were collapsed to compare against the decentralized mode to test Hypotheses 4a and 4b. This decision also allowed recoding ten of the firms that had not been assigned to any of the governance modes until the previous step, yielding 90 firms (58.1 %) for the centralized/federal category and 65 cases (41.9 %) for the decentralized one.

D. STATISTICAL ANALYSES

Given the cross-sectional nature of this research, correlation and hierarchical regression analyses (Cohen, Cohen, West & Aiken, 2003) are reported in the following chapter. All analyses were completed using the statistical software package SPSS 11. Spearman's **ρ** (rho) correlations were calculated for most variables in this research. This non-parametric statistic is more appropriate than the popular Pearson's coefficient, in the event that the variables are not continuous or ratio measurements, but can be best described as ranks, as is the case with Likert-type scales. Additionally, ρ is more resistant to the effects of outliers, and its interpretation is analogous to Pearson's correlations (Myers and Well, 2003). In the case of dichotomous variables, point-biserial correlations were calculated, following Cohen and colleagues' (2003) recommendation.

For hypothesis testing, hierarchical regression models (Cohen et al, 2003) were calculated for the HRTI independent variable in this research. At first, sub-sample regressions were used on records by nationality, but aggregation of both sub-samples was deemed more desirable to maximize statistical power. On the full sample, Mahalanobis distance tests (Tabachnick and Fidell, 2001) were used in an attempt to detect outliers, in addition to visual inspection of Q-Q plots. Multicollinearity was also checked in two ways: first, correlations between variables were inspected to ensure that the threshold value of .70, suggested by Tabachnick and Fidell (2001) was not exceeded. In addition, Variance Inflation Factor (VIF) values were inspected to ensure that values of 10 or above were not signaling a potential multicollinearity problem, as recommended by Neter, Wasserman & Kutner (1990). Finally, an alternate dependent variable –the Sum of Percentages of Penetration of HR Technologies— was utilized in the regression equations, to discover whether convergent evidence for the results would be available.

E. CHAPTER CONCLUSION

In this chapter I described the sample of respondents, to show that their characteristics suggest that their answers must have been well-informed for the research issue. I also described the sample in terms of the organizational characteristics, to allow for useful comparisons between this research and similar research efforts. Then I detailed the web-based survey strategy I used to elicit responses from the target population. I next explained the operationalization of the constructs and the psychometric characteristics of the corresponding variables. To end this section, I have outlined the statistical analyses reported in Chapter V, which offer support to some of the hypothesis from the previous chapter. To my knowledge, this is the first large-scale investigation focused on HRITs that uses a Diffusion of Innovations perspective in a way comparable to that used in the MIS literature.

V. RESULTS

A. CORRELATION ANALYSES

Table V.1 shows the Spearman's **ρ** (rho) correlations between the variables in this research. As stated in the previous chapter, this non-parametric statistic is more appropriate than the popular Pearson's coefficient, in the event that the variables are not continuous or ratio measurements, but can be best described as ranks –as is the case with Likert-based measures, where respondents are asked to express their agreement with statements by selecting from an ordered set of discrete possibilities. In addition, ρ shows a higher degree of resistance to the effects of outliers, and its interpretation is akin to Pearson's correlation coefficients: both are measures of linearity (Myers and Well, 2003). Comparing Spearman's ρ to Pearson's correlation coefficients for the sample in this research, the former showed slightly more conservative results, except for one of the variables (HR Technology Champion). Only in the case of HRIT Governance, a dichotomous variable, point-biserial correlations are reported, as these are the appropriate association measures for this case (Cohen et al., 2003).

It should also be stated that, while correlational analyses are frequently interpreted as "supporting" hypotheses, results from regression analyses can categorically reject such support because the latter take into consideration simultaneous effects of the variables in the model (Cohen et al., 2003). For this reason, the following section should not be interpreted as statistical substantiation, but simply as relationships consistent (or inconsistent) with the theoretically predicted direction.

1. Correlational Data and Implications

The first hypothesis predicted a positive relationship between HR Technology Intensity (the main dependent variable) and Environmental Turbulence. The correlation between these two variables (-.19) offered weak indication to the contrary, as the sign was negative, and the significance level ($p = .06$) can be interpreted as marginal support at best; it did not reach traditional acceptance levels for the social sciences ($p \leq .05$). As correlational analyses might be disconfirmed by regression techniques, plausible explanations for this unexpected result are offered after the regression results are presented, in the next section of this chapter.

The next two hypotheses are related to organizational factors. Hypothesis 2a predicted that Top Management Support is positively related to HRTI. The correlation coefficient (.31) showed agreement with this hypothesis, by means of a positive, very significant value ($p \leq .001$). Hypothesis 2b summarized the inference that Uniqueness of HR Practices should be negatively related to HRTI. This hypothesis did not receive any backing, as the correlation coefficient was close to zero and correspondingly non-significant.

Three hypotheses addressed the influence of departmental factors on the level of HRTI. Hypothesis 3a, which captured the expectation that the HR Department's Innovation Climate be positively related to HRTI, received only marginal consensus from the data analysis. The positive correlation coefficient suggests that the relationship is on the predicted direction (.17), but its significance level ($p = .06$) can be interpreted, at best, as marginally significant. Hypothesis 3b stated that the HR function's IT Absorptive Capacity should be positively related to HRTI levels. The Spearman's ρ coefficient for these measures did not hold up this hypothesis: .08 ($p = .38$). Finally, hypothesis 3c, which states that the presence of an HRT Champion in the organization will be positively related to HRTI, received statistically significant endorsement: ρ coefficient equaled to .18, significant at $p \leq .05$.

Hypotheses 4a and 4b relate factors from the IS function to HRTI levels in the firm. In Chapter III, a moderated mediation functional form was posited for these variables. In other words, only when the IS department is included in the locus of responsibility for the HRTIs, were these factors expected to be significant. Accordingly, Spearman's ρ coefficients were calculated on two different subsets of the sample. The first subset incorporated only records where the locus of responsibility for HR ITs included the IS function –either "Federal" or "Centralized" IT governance modes, using Sambamurthy & Zmud's (1999) terms, as detailed on the "Locus of Responsibility for HR Technology" section on page 59—(n = 90 or 58.1% of responses that included this information), and the second subset was composed of records where the locus of responsibility for HR ITs did not include the IS function –a "Decentralized" IT governance mode—(n = 65 or 41.9%).

For the first subset (the IS function is included in the locus of responsibility), HRTI turned out an unexpected, statistically significant coefficient with IS Resource Availability for HR Technology (ρ = -.24, p = .04, n = 73). This relationship, anticipated to be positive from theoretically derived inferences (Hypothesis 4a) displayed a negative value for this sample (the more IS Resource Availability for HR Technology, the less HR-Technology Intensity). In contrast, Hypothesis 4b did show results consistent with the predictions developed in Chapter III. HRTI has a strong, positive relationship with HR-IS Relationship (ρ = .42, p = .000, n = 72).

As for the second subset (the IS function is not included in the locus of responsibility for IT), consistent with the moderated mediation functional form posited above, HRTI was not significantly related to either IS Resource Availability for HRTs (ρ = .24, p = .11, n = 46), or to HR-IS Relationship (ρ = .16, p = .30, n = 46). Given the smaller number of cases for this subset, there might be a greater possibility of a Type II error (i.e., statistical power is correspondingly low when the number of cases is low). However, no inaccurate conclusions can be drawn from a Type II error, as low power simply reduces the possibility of correctly rejecting a false null hypothesis; in other words, true null hypotheses are not incorrectly rejected

Table V.1 Non-Parametric Correlations

	Mean (s.d.)	1	2	3	4	5	6	7	8	9	10	11
1. HRTI	41.53 (27.34)	-										
2. Total % Penetration HR Functions	269.54 (139.92)	.50***	-									
3. Worldwide employees (log)	8.31 (1.52)	.35***	.26**	-								
4. Environmental Turbulence	13.14 (7.88)	-.19†	-.01	-.19*	-							
5. Top Management Support	4.34 (1.35)	.31***	.26**	.14†	.07	(.87)						
6. Uniqueness of HR Practices	5.23 (1.05)	-.05	.05	-.07	.03	-.02	(.73)					
7. HR Innovation Climate	5.28 (.97)	.17†	.24*	-.26**	.02	.29***	.21**	(.91)				
8. HR-IT Absorptive Capacity	4.31 (1.40)	.08	.14	-.16†	-.01	.45***	.26**	.51***	(.81)			
9. HR Technology Champion	5.13 (1.44)	.18*	.19*	-.02	.02	.44***	.23**	.29***	.26**	(.93)		
10. IS Resource Availability for HRT	3.99 (.95)	-.07	-.07	-.11	.12	-.15†	.26**	.06	-.01	-.01	(.81)	
11. HR-IS Relationship	4.55 (1.39)	.33***	.17†	.08	-.12	.56***	.04	.40***	.48***	.34***	-.25**	(.89)
12. HRIT Governance (dummy variable)	58.1%	-.10	.01	-.19*	.08	-.18*	.09	.15	-.04	.14†	.06	-.22*

Notes: Correlations reported are Spearman's ρ, except for the last row, which shows point-biserial correlations (0 = the IS function is included in the locus of responsibility for HRIT's, either on a centralized or a federal governance mode; 1 = the IS function is not included; the firm uses a decentralized governance mode). Number of records varies from 107 to 145, as pairwise deletion was used to take full advantage of valid responses. Cronbach's alpha coefficients for reliability of Likert-type scales are reported in parenthesis, on the main diagonal. Statistical significance: † $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

when available statistical power is low. To sum up, the moderated mediation form for the IS function factors received tentative backing from these correlation analyses, albeit one of the hypotheses (4a) showed a relationship opposite of what was inferred from theory.

2. Summary for Correlation Analyses

Correlation analyses generated results that are consistent with Hypothesis 2a (Top Management Support is positively related to HRTI), with Hypothesis 3c (HRT Champion is positively related to HRTI), and with Hypothesis 4b (HRIS Relationship is positively related to HRTI when the locus of responsibility for HR Technology includes the IS function). In addition, the sign of the coefficient associated with Hypothesis 3a (the HR Department's Innovation Climate and HRTI are positively related) was in the expected direction, but did not reach statistically significant levels. Surprisingly, Hypothesis 1 (Environmental Turbulence and HRTI are positively related) and Hypothesis 4a (IS Resource Availability is positively related to HRTI when the locus of responsibility for HR Technology includes the IS function) showed support *in the opposite direction*, although the first fell short of typical significance levels. Contrary to expectations, Hypothesis 2b (Uniqueness of HR practices is negatively related to HRTI) and Hypothesis 3b (IT Absorptive Capacity is positively related to HRTI) did not receive any statistical endorsement through this correlation analysis. Attention now turns to more rigorous tests of hypotheses, via hierarchical regression analyses.

B. REGRESSION ANALYSES

1. Analyses by Country

As explained in the Response Rate section (p. 63), almost one third of respondents (47 out of 155) reported being based in Canada. To make sure that the sub-samples are comparable across countries, a dichotomous variable was defined to run as dependent variable in logistic regression models, using all the measures on Table V.1 (dependent or independent

variables) as predictors. A value of 0 was assigned to the USA-based firms, and a value of 1 to the firms based in Canada. No statistically significant coefficient was found for any of the logistic regression models, but p-values for two variables –HR IT-Absorptive Capacity (p = .057) and HR-Technology Champion (p = .086)—were close to the traditional significance level of .05. When these variables were run in an isolated way as explanatory variables for the dichotomous country-of-origin measure, their significance levels dropped –HR IT-Absorptive Capacity (p = .065) and HR-Technology Champion (p = .206). Complementary, *t*-test analyses were run confirming these results –the mean for US-based firms was calculated at 4.49, while the mean for those based in Canada was 4.02 (*t* = -1.88; p = .063). Therefore, at this point the only dimension in which these two sub-samples seem to differ is HR IT-Absorptive Capacity.

Hierarchical regression models (Cohen et al, 2003) were then run for the HRTI independent variable by country, as shown on Table V.2, and Table V.3. As it can be seen on Step 3 in both tables, the regression coefficient for HR IT-Absorptive Capacity is not significant for either sub-sample, perhaps due to the reduction in statistical power as the number of cases available for the regression drops to 64 and to 43, given the listwise deletion treatment of missing values. In the case of the US sub-sample—the larger one, with 64 records—, there are three correlation coefficients reaching statistically significant levels: Top Management Support, Uniqueness of HR Practices, and HR Innovation Climate (in addition to the control variable, the log of Worldwide Employees). It is unclear whether the other variables do not reach statistical significance because of lack of statistical power or because the relationships are indeed non-significant –Table V.3, with only 43 records, shows marginal significance for the variables measuring IS HR-Technology Resource Availability and the HR-IS Relationship. In sum, the only variable –HR IT-Absorptive Capacity—that was statistically significantly different among the two nationality samples shows no strong explanatory power with respect to the dependent variable, HRTI. Thus, in order to increase statistical power, with little or no confounding to the

Table V.2 Hierarchical Regression Results for the HR Technology Intensity (HRTI) – US-based Firms Only

	Variables	B	R^2	Adjusted R^2	R^2 Change	F Change
Control Variable	Constant	-14.68				
	Log of Worldwide employees	7.02***	.12	.10	-	8.03***
Step 1	Environmental Factor					
	Environmental Turbulence	-.70	.16	.13	.04	2.97†
Step 2	Organizational Factors					
	Top Management Support	10.206***				
	Uniqueness of HR Practices	-5.77**	.41	.37	.25	12.73***
Step 3	Departmental Factors –User (HR) Function					
	HR Innovation Climate	10.02***				
	HR IT-Absorptive Capacity	-3.51				
	HR-Technology Champion	-.67				
	Departmental Factors –IS Function					
	IS HR-Technology Resource Availability	.73				
	HR-IS Relationship	3.60	.48	.39	.07	1.44

Notes: n = 64, as listwise deletion was used to maximize estimators' stability. Significance: †p ≤ .10; *p ≤ .05; **p ≤ .01; ***p ≤ .001.

Table V.3 Hierarchical Regression Results for the HR Technology Intensity (HRTI) – Canadian-based Firms Only

	Variables	B	R^2	Adjusted R^2	R^2 Change	F Change
Control Variable	Constant	-45.59*				
	Log of Worldwide employees	10.25***	.31	.29	-	18.38***
Step 1	Environmental Factor					
	Environmental Turbulence	.71	.33	.30	.02	1.46
Step 2	Organizational Factors					
	Top Management Support	.83				
	Uniqueness of HR Practices	5.75	.38	.31	.04	1.33
Step 3	Departmental Factors –User (HR) Function					
	HR Innovation Climate	4.35				
	HR IT-Absorptive Capacity	1.59				
	HR-Technology Champion	3.59				
	Departmental Factors –IS Function					
	IS HR-Technology Resource Availability	6.26†				
	HR-IS Relationship	4.97†	.53	.40	.15	2.17†

Notes: n = 43, as listwise deletion was used to maximize estimators' stability. Significance: †p ≤ .10; *p ≤ .05; **p ≤ .01; ***p ≤ .001.

relationships in the investigation, it seems safe to use both the US-based and Canadian samples in the same regression models.

2. Analyses on the Entire Sample

Table V.4 shows hierarchical regression models with all records available through listwise deletion (both US and Canadian based firms) for the HRTI independent variable in this research. Mahalanobis distance tests (Tabachnick and Fidell, 2001) were used in an attempt to detect outliers, but no cases failed the test. As a control variable, the logarithm of worldwide number of employees for the firms in the sample was entered before the blocks of factor variables. As in many other studies (e.g., DeTienne and Koberg, 2002), a log transformation was necessary to normalize the distribution of this variable, after visual inspection of Q-Q plots. A non-surprising B coefficient of 8.18 ($p = .000$) was found for a significant regression equation ($R^2 = .16$; Adjusted $R^2 = .17$; $F = 22.05$; $p = .000$), indicating that larger firms are significantly more likely to have higher HRTI scores than are firms with a smaller number of employees. Multicollinearity did not seem to be a concern in these analyses, as the highest correlation among the research variables was .56, well below the .70 threshold suggested by Tabachnick and Fidell, (2001). In addition, no Variance Inflation Factor (VIF) reached a value of 2 or above; Neter, et al (1990) identify VIF values of 10 and above as indicators of multicollinearity.

a) Hypothesis 1: Environmental Turbulence

Similar to the correlation analyses above, the regression coefficient for Environmental Turbulence (-.34) had a sign opposite from the expected, and did not reach significance levels. Therefore, Hypothesis 1 is not supported by the dataset collected for this investigation.

The possibility of a restriction of range in the responses (i.e., that most respondents had submitted answers within a very small span), can be discarded because the standard deviation for the Environmental Turbulence variable was not small (7.88). It might be speculated that

variations in the business environment experienced by HR executives at the time of this study (end of the year 2002) were so intense that they washed away any relation with HRTI. Even the fact that firms in the study are based in two countries (Canada and the USA), which must have introduced more variability in the form of a different set of sources of Environmental Turbulence, did not show the theoretically inferred result. Another logical explanation is that the need to use HRITs has been perceived across all environments, regardless of the turbulence they are experiencing (for example, due to widespread cost-cutting pressures), thus rendering this relationship non-significant. An alternative reason for this result might be that the Environmental Turbulence measure utilized for this investigation is too coarse; perhaps fine-tuning the measure by the origin of the turbulence or in some other meaningful way (e.g., regulatory agencies vs. labor market, etc.) might reveal the theoretically derived relationships. Finally, giving credit to the possibility that Hypothesis 1 *should* be rejected, it could be that most HRITs have an "intra-organizational" locus of impact; their contribution to the firm's dealings with its environment might be so small that the HRITs are not really that helpful in dealing with the environment, regardless of its turbulence levels.

b) Hypotheses 2: Organizational Factors

Adding organizational factors in the next step, regression analyses are consistent with correlation results above: Top Management support obtained a positive, significant coefficient (6.62; $p < .000$), but the coefficient for Uniqueness of HR Practices did not reach statistical significance (-3.31; $p = .13$). In consequence, Hypothesis 2a is supported, while Hypothesis 2b is not.

With respect to the latter (Uniqueness of HR Practices), the somewhat high mean score (5.23 out of seven) suggests that executives in the sample did perceive their firms as requiring above average idiosyncrasy in their HR practices. That average level for the scale, together with a decent standard deviation for this score (1.05) lowers the possibility that the sample was

Table V.4 Hierarchical Regression Results for the HR Technology Intensity (HRTI)

	Variables	B	R^2	Adjusted R^2	R^2 Change	F Change
Control Variable	Constant	-19.81				
	Log of Worldwide employees	7.99***	.17	.16	-	22.05***
Step 1	Environmental Factor					
	Environmental Turbulence	-.34	.18	.17	.01	1.10
Step 2	Organizational Factors					
	Top Management Support	6.62***				
	Uniqueness of HR Practices	-3.31	.29	.26	.11	7.93***
Step 3	Departmental Factors –User (HR) Function					
	HR Innovation Climate	7.78**				
	HR IT-Absorptive Capacity	-1.30				
	HR-Technology Champion	0.40				
	Departmental Factors –IS Function					
	IS HR-Technology Resource Availability	3.09				
	HR-IS Relationship	4.08†	.39	.33	.10	3.06*

Notes: n = 108, as listwise deletion was used to maximize estimators' stability. Significance: †p ≤ .10; *p ≤ .05; **p ≤ .01; ***p ≤ .001.

inappropriate for testing this hypothesis. Rather, it might be theorized that HR information technology is so flexible that the customization or setup phase typical of any HRIS implementation has reached a point in which even companies with unique HR practices can and will utilize HRITs as they perceive necessary to make their HR functions more efficient. Having idiosyncratic HR practices seems to be no excuse to keep the HR function low in automation.

c) Hypotheses 3: Departmental Factors

Step 3 in the hierarchical regression included departmental factors relevant for the user department (HR) and for the IS function. Having a favorable HR Innovation Climate (Hypothesis 3a) received strong statistical support ($B = 7.78$; $p < .01$), but not so Hypothesis 3b –about the HR IT-Absorptive Capacity—(-1.30; $p = .58$), nor Hypothesis 3c –on having an HR Technology Champion—($B = .40$; $p = .87$). These regression results are partially consistent with correlation analyses in that both support Hypothesis 3a and offer no statistical backing for Hypothesis 3b. In contrast, Hypothesis 3c was consistent with correlation analyses, but the more rigorous hierarchical regression strategy recommends its rejection. Consequently, both HR IT-Absorptive Capacity and the HR Technology Champion variable were dropped from the analyses in the following section.

For the first of these two variables (HR IT-Absorptive Capacity, from Hypothesis 3b) it was surprising to find no support for its relationship with HRTI. It might be argued that absorptive capacity is more necessary for organizational tasks where there is less method and structure and more need for creative, idiosyncratic solutions than it seems to be the case for the automation of HR practices. It might also be the case that the need to use HRITs is so important that knowledge factors internal to the user departments are less influential than the executive decision (shown in the form of Top Management Support) and the departmental endorsement (through a Climate that's favorable for HR Technological Innovations). In the context of this investigation, it can only be speculated whether departmental Absorptive Capacity is required

under less structured circumstances than the use of IT for the HR function would involve; further research in this direction is evidently needed.

With respect to the last construct in the scope of the User Department –HR Technology Champion, from Hypothesis 3c—, the fact that endorsement for its relationship with HRTI was found only in correlational analyses might be instructive. Correlational analyses as the ones used in the previous section test bivariate relationships, not multivariate ones –that is, the simultaneous effects of the independent variables on the dependent variable—like regression does. The fact that support for this hypothesis was found only in bivariate statistics –but not in regression analyses—suggests that other variables in the model might have stronger explanatory power than the one at hand. In particular, it might be the case that the relationship between the dependent variable and HR Innovation Climate (discussed above) is so strong – and to some extent sharing variance with HR Technology Champion—that the latter loses its explanatory power when included in the block of Departmental factors simultaneously to the former independent variable. To empirically test this explanation, additional regression models were run without the HR Innovation Climate variable, on both dependent variables. Only using the ancillary dependent variable (the sum of Percentage Penetration of IT for HR) was marginal support for this alternative explanation found (B = 24.00; p = .070; $F(6,93) = 2.999$; p = .010). Clearly, more conceptual and empirical work is needed to better understand this issue.

Step 3 also included two IS Function factors (IS HR-Technology Resource Availability and HR-IS Relationship), to identify their independent effect on the dependent variable, HRTI. Only the HR-IS Relationship variable received statistical support that could be considered marginal (B = 4.08; p = .062). Accordingly, the IS HR-Technology Resource Availability is not considered for the following analyses either (B = 3.09; p = .233). That this variable received no support from either correlation or regression analyses is somewhat puzzling. This is essentially saying that executives that perceive less (or more) resources available for HRITs in their firms do not have significantly less (or more) intensity in their HR automation. At first glance, it might

be tempting to seek fault in the operationalization of this variable, as this is the one measure whose mean was the closest to the mid-range of the scale (3.99 out of seven), and the one that showed the smallest standard deviation (.95). Nevertheless, other scales exhibited similarly small standard deviations (HR Innovation Climate in particular, with a .97 s.d.), yet received highly significant regression coefficients, in support of the corresponding hypotheses. Besides, this scale (IS Resource Availability for HRT) has been a significant predictor in other contexts (Klein, Conn & Sorra, 2001) and its reliability coefficient for this study was quite acceptable (α = .81). Accordingly, if the measure shows acceptable properties, it must be the relationship between the constructs that is problematic. Perhaps the need to use HRITs is so strong –and prices much less significant than they were in the past—that resource availability has lost its importance as a predictor of HRTI. In addition, most of the firms in this investigation can be classified as large (see the Organizational Demographics section on page 64); maybe these constructs are related when the firms are small or medium sized and costs associated with HRITs are proportionally greater than for companies in this investigation.

d) Hypotheses 4: IS Department Factors as Moderators

To test the hypothesized moderated mediation form (James & Brett, 1984) of the IS Function factors, as represented by the model and formally stated in Hypotheses 4a and 4b, additional regression models were run. Table V.5 summarizes the results of these additional analyses. The first subset of regression equations utilized the records where the respondents reported that the IS Function played a significant role on HRTI Governance (either a Centralized or a Federal governance mode); the second subset included only records where the role of the IS Function was reported as less substantial (a Decentralized governance mode, where the HR function has more responsibility over the IS function). It was expected that IS Factors would mediate the relationship between the HR Function factors and HRTI only when the IS Function was included in the locus of responsibility for HR-Technology.

Tests for mediation used Baron and Kenny's (1986) algorithm. It consists on calculating three regression equations that must show statistically significant unstandardized coefficients: (1) the Mediator Variable (MV) on the Independent Variable (IV); (2) the Dependent Variable (DV) on the IV; and (3) the DV on both the IV and the MV. Full or "perfect" mediation (p. 1177) is established when the IV has no effect on the DV when the MV is controlled. As Table V.5 shows, support was found for full mediation in the set of records where HRIT Governance includes the IS Function, in support for Hypothesis 4b. Also consistent with this hypothesis, when the regression equations were calculated on the subset of records where HRIT Governance does not include the IS Function, only the first of the three regression equations was significant, suggesting that the HR-IS Relationship does mediate the relationship between HRTI and the HR Innovation Climate, only when the locus of responsibility for HR-Technology includes the IS Function.

Table V.5 Tests of Moderated Mediation for IS Function Factors

Regression equations	Unstandardized B	p level	Condition held?
Models where HRIT Governance is Federal or Centralized (IS Function included) n = 90			
1. HR-IS Relationship on HR Innovation Climate	.66	.000	Yes
2. HRTI on HR Innovation Climate	6.60	.039	Yes
3. HRTI on HR Innovation Climate and on HR-IS Relationship	.47 9.20	.894 .002	Yes
Mediation effect:	**Full**		
Models where HRIT Governance is Decentralized (the IS Function NOT included) n = 65			
1. HR-IS Relationship on HR Innovation Climate	.55	.015	Yes
2. HRTI on HR Innovation Climate	5.16	.277	No
3. HRTI on HR Innovation Climate and on HR-IS Relationship	4.85 1.32	.315 .644	No
Mediation effect:	**Not supported (as expected theoretically)**		

3. Ancillary Analyses

a) On the Moderated Mediation Functional Form

Also shown on Table V.5 is the number of records that were used in these calculations. Fifty-eight percent (90/155) of respondents reported that the IS Function was included in HRIT Governance, and the remaining respondents that this function was not. Because the number of cases drops down to 46 in some of the regressions (listwise deletion is used to maximize the stability of regression estimators), another regression model was run on this sub-sample, to test whether the effect size of the HR Function factors on the dependent variable is large enough to

be perceived, even with the smaller number of records, as hypothesized by the theoretical model.

Results are shown on Table V.6, offering additional backing to the notion that, when the governance role of the IS Function is less significant than that of the HR Function, the HR Innovation Climate (B = 10.37; p = .022) and the HR Technology Champion (B = 8.50; p = .011) are strong and significant predictors of HRTI, as predicted by Hypotheses 3a and 3c. Lack of statistical power is unlikely to be the main cause for the failure to find statistical support for the connection between HRTI and the HR-IS Relationship when the IS Function shares responsibility for HRTI Governance.

These results, which are also consistent with correlation analyses from the previous section, suggest that the influence of some predictors like the HR Technology Champion may be more significant when the moderator (HRIT Governance) places ultimate responsibility for IT's on the HR Function than when this responsibility is shared with the IS Function. An analogous statement with an emphasis on the practical significance of this finding would be that, in organizations in which the IS Function does not play a significant role in the management of HRITs, the HR Function's Innovation Climate and existence of an HR-Technology Champion are important predictors of HR Technology Intensity. Notwithstanding the smaller size of this sub-sample, the combined effect of these two variables is empirically more important than Organizational Factors such as Top Management Support.

b) On an Alternate Dependent Variable

The exploratory nature of the dependent variable (HRTI), in addition to its multi-dimensional nature (sum of the assimilation stage of technologies X their functional penetration) deserves looking at some sort of convergent validity. A set of ancillary analyses was calculated using the sum of percentages of penetration of HR Technologies for the different HR sub-functions, as an alternate dependent variable. Respondents were asked to "estimate the

percentage of work transactions the HR function is responsible for that has been automated with Information Technology" for eight HR areas: Recruitment, External Selection, Training and Development, Compensation Administration, Benefits Administration, Performance Management, Career Management, and Compliance Management. A variable containing the sum of those percentages was created to use as dependent variable and examine whether it has similar predictors as HRTI does. Figure V.1 shows the distribution of this variable. Unfortunately, a considerable proportion of respondents did not provide enough data to calculate this information –perhaps these items were not so easy to calculate. Nevertheless, one-hundred and twelve cases are sufficient to illustrate whether the relationships with this alternate dependent variable are similar to those with HRTI or not.

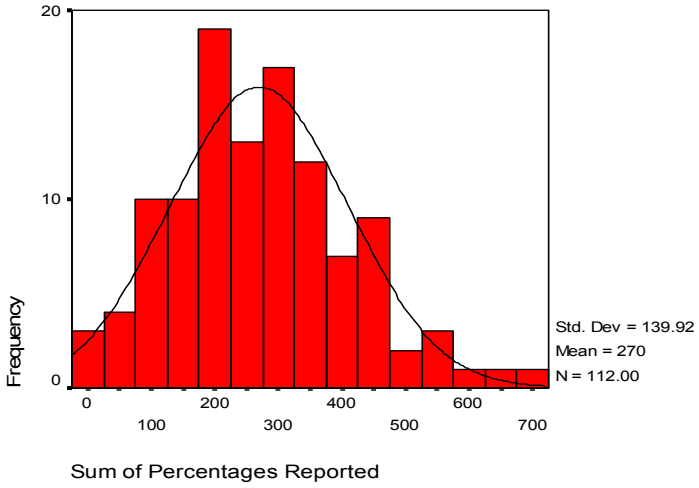

Figure V.1 Sum of Percentage Penetration of IT for HR

Even though this variable is conceptually and empirically different from the HR Technology Intensity (HRTI) variable originally developed for this dissertation, it can be argued that it also measures the level of automation of the HR function in the firm, as firms that have automated their HR sub-functions aggressively will have a higher score than those that have

only programmed a few[19]. In fact, as Table V.1 shows, the correlation between these two measures is moderately high and significant ($\rho = .50$; $p < .001$), adding support to the idea that these variables are similar and related, although not as much as one might expect. One explanation for this may be that formal HR-technology strategies were not well developed across responding firms. Watson Wyatt (2002b) found that less than one-fifth of the companies surveyed had implemented a formal strategy for HRITs. Those that had done so reported superior performance on key performance measures. If that argument holds in this sample too, then many respondents may have made considerable investments in HRIT initiatives but failed to coordinate their combined capacity. On the other hand, it could also be that companies base their automation decisions primarily on transaction volume or its accompanying competency requirements (e.g., applicant tracking and testing) instead of systematically automating entire HR sub-functions. This should also translate into lower correlations between these two variables (Florkowski & Olivas-Luján, 2003).

Table V.7 shows the results for this complementary hierarchical regression model. Similarities between this table and Table V.4 (the regression models for HRTI, the original dependent variable) are striking. In both models, the log transformation of Worldwide Employees obtains a large and significant coefficient, as also do Top Management Support and HR Innovation Climate, but not any other environmental, organizational, or user-departmental variables. The only difference is that HR-IS Relationship in this model did not reach significance levels ($p = .520$). As in the previous models, no outliers were found using Mahalanobis distance tests and all VIF scores remained below 2, well below the flag score of 10 (Neter et al, 1990). Also as in previous sections, the final number of cases used in the equation ($n = 100$) is lower than the number of data points available for this measure ($n = 112$). This is due to the selection of listwise deletion of missing values, to maximize stability in estimators.

[19] I thank Dr. G. Florkowski for suggesting this set of tests for the dissertation model.

Table V.6 Hierarchical Regression on HRTI for Companies where IS Does Not Share Primary Responsibility for HRITs

	Variables	B	R^2	Adjusted R^2	R^2 Change	F Change
Control Variable	Constant	-34.91				
	Log of Worldwide employees	9.19***	.35	.33	-	21.17***
Step 1	Environmental Factor					
	Environmental Turbulence	.14	.35	.31	.01	.10
Step 2	Organizational Factors					
	Top Management Support	1.82				
	Uniqueness of HR Practices	3.51	.38	.31	.03	.88
Step 3	Departmental Factors –User (HR) Function					
	HR Innovation Climate	10.37*				
	HR IT-Absorptive Capacity	-3.66				
	HR-Technology Champion	8.50*	.58	.49	.20	5.41**
Step 4	Departmental Factors –IS Function					
	IS HR-Technology Resource Availability	3.67				
	HR-IS Relationship	-.98	.60	.49	.03	1.01

Notes: n = 42. Significance: † $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Table V.7 Hierarchical Regression Results for the Sum of Percentage Penetration of IT for HR Areas

	Variables	B	R^2	Adjusted R^2	R^2 Change	F Change
Control Variable	Constant	57.54				
	Log of Worldwide employees	25.46**	.08	.07	-	8.29**
Step 1	Environmental Factor					
	Environmental Turbulence	.86	.08	.06	.003	.26
Step 2	Organizational Factors					
	Top Management Support	20.67*				
	Uniqueness of HR Practices	5.21	.12	.08	.04	2.20
Step 3	Departmental Factors –User (HR) Function					
	HR Innovation Climate	42.10**				
	HR IT-Absorptive Capacity	3.52				
	HR-Technology Champion	19.95				
	Departmental Factors –IS Function					
	IS HR-Technology Resource Availability	-7.01				
	HR-IS Relationship	-7.62	.23	.15	.10	2.41*

Notes: n = 100. Significance: † $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

On the whole, the correspondence among these regression models provides evidence to support the claim that the HRTI index and the Sum of Percentage Penetration of IT in HR are converging, complementary dependent variables. They both seem to be related to the same set of predictors. Finally, even though their correlation coefficient reached moderate levels (.50), they do not overlap as strongly as it could have been expected, giving added relief in that two theoretically convergent measures show harmonizing empirical results.

C. SUMMARY

Table V.8 summarizes the results from this chapter. After running nation-based models, I made the decision to group both the US and Canadian samples to maximize statistical power, given the minimal differences found between them. I found empirical support for Hypothesis 2a (on a positive relation for HRTI and Top Management Support), Hypothesis 3a (positive relation between HR Innovation Climate and HRTI) and Hypothesis 4b (HR-IS Relationship mediating the effect of HR Innovation Climate on HRTI when HRIT Governance includes the IS Function). In contrast, Hypothesis 1 (on Environmental Turbulence) did not receive statistical support, and neither did Hypothesis 2b (on Uniqueness of HR Practices), nor Hypothesis 3b (on HR-IT Absorptive Capacity). Finally, although Hypothesis 3c (on HR Technology Champion) and Hypothesis 4a (on HR-IS Resource Availability as moderated mediator) exhibited correlations that are consistent with theoretically derived expectations, regression analyses results showed no support for those relationships when the effect of other variables is simultaneously taken into consideration. I discuss implications of these results in the following chapter.

Table V.8 Summary of Results for Hypotheses Testing

Hypothesis	Correlation coefficient	Regression coefficient	Support?
1. Environmental Turbulence is positively related to HRTI	-.19†	-.34	No, with neither dependent variable
2a. Top Management Support positively related to HRTI	.31***	6.62***	Yes, in both analyses, including ancillary variable
2b. Uniqueness of HR Practices, negatively related to HRTI	-.05	-3.31	No, with neither dependent variable
3a. HR Innovation Climate, positively related to HRTI	.17†	7.78**	Tentative in correlation analysis, and strong in hierarchical regression, including ancillary variable
3b. HR IT Absorptive Capacity, positively related to HRTI	.08	-1.30	No, with neither dependent variable
3c. HR Technology Champion, positively related to HRTI	.18*	.40	Only in correlation analysis; no regression support with either dependent variable
4a. HR IS Resource Availability mediates HR Function factors to HRTI, when locus of responsibility includes the IS Function	-.24* .24 [a]	3.67	The negative sign in correlation analysis contradicts theoretical prediction but hierarchical regression does not confirm this result using either of the dependent variables
4b. HR-IS Relationship mediates HR Function factors to HRTI, when locus of responsibility includes the IS Function	.42*** .16 [a]	9.20** 1.32 [a]	Yes, in both analyses

Notes: Significance: † p ≤ .10; * p ≤ .05; ** p ≤ .01; *** p ≤ .001.

[a] Coefficients calculated only on firms that do not include the IS Function in the locus of responsibility for HR-Technology

VI. CONTRIBUTIONS, LIMITATIONS, AND FUTURE RESEARCH

This concluding chapter offers an informed interpretation of the results from the previous chapter. More concretely, the following sections detail: (a) the perceived contributions made by this dissertation, (b) the limitations that readers should have in mind to fairly assess such contributions, and (c) suggestions for future research.

A. CONTRIBUTIONS

As with most Business Administration dissertations, this research has two main stakeholders or target markets: business scholars and business practitioners. The former constitute a primary audience for this work, given the need to use the scientific method to add to the current knowledge base of the discipline. The latter are the raison d'être for business schools and their educational and research activities. By identifying the contributions in terms of their implications to these stakeholders, it is expected that the value of this research will be made more evident.

This research has utilized a Diffusion of Innovations (DOI) framework to explain the intensity with which Information Technology is being used in Human Resource departments in Canada and the USA. Although the use of the DOI framework in the Human Resource Information Systems area seems to be a novelty, its deployment in a variety of areas (from agriculture to biology, including Information Systems and other business disciplines; cf. Rogers, 2003) legitimizes its use in this research. In fact, Prescott & Conger (1995), after reviewing about ten years of research in IT, found that DOI theory seems more adequate for innovations

with an intra-organizational locus of impact than for innovations with other loci of impact (namely, the IS unit or inter-organizational loci).

Another notable feature of this project has been the use of an aggregated measure – Human Resource Technology Intensity or HRTI—which, according to Fichman (2001) should increase the generalizability of its findings. This measure was developed specifically for this study, using solid precedent from the HR (cf. Fiorito, Jarley, and Delaney, 2000; Huselid, 1995; Koch and McGrath, 1996; MacDuffie, 1995; Youndt, Snell, Dean, and Lepak, 1996) and MIS literatures (cf. Fichman and Kemerer, 1997; Grover, Fiedler, and Teng, 1997; Ravichandran, 2000). In sum, this research has been crafted using solid scientific precedent both in theory and operationalization, features that should be appealing primarily to business scholars.

At the same time, there could be alternative operationalizations that might yield more parsimonious or more fine-tuned results when using this multidimensional variable. For example, using a dichotomous, instead of a four-stage assimilation coding might yield different results from the ones reported here. It is possible that anything short of general deployment of the HRITs has little practical significance in terms of really incorporating IT in HR processes, and that might be a more essential issue to be studied. Other psychometric improvements beyond collapsing assimilation stages might include weighting or bundling of HRITs. Weights might be useful –for example—to better capture differences involved in adopting technologies that are dissimilar in costs, levels of difficulty in implementation and administration, etc. In a similar venue, the fact that some vendors are packaging options together (e.g., HR software suites increasingly are adding self-service modules to their product offerings) might require aggregation or bundling by technology types or commercially available offerings. Finally, empirically using typologies as the ones described in Chapter II (e.g., Swanson's or Prescott & Conger's) or others that meaningfully group technologies by intended users or the nature of the transaction purposes (e.g., some technologies might be needed for standardizing processes,

others for tailoring practices, others for improving interaction between HR and its clients) could draw intellectually interesting and practically significant resources.

As for the second audience targeted by this work –business practitioners—, it can be stated that the subject matter or topic of this dissertation (information technologies for the Human Resource function) has been gaining greater practical importance. Computer technology has advanced to the point of being able to manage the large and complex amounts of information that in the past made it so difficult for HR departments to profit from automation. In addition, the ubiquity of technology-mediated communications, aided by self-service modes of operation (i.e., the fact that users –whether employees or managers—of the HR ITs are able to generate their own transactions with little or no intervention of HR staff) has been increasing the efficiency of organizations that use HRITs. This dissertation identifies certain factors that affect the assimilation of such technologies; consequently, the results should be of particular interest to HR professionals, to HRIT providers and to the business community in general.

A surprising result in this project was the fact that Environmental Turbulence showed no significant relationship to either of the dependent variables (HR Technology Intensity or the sum of Percentage Penetrations of IT for HR). In fact, the correlation coefficient that almost reached statistical significance had a sign opposite of what was theoretically predicted, as if Turbulence was negatively related to HRTI. More research is needed on this area, to clarify whether this result was an empirical anomaly, or (as suggested in the previous chapter) there are factors specific to the HRTI assimilation and the Sum of Percentage Penetration of IT –the ancillary dependent variable—that make them resilient to environmental shocks.

At the organizational level, as expected, support from Top Management was found strongly related to HRTI –and also to the sum of Percentage Penetrations of IT for HR—but that was not the case for the Uniqueness of HR Practices. The former result increases confidence that this study and its findings belong in the DOI and related Organizational Theory literatures. This is also a finding of great importance for practitioners, as it becomes clear from the strong

correlations and regression coefficients that Top Management endorsement of ITs in the HR department is vital to HR Technology Intensity and to the penetration of automation in the different HR sub-functions. Inability to secure this support might severely hamper the use of HR technologies and consequent realization of their advantages to the firm. No empirical support was found for Uniqueness of HR Practices; while some alternative explanations have been advanced in the previous chapter, it is clear that further research on this area is warranted.

At the Departmental level, also in consistence with well-established research streams (e.g., Schneider and Bowen, 1985; Schneider, 1990), having an HR Climate for Innovation received statistical support, particularly in multivariate regression analyses. Both HRTI and the ancillary dependent variable –the sum of Percentage Penetrations of IT for HR—offered strong statistical support for the notion that those HR departments where employees perceive automation as important for the organization will have higher levels of Technology Intensity. An implication for practice is that not only top managers matter in the use of ITs within the HR department: it is also important that employees perceive the use of technology as crucial for their organization. This might even be of greater consequence for technological innovations as it is not unusual for people to feel their jobs threatened when automation starts in an organization. Whether the presence of a favorable HR Climate for Innovation correlates negatively with perceived threats of job loss is an empirical question worthy of future investigation. Yet another implication for practice could be the issue of managerial actions that positively affect the HR Climate for Innovation. It is currently unclear the extent to which training, participation, involvement, or other managerial behaviors contribute in shaping employees' expectations toward achieving a favorable climate. Managers would be well-advised to use such actions if they are to maximize their organizations' receptiveness of HRIT. Researchers should delve into the specific actions that best contribute to maximize such an organizational climate in the most efficient manner. The IS literature is replete of studies and anecdotal accounts showing that unreceptive organizations may render technological

investments a useless expense; companies cannot afford to invest the money, time and additional resources to bring in technologies that are not going to be used as intensely as it is favorable for its objectives.

On the other hand, it was surprising to find no support for the relationship between HR IT Absorptive Capacity and HRTI, and only correlational support for the existence of an HR Technology Champion. On the first construct, it might be that absorptive capacity is a contributing construct in the case of organizational tasks where there is less structure and more need for creative, idiosyncratic solutions than it would be the case for the automation of HR practices. It could also be that the need to use HR ITs is so large in the firms from the sample, that knowledge factors internal to the user departments are less influential than the executive decision (in the form of Top Management Support) or the departmental endorsement (through an organizational climate that's favorable for HR Technology Innovations). More research is required to assert whether departmental Absorptive Capacity is required under less structured circumstances than the use of IT for the HR function would involve.

Another post-hoc explanation rests on the operationalization and content domain of this construct. Scale items are phrased in such a way that HR IT Absorptive Capacity is measured as "residing" in HR personnel, particularly Senior HR Executives. It is possible then, that the scale used in this research did not appraise the construct adequately, perhaps even that theoretical work in this area needs more development in its content domain. With the recent emergence of ASPs (Application Service Providers), it is possible that companies are now in a position to "buy" the knowledge necessary to implement and manage their HRIT needs from these firms, as suggested by Lepak & Snell (1998) in their work on "Virtual HR" reported in Chapter I. ASPs might be substitutes or enhancers of organizational capabilities related to HR (and other functional) Information Technologies. As a last point, it might also be interesting to investigate whether inter-organizational alliances are part of the HR Function that contribute to its IT Absorptive Capacity.

With respect to the HR Technology Champion construct, more work seems to be needed to better explain the lack of support for this hypothesis. Only using bivariate statistics –but not multivariate analyses—the data seemed to endorse the theoretical inference. Additional, post-hoc regressions only weakly supported the notion that the presence of the HR Innovation Climate in the equation had washed away the effects of the HR Technology Champion. Perhaps trying to circumscribe the presence of the HR Technology Champion within the HR department unnecessarily confounded the model; it might be that the champion needs not be located within the HR Department, although it might have been the most intuitively appealing choice. It is quite plausible that HR Technology Champions could be found in the IS Function or even in other functional areas (e.g., Finance) that use the services intensely and might benefit from a more automated HR service delivery. Psychometric scales adapted to control for these possibilities should be incorporated in measuring the presence of champions in future organizational research. Clearly, the last word on whether the presence of such champions influences HRTI in the firm still needs to be written.

All in all, this dissertation has tested several constructs that have received recent scholarly attention from different factors documented in the DOI literature. A quite innovative data collection design was utilized successfully –an Internet-based questionnaire—on a sample that is well known to consistently have very low response rates: Human Resource executives. It is expected that these results help both extend the existing research frontier, and understand important practical implications of using Information Technologies in HR departments. However, no research study is perfect; now follow some limitations that should be kept in mind when reading this report.

B. LIMITATIONS

There are three important aspects that suggest that generalizing findings beyond this sample should be done with caution: the sampling method, the world region that originated

these responses, and the response rate. Firstly, the sampling method was not truly random. Firms that responded had to be members of SHRM or IHRIM, or subscribers to the Canadian HR Reporter. This might bias the sample in the direction of the more successful companies, giving little or no voice to those firms that have less resources or less professionalized an HR function as to have paid memberships in those organizations. Secondly, the fact that only Canadian and US firms were included in the study opens the possibility that firms from other countries might be affected differently by these factors, or that other factors not included in this study might be more relevant, particularly those firms located in countries that are in less advanced technological stages (e.g., emerging economies or countries where other regulatory and social factors exist that impede the aggressive automation that characterizes the countries in this investigation). Thirdly, while the response rate compares favorably with similar studies (as reviewed on Chapter IV), the possibility that the population parameters are different to those obtained in this study cannot be discarded.

Another limitation of this research is that it is based on answers from the companies' "best-respondents" instead of having more varied sources for the data. Organizational researchers who have debated the virtues and defects of this type of studies (cf. Gerhart, Wright, McMahan & Snell, 2000; Huber and Power, 1985) seem to agree in that, while less than desirable, this research design is still of great value, particularly in areas where there is so little known, as is the case on the topic of this project.

A final limitation that readers should keep in mind relates to the data collection method. While the extant literature supports the view that Internet-based surveys are equivalent –or even preferable—to paper-and-pencil ones, it is not impossible that other issues showing involuntary biases might be discovered in the future. The contact regime used with participants might also have affected the types of responses received, as an argument can be made that it favored technologically inclined executives. Clearly, more research is necessary to optimize the use of

web-based questionnaires that, having so many advantages (as detailed on Chapter IV), are not likely to fade away, in spite of the inherent technical and social difficulties.

C. FUTURE RESEARCH

As with all novel research streams, exciting avenues for future research are many. Speculations from Section A and elaborations from Section B in this Chapter already have hinted future research opportunities. To specify only a few that come directly from the sections above, Environmental Turbulence measures might need more empirical work to show the relationships suggested by theory; also, further exploring the ways in which technologically-based data collection methods affect the results is a much needed research area.

Additionally, replicating and extending this research design to other countries is an endeavor that should be productive to test the generalizability of findings here reported. The work of Child (2000) and also that of Cheng (1989) could be helpful in guiding international extensions to this project in ways that might advance our understanding of this issue more efficiently. They suggest that the choice of nations or samples for international organizational research should be guided by the contexts that could be expected to affect the phenomena under study. In this line, extending this research for example to countries that use other languages natively (not English) might help us understand whether and to what extent this is an important consideration in explaining the diffusion of ITs in HR departments. A related example would be selecting nations that socio-economically are in different stages of development, again to examine if these are issues that drive strongly the use of such technologies and how these influences compare to other documented influences such as culture or the types of technologies (Kedia & Bhagat, 1988; Bhagat, Kedia, Harveston & Triandis, 2002).

Also important, the addition of other factors not included in the model might be a worthwhile venture. While the model examined here never pretended to be exhaustive, the selection of specific constructs was guided more by how recently the research stream had been

published than by an expectation that some of these constructs would be more important than the others, as the tests of the hypotheses (see Chapter V) ended up suggesting. The explanatory power of other constructs not included in the model hereby tested should be empirically examined and compared with the results from this dissertation if the knowledge frontier in this area is to be advanced.

The inclusion of outcome constructs, both for the functions involved (IS and HR) and for the organizations at large should prove a valuable research endeavor. For example, a recent consultant report (Watson Wyatt, 2002b) suggests that firms with more automated HR functions are not necessarily those with the best HR performance. Future research should examine this claim carefully and with scientific rigor, perhaps seeking to identify factors that might affect organizational outcomes (e.g., IS planning, organizational acceptance of the technologies, etc.).

In a similar frame of mind, as Florkowski and Olivas-Luján (2003) state, extending this methodology to individual business units might prove to be a very valuable research thrust. Examining *intra*-firm diffusion patterns, it would be possible to better understand where HRITs have spread and how long they have been operating in particular segments of the organization. This knowledge, in turn, can better shape the appropriate scope (i.e., business unit, divisional, regional, or company-wide) for metrics to assess the impact of these innovations. International business research should gain from this practice too. Examining the extent and rate of HRITs' cross-border diffusion within multinational enterprises (MNEs) would make clear the comparative difficulty of expanding use from domestic to international operations. This line of inquiry would be consistent with increasing academic interest in the transnational transfer of strategic organizational practices (e.g., Kostova, 1999; Martin & Beaumont, 1998).

There is an even more pressing need to document the effects that HRITs have on HR staff, the larger HR function, and the firm. How likely is it that HR's internal customers will embrace and use IVR systems, HR intranets, ESS/MSS applications, or HR portals? The MIS literature has much to offer in explaining the dynamics of technology acceptance by individual

users. What impact does the automation of HR transactions have on HR staff? Do attitudes like job satisfaction, organizational commitment and professional commitment improve because less time is consumed performing mundane tasks, or is there heightened work stress, job insecurity, and intentions to leave in the face of perceived changes in competency requirements? Does the productivity of HR staff actually increase as service delivery becomes more technology intensive, and is the relationship linear? Answers to these questions would facilitate more effective change strategies for HRITs and more accurate cost-benefit analyses when trying to develop the business case for their introduction.

Similarly, is there evidence that information technology has increased the HR function's power or led to greater strategic involvement in business decision-making? What strategies are most effective in repositioning the function and its staff to competently execute transformational roles in the aftermath of HRIT assimilation? Do HRITs positively impact the firm's talent management activities (e.g., elevating interest among job seekers by projecting a labor-market image of being “technologically savvy;” strengthening retention by fostering perceptions of empowerment or better work-life balance)?

As technology becomes an increasingly vital component of HR service delivery, researchers must expand their efforts to understand the opportunities and threats that it fosters. Human-resource information technologies may be a key enabler allowing HR professionals to successfully balance the competing roles of administrative expert, employee champion, change agent, and strategic partner (see Ulrich, 1997). There also is a risk that large investments in IT will not improve internal customer satisfaction or render the HR function a more efficient cost center. This may be an outgrowth of low technology-acceptance among intended users, inappropriate technology choices, or other factors. Until we know more, investments in these innovations should proceed with caution.

D. CONCLUDING REMARKS

This dissertation found empirical support for several of the theoretically developed hypotheses on the use of Information Technologies for the Human Resource function. It offers some contributions to the extant literatures on HR and MIS. It also shows the appropriateness of the DOI framework for studying this organizational phenomenon. Finally, it details some implications that should be valuable for both practitioners and researchers interested in the use and diffusion of information technologies for the human resource function.

APPENDICES

APPENDIX A

VARIABLES, OPERATIONALIZATION, AND SOURCE

Table A.1 Variables, Operationalization, and Source

VARIABLE	DEFINITION	SCALING	SOURCE
Predictors	**Environmental Factors**		
Environmental Turbulence	The extent to which major environmental dimensions affecting firm competitiveness have changed	Respondents will be asked to assess the extent to which each of the following environmental factors has (1) impacted on their firm's competitiveness, and (2) changed over the last 5 years: • Availability of qualified employees • Cost of hiring and retaining qualified employees • Government regulation • Customer relations • Supplier relations • Technology Responses on each scale can range from 'none' to 'extensive'. The 2 scores for each factor will be multiplied and then summed across factors to create a single index value reflecting overall turbulence	Adapted from Jones, Rockmore & Smith (1996)

Table A.1 (continued)

VARIABLE	DEFINITION	SCALING	SOURCE
	Organizational Factors		
Top Management Support for HRT	The extent to which executives support, participate in, and give priority to utilization of HR-technologies	Six-item Likert scale with responses ranging from 'strongly disagree' to 'strongly agree' • Top management participated in the development of the information technologies we use in our HR operations • Top management maintains regular contact with the sponsor(s) of IT use in our HR operations • Resource support is high for the adoption and diffusion of IT in our HR operations • Top management perceives that it is important to utilize IT in our HR operations • Top management provides constructive feedback on the use of IT in our HR operations • The utilization of IT in our HR operations is regarded as a high priority by top management	Adapted from Rai & Bajwa (1997)
Uniqueness of HR Practices	The extent to which HR practices in the firm are seen as idiosyncratic or unique	Four-item Likert scale with responses varying from 'strongly disagree' to 'strongly agree' • Our HR practices are tailored to fit the nature of our business operations • Solving HR problems here requires knowledge of our business strategy • In this firm, you have to understand the history and culture before you can help solve HR problems • You can't solve HR problems here unless you know our business	Klaas, McClendon & Gainey (2001)

Table A.1 (continued)

VARIABLE	DEFINITION	SCALING	SOURCE
	User (the HR Function) Factors		
HR Department's Innovation Climate	The extent to which the HR department places an emphasis on innovation	Seven-point Likert scale with responses ranging from 'strongly disagree' to 'strongly agree' In my firm, the HR department: • recognizes and rewards new ideas from HR staff • and its staff generally display flexibility and adaptability • and its staff generally display a willingness to take risks • and its staff generally display tolerance of failure of new ideas • is always moving toward the development of new answers • staff provides practical support for new ideas and their application	First four items: Tannenbaum & Dupuree-Bruno (1994) Last two items: Anderson & West (1998)
HR's IT Absorptive Capability	Assessment of how technologically oriented the HR personnel in the firm is	Seven-point Likert scale ranging from 'strongly disagree' to 'strongly agree' In my firm, senior HR executives: • have a long history of interacting directly with the IS department • possess considerable first-hand experience working on IT projects • and HR managers have sufficient IT awareness to recognize available telephony and web-based applications that could benefit the HR department • Collectively, the HR professionals in my firm (including HRIS staff) have sufficient IT competencies to independently implement telephony and web-based applications for the HR department	Derived from Sambamurthy & Zmud (1999), Cohen & Levinthal (1991), Boynton, Zmud & Jacobs (1994)

Table A.1 (continued)

VARIABLE	DEFINITION	SCALING	SOURCE
HR-Technology Champion	Existence of an person championing the use of HR Technology in the department	Seven-item, seven-point Likert scale with responses ranging from 'strongly disagree' to 'strongly agree' • It is easy to identify one (or more) person(s) that has (have) been instrumental in the automation of the HR services in this firm The level of IT in our HR operations can be attributed to: • the vision of key person(s) in HR • enthusiastic promotion by key person(s) in HR • the ability of key person(s) in HR to get top-level support • ability of key person(s) in HR to get the right people involved in its implementation • the problem-solving skills of key person(s) in HR • the tenacity of key person(s) in HR in overcoming obstacles	Derived from Beatty (1992) and Howell & Shea (2001)

Table A.1 (continued)

VARIABLE	DEFINITION	SCALING	SOURCE
	IS Function Factors		
IS HR-Technology Resources	Extent to which the IS function has resources to effectively service the HR department	Seven-point Likert scales, ranging from 'strongly disagree' to 'strongly agree' • The IS function's financial constraints have made it difficult to offer as much training for using HR systems as needed. (r) • Because of the department's financial constraints, implementation team members for HR applications have been unable to devote as much time as needed to its implementation. (r) • Financial pressures have caused our IS department to rush ahead with the implementation of HR applications before they were really ready. (r) • In this IS function, money has been readily available to support activities related to the implementation of HR applications. • We have had to implement HR applications on a tight budget. (r) • This IS department can't afford to pay for all the HR applications, consulting, and education needed to implement them effectively. • Adequate funds are available to finance this firm's HR applications implementation effort.	Adapted from Klein, Conn, and Sorra (2001)

Table A.1 (continued)

VARIABLE	DEFINITION	SCALING	SOURCE
HR-IS Relationship	Characterization of the overall relationship between the IS and HR departments	Seven-point Likert scale, ranging from 'strongly disagree' to 'strongly agree' • How informed is the IS team about HR operations? • How informed is the IS team about HR strategies? • In this organization, HR ideas are given due attention in IT planning and implementation • The IT specialist-HR user relations in our firm are constructive	Derived from Boynton, Zmud & Jacobs (1994), and from Karimi, Gupta & Somers (1996)

Table A.1 (continued)

VARIABLE	DEFINITION	SCALING	SOURCE
Dependent Variables			
HR-Technology Intensity	The cumulative presence of IT in the infrastructure for HR-service delivery to internal customers	$\sum_{i=1}^{8} IT_i p_i$ *such that* $IT_i = j$ where: IT_i = an HR information technology (8 types of Information Technologies are examined in this study) (1) Functional HR applications (2) HR Integrated Voice Response (IVR) telephony applications (3) HR intranet applications (4) Employee Self-Service (ESS) applications (5) Manager Self-Service (MSS) applications (6) HR extranet applications (7) HR portal applications (8) Wireless HR services j = assimilation stage for IT_i (5-point Guttman scale) 0 = not acquired 1 = acquired 2 = commitment/approval to deploy 3 = limited deployment (less than 25 %) 4 = generalized deployment (25 % or more) p_i = penetration; number of functional areas in HR where t_i has been deployed or there are formal plans to deploy it (in the case of commitment/approval assimilation stage)	Created for this study, consistent with aggregated measure of IT-innovation (Fichman, 2001; Fiorito, Jarley & Delaney, 2000), Technology diversity (Grover et al., 1997; Fichman & Kemerer, 1997); Intensity of TQM adoption in IS development (Ravichandran, 2000); HR sophistication (Koch & McGrath, 1996; Huselid, 1995; Delaney et al., 1996), and HR-bundles (MacDuffie, 1995)

Table A.1 (continued)

VARIABLE	DEFINITION	SCALING	SOURCE
Sum of Percentages of Penetration of HR Technologies	Addition of reported percentages of penetration of ITs for different HR sub-functions	For each of the following areas, please estimate the percentage of work transactions the HR function is responsible for that has been automated with Information Technology: (1) Recruitment (job postings, résumé intake/ management, etc.) (2) External selection (applicant tracking, screening, testing) (3) Training & development (overviews, registration, e-learning) (4) Compensation administration (salary adjustments, job evaluation, surveys) (5) Benefits administration (enrollments, planning, modeling) (6) Performance management (goal setting, appraisals, skills tracking) (7) Career management (succession planning, career planning (8) Compliance management (demographic tracking, compliance reporting) The variable is the algebraic sum of responses (1) through (8)	Created for this research

Table A.1 (continued)

VARIABLE	DEFINITION	SCALING	SOURCE
Mediating Moderator			
Locus of Responsibility for HR-Technology	The extent to which the HR and IS functions control decisions pertaining to HR-Technologies	5-item scale with responses indicating the departmental locus of responsibility In this firm, • priorities for the development and implementation of HR-technologies are set by • standards for the computer hardware and software used for HR-technologies are set by • development activities for HR-technologies are performed by • primary responsibility for the operation and maintenance of HR-technologies resides with • the cost of activities associated with HR-technologies is charged to the budgets of Options to choose from: 1. The HR function 2. The IS function 3. Joint responsibility	Derived from Gordon & Gordon (2000) Sambamurthy & Zmud (1999)

Table A.1 (continued)

VARIABLE	DEFINITION	SCALING	SOURCE
Control and Descriptive Variables			
Firm Size	How large the firm is	Number of employees	
Industry	Type of industry in which the firm competes	Categories used: Agriculture, Manufacturing, Transportation, Mining, Pharmaceuticals / Life sciences, Energy / Public Utilities, Construction, Wholesale / Retail, Computers / Information Technology, Telecommunications, Financial Services, Management Services, Other.	
Home Country	Country where the company's headquarters is located	Canada, USA	
Respondent Information			
Contact information (optional, as this study is not at the ***individual*** level of analysis, but at the ***firm*** level, in addition to complying with IRB requirement)	Self-explanatory	Name, address, email, company, tenure, position, professional experience in HR, academic concentration, total work experience, time taken to answer web-based questionnaire Note: This information was necessary for: (1) sending respondents a copy of the study report as an incentive for their participation and (2) identifying and deleting less-than-appropriate responses (e.g., inappropriate respondents, responses generated too rapidly, etc.).	

APPENDIX B

SAMPLES FOR THREE-CONTACT COMMUNICATIONS PROTOCOL WITH RESPONDENTS

FIRST INVITATION LETTER

<Addressee>
<Street address>
<City, State, Zip Code>

Dear M. <Last Name>,

This letter is to request your help. You have been identified as a professional with expertise on Information Systems for Human Resources. I am in great need of your responses. I am a doctoral student from the Katz School of Business, in the process of writing my dissertation on Information Technology (IT) within Human Resource (HR) departments. Within the next week, I will send you an email message to request your participation in an on-line survey about the use of IT within your firm's HR (or Personnel) department.

Completing the survey should take you about 25-40 minutes online. To make the process simpler, I have programmed the web application to dynamically request only the information that is relevant to your department, as a function of your own responses. To start answering the survey, please open the following web-page using a recent web browser such as Netscape or Explorer:

www.eHRresearch.org

This study is important for at least three reasons. First, according to some recent industry reports (e.g., Watson Wyatt's or IDC's "eHR" reports), the use of information technology in HR functions is not easy to explain or justify from a business point of view. Second, during my studies, I have not found any rigorous, large-scale study about the use and consequences of Computer Technology within the HR profession; with your help, I believe I can fill this gap. This dissertation represents the conclusion of my doctoral program (already over five-year long!). Finally, about three weeks after the overall data collection is finalized, I will send study respondents a summary of the data, free of cost, as a token of appreciation. As an HR and/or IS professional, I hope this summary represents a valuable opportunity to benchmark your operations.

If another person in your company is better informed about the technologies for HR currently in use, or if you would rather not participate in this study, please call me or email me and I will not contact you again. Also, feel free to contact me if you have any questions. Thank you for your time and consideration. Only with the generous help of professionals like you can this research be successful.

Sincerely,

Miguel R. Olivas
Ph. D. Student
Tel: 412-648-1512 | Fax: 412-624-2875 | Email: molivas@katz.pitt.edu

P.S. Please accept the enclosed token of appreciation as a way of thanking you for your help.

Encl.

SECOND LETTER, SENT VIA E-MAIL WHEN ADDRESS AVAILABLE

Date: <System based date>
To: <HRISmgr@company.com>
From: <molivas@katz.pitt.edu>
Subject: Research on Information Technology for HR departments

Dear M. <Last Name>,

This message is to request your participation in an on-line survey about the use of Information Technology within firm's Human Resource departments. I hope you received the letter I sent you a few days ago to notify you about this study.

In case you did not (or might soon!) receive that letter, let me briefly tell you that I am working on a topic that has received little academic attention: the use of Information Systems in HR departments. I need your responses to complete my doctoral dissertation at the Katz School of Business (U. of Pittsburgh).

Completing the survey should take you about 25-40 min online. To make the process simpler, I have programmed the web application to dynamically request only the information that is relevant to your department, as a function of your own responses. To start answering the survey, please open the following web-page using a recent web browser such as Netscape or Explorer:

www.eHRresearch.org

For your convenience, a printable version of the survey is available on PDF (Adobe Acrobat readable) format, so you can send your responses by fax or regular mail in addition to via the Internet. I will send respondents a summary of the data, free of cost, as a token of appreciation, within three weeks of your response. I hope this summary represents a valuable opportunity to benchmark your HR-IS operations. Feel free to contact me if you have any questions. Thank you for your time and consideration; only with the generous help of professionals like you can this research be successful.

Sincerely,

Miguel R. Olivas
Ph. D. Student
Tel: 412-648-1512
Fax: 412-624-2875
Email: molivas@katz.pitt.edu

P.S. If you are not the most adequate person for answering this survey in your firm, please forward this message to the person you believe could best help.

THIRD LETTER, SENT BY 1ST CLASS MAIL AS LAST REMINDER

<Addressee>
<Street address>
<City, State, Zip Code>

Dear M. <Last Name>,

During the past few weeks, I have sent you a couple of mailings about an important on-line research study I am conducting about the use of Information Technology within Human Resource departments.

I am conducting this study because this is a topic that has received little academic attention; because the business consequences of automating the HR department are unclear; and (on a personal note) because I need your responses to complete my doctoral dissertation at the Katz School of Business (U. of Pittsburgh).

The study is drawing to a close, and this is the last contact that will be made with potential participants like yourself. I am sending this final note because of concern that people that have not responded may have had different circumstances than those who have. Hearing from everyone in this small sample helps assure that the research results are as accurate as possible.

Completing the survey should take you about 25 to 40 min online. To make the process simpler, I have programmed the web application to dynamically request only the information that is relevant to your department, as a function of your own responses. To start answering the survey, please open the following web-page using a recent web browser such as Netscape or Explorer:

www.eHRresearch.org

Please recall that, about three weeks after the data are collected, respondents will receive a summary of the data, useful for benchmarking their operations, as a token of appreciation. This report should be a valuable opportunity to benchmark your HR-IS operations.

I also want to assure you that your response to this study is voluntary, and if you prefer not to respond, that's fine. If you are not a professional in the HR and IS areas of your firm, and you think I have made a mistake by including you in the study, please let me know by sending at least a blank email to this letter. This would be very helpful, and your email address will only be used to correct the response rate for the study.

Finally, I appreciate your willingness to consider this request to help understand what drives the use of Information Technology and its consequences for HR departments. Thank you very much.

Sincerely,

Miguel R. Olivas
Ph. D. Student
Tel: 412-648-1512
Fax: 412-624-2875
Email: molivas@katz.pitt.edu

APPENDIX C

SCREENSHOTS OF WEB-BASED SURVEY INSTRUMENT

University of Pittsburgh

Welcome to the survey on the use of

IT in HR Departments

Thank you for participating in this web-based survey! It is only through the responses of professionals like yourself that we will be able to better understand what drives the use of Information Technology and its implications for Human Resource departments.

Click here to start answering! The questionnaire has been programmed to dynamically request only the information that is relevant to your department, as a function of your own responses. You should be done in about 25 to 40 minutes.

Are you ready to start? If so, click this button: Start Survey Here!

(If you don't have time to answer the survey now, you still have two options to help in this project:)

1. **Download a printable version of the survey (click here).** If you would rather answer the survey on paper, away from a computer or "during breaks", you may download and print a paper version, to fax or mail as described in the last page. Please be aware that this paper version ***looks*** much longer--in reality, you will answer the same questions on paper or on the Internet, but the web survey skips irrelevant questions for you.

2. **If you prefer a paper version** of the survey be sent to you by regular mail, please write your contact information in the following space, and I will send it to you as soon as possible (don't forget to include your name, mailing address and zip code):

Send Me a Survey by Mail

However you choose to send your responses, all answers will be held in the **strictest confidence** and will be used for **research purposes only**. Your contact information is requested on the last page of the survey to **send you a summary report** (so you can benchmark your operations) within three weeks of your response, but personal data will not be stored in the same place as your responses to the questions. There are no foreseeable risks associated with this project. The questions in the survey do not involve trade secrets or data that informed outsiders would not be aware of. Your participation is voluntary, and you may withdraw at any time.

If you have a question or comment, please contact me, **Miguel R. Olivas**; by phone: +1-412-648-1512, fax: +1-412-624-2875 (in the United States of America) or email: molivas@katz.pitt.edu

Dissertation Chairman: **Dr. Gary Florkowski,** Associate Professor of Business at the Katz School of Business, University of Pittsburgh.

This research has been reviewed and approved by the Institutional Review Board of the University of Pittsburgh, IRB # 020586.

katz
Graduate School of Business

University of Pittsburgh

Download the survey on the

Use of IT in HR Departments

Thank you for downloading this survey! (Please recall that this paper version ***looks*** much longer than the web-based survey--in reality, you will answer the same questions on paper or on the Internet, but the web survey skips irrelevant questions for you.)

For your convenience, three file formats are available for downloading:

1. **Download an "Acrobat Reader" (.pdf) version of the survey (click here).** You might prefer to open the survey using an "Adobe Acrobat Reader". The link above will start the process.

2. **Download a Microsoft Word (.doc) version of the survey (click here).** If you use Microsoft's popular word processor, clicking here will download a file named **(WWW)Survey_on_IT_in_HR.doc** to your computer. Please save this file on your Desktop or on a directory you remember easily, so you can later open it and print it.

3. **Download a "Rich Text Format" (.rtf) version of the survey (click here).** Most word processors are able to open this type of file. Clicking here will download a file named **(WWW)Survey_on_IT_in_HR.rtf** to your computer. Please save this file on your Desktop or on a directory you remember easily, so you can later open it and print it.

If you have a question or comment, don't hesitate to contact me:

Miguel R. Olivas
Phone: +1-412-648-1512
Fax: +1-412-624-2875 or
E-mail: molivas@katz.pitt.edu

Dissertation supervisor: **Dr. Gary Florkowski,** Associate Professor of Business at the Katz School of Business, University of Pittsburgh.

University of Pittsburgh

Thank you very much for your interest in answering the paper version of the survey on Information Technologies for HR departments! Within the next one or two days, you should be receiving it at the following address:

Joe Doe
Address here
City, State, Zip

If this information is incorrect, please click on your browser's "Back" button and make any necessary changes. I really appreciate your helpfulness. Thank you for visiting this research site!

Sincerely,

Miguel R. Olivas,
Ph. D. Candidate

Section 1 - Questions about your HR department, its technologies and management.

If you have any questions or run into any problems while answering this survey, please call **Miguel Olivas** at: +1-412-648-1512 (in the United States of America), fax +1-412-624-2875 or email: molivas@katz.pitt.edu

Please select the most accurate description of the following, with respect to your firm:

Primary responsibility for the operation and maintenance of HR technologies resides with:	-- Please Select --
If OTHER, please specify here:	
Priorities for the development and implementation of HR-technologies are set by:	-- Please Select --
Standards for computer software for HR-technologies are set by:	-- Please Select --
Development activities for new HR-technologies are performed by:	-- Please Select --
The cost of activities associated with HR-technologies is charged to the budgets of:	-- Please Select --
Which one of the following best describes the roles that the IS and HR top managers play in firm-level strategic planning?	-- Please Select --
Is there a formal strategy for HR-technologies in the firm?	-- Please Select -- If NO or UNSURE, please select your response from the answers, then click here to skip to the next table
Which one of the following best describes the firm's HR-Technology Planning (HRTP)?	-- Please Select --

What percentage of IS/HRIS staff time is actively spent on HR technology planning (if applicable)	-- Please Select --
Who participates actively in HR-technology planning?	-- Please Select --
What time horizon does your firm use for HR-technology planning?	years

Please indicate the degree of influence that the HR department has over company decisions regarding:

As you select your answers, the radio buttons in this column will be emptied	No Influence	Very limited Influence	Limited Influence	Moderate Influence	Extensive Influence
Development of new products or services	○	○	○	○	○
Expansion into new geographic markets	○	○	○	○	○
Strategic direction of the company	○	○	○	○	○
Major capital expenditures	○	○	○	○	○
Choice of strategic business partners or alliances	○	○	○	○	○
Workforce adjustments (i.e., downsizing, expansion, etc.)	○	○	○	○	○
Development of new employment policies and practices	○	○	○	○	○

To what extent are the following issues affecting the competitiveness of your company?

	No Impact	Slight	Moderate	Substantial	Extensive Impact
Availability of qualified employees?	○	○	○	○	○
Cost of hiring qualified employees?	○	○	○	○	○
Cost of retaining qualified employees?	○	○	○	○	○
Technology	○	○	○	○	○
Managing collective knowledge in the workplace?	○	○	○	○	○
Labor union strength?	○	○	○	○	○
Customer relations	○	○	○	○	○
Supplier relations	○	○	○	○	○
Employment regulations?	○	○	○	○	○
Government (other than employment) regulations?	○	○	○	○	○

To what extent have the following issues changed for your company, over the last 3 years?

	Very Negatively	Negatively	Not Perceptibly	Positively	Very Positively
Availability of qualified employees?	○	○	○	○	○
Cost of hiring qualified employees?	○	○	○	○	○
Cost of retaining qualified employees?	○	○	○	○	○
Technology	○	○	○	○	○
Managing collective knowledge in the workplace?	○	○	○	○	○

◉ Labor union strength?	○	○	○	○	○
◉ Customer relations	○	○	○	○	○
◉ Supplier relations	○	○	○	○	○
◉ Employment regulations?	○	○	○	○	○
◉ Government (other than employment) regulations?	○	○	○	○	○

In the delivery of HR services, does your company use:

	No Current Plans to Acquire	Evaluation or Trial Use	Purchased, Not Yet Deployed	Limited Deployment (< 25%)	Generalized Deployment (>= 25%)
◉ Separate HR application for distinct functional activities? (e.g., software programs for selection, performance appraisal, benefits, etc. that automate the personnel department but do not interact directly with employees)	○	○	○	○	○
◉ A fully integrated HR Software suite? (e.g., PeopleSoft Human Resources, mySAP Human Capital Management, Oracle, etc.)	○	○	○	○	○
◉ Interactive / Automated Voice Response (IVR or AVR; telephony-based) systems for HR-related transactions? (e.g., benefits enrollment, etc. using touch-tone phones or voice recognition)	○	○	○	○	○
◉ HR Intranets? (e.g., employee manual, e-training, etc.; delivered by way of a company computer network)	○	○	○	○	○
◉ Employee self-service (ESS) HR applications? (e.g., web-based personal data maintenance, paycheck services, retirement/financial services, etc.; applications for employees)	○	○	○	○	○

Manager self-service (MSS) HR applications? (e.g., web-based salary, career, succession management, etc.; applications oriented toward supervisors rather than employees)	○	○	○	○	○
HR Extranets? (Internet connections to vendor-based HR applications like investment or e-learning)	○	○	○	○	○
HR Portals? (personalized, one-web page access to various HR applications)	○	○	○	○	○
Wireless HR services? (HR services accessible through mobile devices like PDAs, cell phones, etc.)	○	○	○	○	○

To what extent has the use of IT in the HR department affected the following for HR staff members?

	Very Negatively	Negatively	Not Perceptibly	Positively	Very Positively
Professional commitment	○	○	○	○	○
Organizational commitment	○	○	○	○	○
Commitment to the HR department	○	○	○	○	○
Job satisfaction	○	○	○	○	○
Job security	○	○	○	○	○
Work stress levels	○	○	○	○	○
Group cohesiveness of HR staff	○	○	○	○	○
You are about:	30 % Complete		...	...	

If you have any comments about this page, please write them in this box (maximum of 255 characters).

Next Page

Would you like to see the whole survey?

You seem to have submitted very few responses to Page 1 in the Web Survey. Maybe you would like to see the whole survey before you answer it; maybe you clicked on the **"Next Page"** button unintentionally. Please choose from the following options:

- If you want to see the entire survey,
  Please click on this link to see downloading options
- If you want to start answering the survey now,
  Please click here to return to Page 1

Thanks in advance for your help! If you have a question or comment, don't hesitate to contact me:

Miguel R. Olivas
Phone: +1-412-648-1512
Fax: +1-412-624-2875 or
E-mail: molivas@katz.pitt.edu

Section 2 - Questions about HR in your firm.

If you have any questions or run into any problems while answering this survey, please call **Miguel Olivas** at: +1-412-648-1512 (in the United States of America), fax +1-412-624-2875 or email: molivas@katz.pitt.edu

You are about:	30 % Complete	...	...

Using the scale on the right, please indicate the degree to which you agree or disagree with the following statements:

As you select your answers, the radio buttons in this column will be emptied	Strongly Disagree (SD)	Moderately Disagree	Somewhat Disagree	Neither Disagree nor Agree	Somewhat Agree	Moderately Agree	Strongly Agree (SA)
This firm conducts detailed analyses of the ways that we can best use our IT capabilities to make HR more technologically intensive	○	○	○	○	○	○	○
In this firm, detailed analyses are conducted about how competitors are using their IT capabilities to make HR more technologically intensive	○	○	○	○	○	○	○
This firm conducts detailed analyses of the ways that emerging and breakthrough technologies could be utilized for HR purposes	○	○	○	○	○	○	○

◉Top management participated in the development of the IT's we use in our HR operations	○	○	○	○	○	○	○
◉Top management maintains regular contact with the sponsor(s) of IT use in our HR operations	○ (SD)	○	○	○ (N)	○	○	○ (SA)
◉ Resource support is high for the adoption and utilization of IT in our HR operations	○	○	○	○	○	○	○
◉It is important for top management that our operations utilize IT's	○	○	○	○	○	○	○
◉ Top management provides constructive feedback on the use of IT in our HR operations	○	○	○	○	○	○	○
◉The utilization of IT in our HR operations is regarded as a high priority by top management	○	○	○	○	○	○	○
◉In this firm, HR is involved in major strategic decisions	○ (SD)	○	○	○ (N)	○	○	○ (SA)
◉In this firm, HR helps make decisions about broader business issues	○	○	○	○	○	○	○

The IS department's financial constraints have made it difficult to offer needed training for use of HR technologies in this firm							
The IS department lacks sufficient funds to purchase suitable HR technology operations							
The IS department lacks enough resources to properly identify HR technology solutions							
Adequate funds are available to fund this firm's HR applications implementation efforts	(SD)			(N)			(SA)
It is easy to identify one (or more) person(s) that has (have) been instrumental in the automation of the HR services in this firm							
The level of IT in our HR operations can be attributed to the vision of key person(s)							

◉ IT levels in our HR operation can be attributed to enthusiastic promotion by key person(s)	○	○	○	○	○	○	○
◉ The use of IT in our HR function is partially because of the ability of key person(s) to get top-level support	○	○	○	○	○	○	○
◉ HR-IT's in this firm are partially due to the ability of key person(s) to get the right people involved in its implementation	○ (SD)	○	○	○ (N)	○	○	○ (SA)
◉ Problem-solving skills of key person(s) have increased our use of HR-IT's	○	○	○	○	○	○	○
◉ The tenacity of key person(s) in HR in overcoming obstacles has improved our use of HR-IT's	○	○	○	○	○	○	○
◉ Overall, managers in this company are <u>not</u> satisfied with the timeliness of HR services	○	○	○	○	○	○	○
◉ Overall, managers in this company are satisfied with the responsiveness of HR services	○	○	○	○	○	○	○

Overall, managers in this company are satisfied with the accessibility of HR services	(SD)			(N)			(SA)
Overall, managers in this company are <u>not</u> satisfied with the cost of HR services							
Overall, employees in this company are <u>not</u> satisfied with the timeliness of HR services							
Overall, employees here are satisfied with the responsiveness of HR services							
Overall, employees are satisfied with the accessibility of HR services							
Our HR practices are tailored to fit the nature of our business operations	(SD)			(N)			(SA)
Solving HR problems in this firm requires knowledge of our business strategy							
In this firm, you have to understand its history and culture before you can help solve HR problems							

◉You can't solve HR problems here unless you know our business	○	○	○	○	○	○	○
◉In this company, HR recognizes and rewards new ideas from HR staff	○	○	○	○	○	○	○
◉ The HR department and its staff display flexibility and adaptability	○ (SD)	○	○	○ (N)	○	○	○ (SA)
◉HR and its staff display a willingness to take risks	○	○	○	○	○	○	○
◉ The HR department and its staff display flexibility and adaptability	○	○	○	○	○	○	○
◉The HR department is always moving toward the development of new answers	○	○	○	○	○	○	○
◉ The HR department staff provides practical support for new ideas and their application	○	○	○	○	○	○	○
◉ Major competitors in our industry utilize high levels of information technology in their HR activities	○ (SD)	○	○	○ (N)	○	○	○ (SA)

Major firms in our geographic region(s) utilize high levels of IT in their HR activities							
The level of HR-technology present in our major competitors influenced this firm's decision to be more technologically-intensive in its HR operations							
HR technologies in other firms in our region influenced this firm's decision to use more technology for HR operations							
Senior HR executives have a long history of interacting directly with the IS department in this firm							
Senior HR executives possess considerable first-hand experience working on IT projects	(SD)			(N)			(SA)
Senior HR executives and HR managers have sufficient IT awareness to recognize available telephony and web-based applications that could benefit the HR department							

Collectively, HR professionals in this firm (including HRIS staff), have sufficient IT competencies to independently implement telephony- and web-based applications for the HR department	○	○	○	○	○	○	○
The IS team is well informed about the HR department's operations	○	○	○	○	○	○	○
The IS team is well informed about the HR department's long term vision	○	○	○	○	○	○	○
In this firm, HR ideas are given due attention in IT planning and implementation	○ (SD)	○	○	○ (N)	○	○	○ (SA)
The IT specialist-HR user relations in our firm are constructive	○	○	○	○	○	○	○

Please provide the following information about the company and the HR department:

Number of company employees in your country?	employees nationally
If a multinational, total number of full-time employees worldwide?	employees worldwide

Company's headquarters are located in:	-- Please select -- country
Total number of full-time HR staff in the firm	full-time HR staff
Percentage of HR staff classified as professionals or managers:	% professional HR staff
Percentage of HR staff classified as generalists:	% generalist HR staff
Full-time HRIS staff in the company:	number
Full-time IS staff in the company, dedicated to HR-systems support:	number
Onsite staff supporting HR-systems from IT vendors contracting directly with HR department	number
Onsite staff supporting HR-systems from IT vendors contracting directly with IS department	number
How frequently do you work with IS staff or managers during the course of performing your job?	-- Please select --
What is your company's primary industry?	-- Please select --
IF OTHER, please type here:	industry

If you have any comments about this page, please write them in this box (maximum of 255 characters).

Enter the Last Page!

Section 3 - Questions about HR Technologies.

If you have any questions or run into any problems while answering this survey, please call **Miguel Olivas** at: +1-412-648-1512 (in the United States of America), fax +1-412-624-2875 or email: molivas@katz.pitt.edu

You are about:	70 % Complete	...

Please answer the following questions with respect to the *software HR applications* for HR functional activities:

(e.g., software programs for selection, performance appraisal, benefits, etc. that automate the personnel department but do not interact directly with employees)

When did the firm acquire the first of these HR applications?	calendar year
What was the primary reason your company implemented HR applications?	-- Please select --
If OTHER, please type here:	reason
How successfully have the HR applications met their primary objectives?	-- Please select --
How are the HR applications sourced?	-- Please select --

Are the following functional activities assisted by these HR applications?

• Recruitment:	-- Select--	• Selection:	-- Select--
• Career Management:	-- Select--	• Compensation Administration:	-- Select--
• Benefits Administration:	-- Select--	• Performance Appraisal:	-- Select--
• Training & Development:	-- Select--	• Regulatory compliance:	-- Select--

If other activities are assisted by HR applications, please specify here: functional activities

Please answer the following questions with respect to the *fully integrated HR Software Suite* in your firm:

(e.g., PeopleSoft Human Resources, mySAP Human Capital Management, Oracle, etc.)

When did the firm acquire the HR software suite?	calendar year

What was the primary reason your company implemented the HR software suite?	-- Please select --
If OTHER, please type here:	reason
How successfully has the HR software suite met its primary objectives?	-- Please select --
How is the software suite sourced?	-- Please select --

Are the following functional activities assisted by the company's HR suite?

• Recruitment:	-- Select--	• Selection:	-- Select--
• Career Management:	-- Select--	• Compensation Administration:	-- Select--
• Benefits Administration:	-- Select--	• Performance Appraisal:	-- Select--
• Training:	-- Select--		

If other activities are assisted by the HR software suite, please specify here:	functional activities

Please answer the following questions with respect to the *Interactive (or Automated) Voice Response (IVR or AVR)* for HR-related transactions:

(e.g., benefits enrollment, etc. using touch-tone phones or voice recognition)

When did the firm acquire the IVR system for HR purposes?	calendar year
What was the primary reason your company implemented IVR for HR services?	-- Please select --
If OTHER, please type here:	reason
How successfully has the IVR system met their primary objectives?	-- Please select --
How is the IVR system sourced?	-- Please select --

Are the following functional activities assisted by the IVR system?

• Benefits enrollment:	-- Select--	• Training registration:	-- Select--
• Job applications from outside:	-- Select--		

If other activities are assisted by the IVR system, please specify here:	functional activities
Percentage of employees who can access IVR that use it at the level desired by the company:	-- Please select --

Please answer the following questions with respect to the *HR intranet*:

(e.g., employee manual, e-training, etc.; delivered by way of a company computer network)

When did the firm acquire the HR intranet?	calendar year
What was the primary reason your company implemented its intranet for HR services?	-- Please select --
If OTHER, please type here:	reason
How successfully has the HR intranet met its primary objectives?	-- Please select --
How is your company's HR intranet sourced?	-- Please select --

How do users access your HR intranet?

• Desktop or laptop access:	-- Select--	• Kiosk access:	-- Select--
If there are other ways employees access your HR intranet, please specify here:	functional activities		

Are the following functional activities assisted by the HR intranet?

• Benefits enrollment:	-- Select--	• Training and development:	-- Select--
• Online applications/job postings:	-- Select--	• Company employee manual:	-- Select--
If other activities are assisted by the HR intranet, please specify here:	functional activities		

Please answer the following questions with respect to the *Employee Self-Service applications (ESS)*:

(e.g., web-based personal data maintenance, paycheck services, retirement/financial services, etc.; applications for employees)

When did the firm acquire its ESS applications?	calendar year

What was the primary reason your company implemented its Employee Self-Service applications for HR?	-- Please select --
If OTHER, please type here:	reason
How successfully have ESS applications met their primary objectives?	-- Please select --
How are the ESS applications sourced?	-- Please select --

What actions can users initiate through the ESS applications in your firm?

• Personal data maintenance:	--Select--	• Paycheck services:	--Select--
• Benefits management:	--Select--	• Retirement/ Financial services:	--Select--
• Online job applications:	--Select--	• Training/ Competency development:	--Select--

If other activities are assisted by the ESS applications, please specify here:	functional activities
Percentage of employees who can access ESS applications that use it at the level desired by the company:	-- Please select --

Please answer the following questions with respect to the *Manager Self-Service applications (MSS)*:

(e.g., web-based salary, career, succession management, etc.; applications oriented toward supervisors rather than employees)

When did the firm acquire its MSS applications?	calendar year
What was the primary reason your company implemented its Manager Self-Service applications for HR?	-- Please select --
If OTHER, please type here:	reason
How successfully have the MSS applications met their primary objectives?	-- Please select --
How are the MSS applications sourced?	-- Please select --

What actions can managers initiate through the MSS applications in your firm?			
• Employee change actions & info:	-- Select--	• Management reports:	-- Select--
• Salary management:	-- Select--	• Career management:	-- Select--
If other activities are assisted by the MSS applications, please specify here:		functional activities	
Percentage of employees who can access MSS applications that use it at the level desired by the company:	-- Please select --		
Please answer the following questions with respect to the *HR extranet*: (Internet connections to vendor-based HR applications like pension administration or e-learning)			
When did the firm acquire its first HR extranet?		calendar year	
What was the primary reason your company implemented its HR extranet(s)?	-- Please select --		
If OTHER, please type here:		reason	
How successfully have the HR extranets met their primary objectives?	-- Please select --		
How are the HR extranet(s) sourced?	-- Please select --		
What actions can users initiate through the Extranet/s available in your firm?			
• Personal data maintenance:	-- Select--	• Paycheck services:	-- Select--
• Benefits management:	-- Select--	• Retirement / financial services:	-- Select--
• Training / competency development:	-- Select--		
If other activities are assisted by the HR extranet(s), please specify here:		functional activities	
Please answer the following questions with respect to the *HR portal*: (personalized, one-web page access to various HR applications)			

When did the firm acquire its HR portal?	calendar year
What was the primary reason your company implemented its HR portal?	-- Please select --
If OTHER, please type here:	reason
How successfully has the HR portal met its primary objectives?	-- Please select --
How is the HR portal sourced?	-- Please select --

What external links are provided to users through your HR portal?

• Information and resources about non-life concerns:	-- Select--
• External vendors offer discounts on personal goods and services:	-- Select--
• Work-related, external databases:	-- Select--
If other activities are assisted by the HR portal, please specify here:	functional activities

Please answer the following questions with respect to the *Wireless applications* for HR:

(HR services accessible through mobile devices like PDAs, cell phones, etc.)

When did the firm acquire its wireless applications (for HR)?	calendar year
What was the primary reason your company implemented its wireless applications for HR?	-- Please select --
If OTHER, please type here:	reason
How successfully have the wireless applications met their primary objectives?	-- Please select --
How are the wireless applications sourced?	-- Please select --

What HR actions can users initiate through the wireless applications in your firm?

• Personal data maintenance:	-- Select--	• Training / competency development:	-- Select--
• Paycheck / financial services:	-- Select--	• Benefits management:	-- Select--

If other activities are assisted by the wireless applications, please specify here:	functional activities
Percentage of employees who can access wireless applications that use it at the level desired by the company:	-- Please select --

For each of the following HR areas, please estimate the percentage of work transactions the HR function is responsible for that has been automated with Information Technology:

• Recruitment:	%	• External selection:	%
• Training & development:	%	• Compensation administration:	%
• Benefits Administration:	%	• Performance management:	%
• Career management:	%	• Compliance management:	%

The following set of questions deal mostly with your firm and your position:

In which area is your position formally classified?	-- Please select --
Which of the following best describes your position in the company?	-- Please select --
If OTHER, please type here:	level
When did the firm first implement client-server computing (for HR or any other purposes)?	calendar year (e.g., 1997)
When did the firm first implement telephony-based applications (regardless of function)?	calendar year
When did the firm first implement web-based applications (for HR or any other purposes)?	calendar year
When did the firm first implement wireless applications (regardless of function)?	calendar year

How long have you been working for this company?	years
Company's CUSIP number *(e.g., 594918)* or ticker symbol *(e.g., MSFT)*	(if applicable)
HR Expenditures for 2001:	sum
Currency: -- Select --	currency (if OTHER)
Firm-wide compensation -salaries and wages-expenses (2001):	sum
Currency: -- Select --	currency (if OTHER)
Firm-wide benefit expense (2001):	sum
Currency: -- Select --	currency (if OTHER)
Firm-wide training and development expense (2001):	sum
Currency: -- Select --	currency (if OTHER)
Total operating expenses (2001):	sum
Currency: -- Select --	currency (if OTHER)
Firm revenues in 2001:	sum
Currency: -- Select --	currency (if OTHER)
Firm absence rate (2001):	absence
Firm turnover rate (2001):	turnover
You are now:	99 % Done!
• Within three weeks, we will send you a summary of the data via a PDF file (readable using the Acrobat reader program or other PDF processors). **Please write down an e-mail address where you would like to receive it:**	e.g.: name.lastname@company.com
• Lastly, please write down your **Zip or Postal code, a comma and your last name or company name**, so we do **not send you a reminder:**	e.g.: {15260, Olivas} or {C7U 8I9, Nortel}

If you have any comments about this page, please write them in this box (maximum of 255 characters).

Click Here to Finish!

University of Pittsburgh

Thanks, but... Are you REALLY not interested in the Summary?

Apparently, you have entered an **invalid email address**. (You entered nothing, or no "@" symbol or no "." was found in the following string:)

As you are aware, you **DON'T HAVE TO** send us your email address to participate in the survey, so, feel free to close your browser window if you prefer not to correct this entry. However, we will only be able to send the **summary of the data to respondents** that *share their email address* with us. It is a token of our appreciation for your time, and we hope that it will provide valuable comparative information for your HR operation. (Allow us to restate that your responses will not be shared with anybody outside of this research project, and that your email address will be stored in a different place than your answers.)

So, this is a last opportunity to enter your email address. You have already earned our appreciation by submitting your responses in the last page, but we hope we can give you a useful summary of the data within about three weeks, as a way to thank you for your time and effort.

Email for the Summary

University of Pittsburgh

Thank you for participating in this research!

As a token of appreciation, you will receive a summary report of the data in this study within about three weeks.

All the information you have submitted will be kept confidential, in separate places from the rest of your responses and will not be shared with anybody outside of this research project.

If you have any questions or comments, do not hesitate to contact me:

Miguel R. Olivas,
Ph. D. Candidate
Email: molivas@katz.pitt.edu
Telephone: +1-412-648-1512
Fax: +1-412-624-2875

University of Pittsburgh

An unexpected event has occurred!

Unfortunately, the website survey found an unexpected event. An error report has been logged and an automated email has been sent to the webmaster, so that appropriate actions can be taken. Some typical reasons for getting this page are:

- The server may be down or overloaded. Please use the **"Back"** button on your browser, then click **"OK"** to attempt re-sending your answers, **OR** start over by clicking on the following link within a few minutes.
- If re-sending your information doesn't work, please take again the questionnaire, Clicking here. I sincerely apologize for the inconvenience.

Should the recommendations above not work, please contact me by:

- calling: +1-412-648-1512
- faxing: +1-412-624-2875 (in the USA), or
- emailing: molivas@katz.pitt.edu

I will do anything within my control to take your valuable responses. I appreciate your help and look forward to sharing the study findings with you.

Miguel R. Olivas
Ph. D. Candidate

APPENDIX D

SURVEY INSTRUMENT – DOWNLOADABLE PAPER VERSION

Survey on Information Technologies (IT) for Human Resources (HR)

Section 1. Questions about your HR department, its technologies and management.

Please cross (X) the most accurate description of the following, with respect to your firm:

1	Primary responsibility for the operation and maintenance of HR technologies resides with:	Information Systems Function	HR Function	Other: _____ please write in		
2	Priorities for the development and implementation of HR-technologies are set by:	Information Systems Function	HR Function	Joint IS-HR Committee	Other	
3	Standards for computer software for HR-technologies are set by:	Information Systems Function	HR Function	Joint IS-HR Committee	IS or Business units depending on standard	Other
4	Development activities for new HR-technologies are performed by:	Information Systems Function	HR Function	HR-led with IS involved	IS-led with HR involved	Joint IS-HR Committee
5	The cost of activities associated with HR-technologies is charged to the budgets of:	HR department	HR department and Business units	Business units		
6	Which one of the following best describes the roles that the IS and HR top managers play in firm-level strategic planning?	Neither the IS nor the HR executive participates formally	Only the IS executive participates formally	Only the HR executive participates formally	Both the IS and the HR executive formally participate	
7	Is there a formal strategy for HR-technologies in the firm?	Yes	No	Unsure	If No or Unsure, please skip to question 12	
8	Which one of the following best describes the firm's HR-technology planning?	HR-technology planning is addressed in IS planning	HR-technology planning is addressed in HR planning	HR-technology planning is a joint process involving IS and HR	HR-technology planning is independent of IS or HR planning	No explicit planning occurs for HR technologies
9	What percentage of IS/HRIS staff time is actively spent on HR technology planning (if applicable)	Less than 2 %	2-4 %	5-6 %	7-8 %	Greater than 8 %
10	Who participates actively in HR-technology planning?	IS staff only	HR staff only	IS and HR staff only	IS and HR staff and top management	
11	What time horizon does your firm use for HR-technology planning?	_____ years				

Please indicate the degree of influence that the HR department has over company decisions regarding:

		No Influence	Very Limited Influence	Limited Influence	Moderate Influence	Extensive Influence
12	Development of new products or services	1	2	3	4	5
13	Expansion into new geographic markets	1	2	3	4	5
14	Strategic direction of the company	1	2	3	4	5
15	Major capital expenditures	1	2	3	4	5
16	Choice of strategic business partners or alliances	1	2	3	4	5
17	Workforce adjustments (i.e., downsizing, expansion, etc.)	1	2	3	4	5
18	Development of new employment policies and practices	1	2	3	4	5

To what extent are the following issues affecting the competitiveness of your company?

		No Impact	Slight	Moderate	Substantial	Extensive Impact
19	Availability of qualified employees	1	2	3	4	5
20	Cost of hiring qualified employees	1	2	3	4	5
21	Cost of retaining qualified employees	1	2	3	4	5
22	Technology	1	2	3	4	5
23	Managing collective knowledge in the workplace	1	2	3	4	5

To what extent are the following issues affecting the competitiveness of your company?

		No Impact	Slight	Moderate	Substantial	Extensive Impact
24	Labor union strength	1	2	3	4	5
25	Customer relations	1	2	3	4	5
26	Supplier relations	1	2	3	4	5
27	Employment regulations	1	2	3	4	5
28	Government (other than employment) regulations	1	2	3	4	5

To what extent have the following issues changed for your company, over the last 3 years?

		Very Negatively	Negatively	Not Perceptibly	Positively	Very Positively
29	Availability of qualified employees	1	2	3	4	5
30	Cost of hiring qualified employees	1	2	3	4	5
31	Cost of retaining qualified employees	1	2	3	4	5
32	Technology	1	2	3	4	5
33	Managing collective knowledge in the workplace	1	2	3	4	5
34	Labor union strength	1	2	3	4	5
35	Customer relations	1	2	3	4	5
36	Supplier relations	1	2	3	4	5
37	Employment regulations	1	2	3	4	5
38	Government (other than employment) regulations	1	2	3	4	5

In the delivery of HR services, does your company use:

		No Current Plans to Acquire	Evaluation or Trial Use	Purchased, Not Yet Deployed	Limited Deployment (< 25 %)	Generalized Deployment (≥ 25 %)
39	Separate HR applications (software) for distinct functional activities (e.g., selection, performance appraisal, benefits, etc. so that HR activities are computer-aided)?	1	2	3	4	5
40	A fully integrated HR Software suite (e.g., PeopleSoft Human Resources, mySAP Human Capital Management, Oracle, etc.)?	1	2	3	4	5
41	Interactive / Automated Voice Response (IVR or AVR; telephony-based) systems for HR-related transactions (e.g., benefits enrollment, training registration, etc.)?	1	2	3	4	5
42	HR Intranets (e.g., employee manual, training, etc.; by way of a company network)?	1	2	3	4	5
43	Employee self-service (ESS) HR applications (e.g., personal data maintenance, paycheck services, retirement/financial services, etc.)?	1	2	3	4	5
44	Manager self-service (MSS) HR applications (e.g., salary, career, succession management, etc.; applications oriented toward supervisors rather than employees)?	1	2	3	4	5
45	HR Extranets (Internet connections to vendor-based HR applications)?	1	2	3	4	5
46	HR Portals (personalized web-based access to various HR applications)?	1	2	3	4	5
47	Wireless HR services (HR applications accessible through mobile devices like PDAs, cell phones, etc.)?	1	2	3	4	5

To what extent has the use of IT in the HR department affected the following for HR staff members?

		Very Negatively	Negatively	Not Perceptibly	Positively	Very Positively
48	Professional commitment	1	2	3	4	5
49	Organizational commitment	1	2	3	4	5
50	Commitment to the HR department	1	2	3	4	5
51	Job satisfaction	1	2	3	4	5
52	Job security	1	2	3	4	5
53	Work stress levels	1	2	3	4	5
54	Group cohesiveness of HR staff	1	2	3	4	5

Section 2. Questions about HR in your firm.

Please indicate to what extent you agree or disagree with the following statements:

		Strongly Disagree	Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Agree	Strongly Agree
55	This firm conducts detailed analyses of the ways that we can best use our IT capabilities to make HR more technology intensive	1	2	3	4	5	6	7
56	In this firm, detailed analyses are conducted about how competitors are using their IT capabilities to make HR more technology intensive	1	2	3	4	5	6	7
57	This firm conducts detailed analyses of the ways that emerging and breakthrough technologies could be utilized for HR purposes	1	2	3	4	5	6	7
58	Top management participated in the development of the IT's we use in our HR operations	1	2	3	4	5	6	7
59	Top management maintains regular contact with the sponsor(s) of IT use in our HR operations	1	2	3	4	5	6	7
60	Resource support is high for the adoption and utilization of IT in our HR operations	1	2	3	4	5	6	7
61	It is important for top management that our HR operations utilize IT's	1	2	3	4	5	6	7
62	Top management provides constructive feedback on the use of IT in our HR operations	1	2	3	4	5	6	7
63	The utilization of IT in our HR operations is regarded as a high priority by top management	1	2	3	4	5	6	7
64	In this firm, HR is involved in major strategic decisions	1	2	3	4	5	6	7
65	In this firm, HR helps make decisions about broader business issues	1	2	3	4	5	6	7
66	The IS department's financial constraints have made it difficult to offer needed training for use of HR technologies in this firm	1	2	3	4	5	6	7
67	The IS department lacks sufficient funds to purchase suitable HR technology applications	1	2	3	4	5	6	7
68	The IS department lacks enough resources to properly identify HR technology solutions	1	2	3	4	5	6	7
69	Adequate funds are available to fund this firm's HR applications implementation efforts	1	2	3	4	5	6	7
70	It is easy to identify one (or more) person(s) that has (have) been instrumental in the automation of the HR services in this firm	1	2	3	4	5	6	7
71	The level of IT in our HR operations can be attributed to the vision of key person(s)	1	2	3	4	5	6	7
72	IT levels in our HR operation can be attributed to enthusiastic promotion by key person(s)	1	2	3	4	5	6	7
73	The use of IT in our HR function is partially because of the ability of key person(s) to get top-level support	1	2	3	4	5	6	7
74	HR-IT's in this firm are partially due to the ability of key person(s) to get the right people involved in its implementation	1	2	3	4	5	6	7
75	Problem-solving skills of key person(s) have increased our use of HR-IT's	1	2	3	4	5	6	7
76	The tenacity of key person(s) in HR in overcoming obstacles has improved our use of HR-IT's	1	2	3	4	5	6	7
77	Overall, managers in this company are not satisfied with the timeliness of HR services	1	2	3	4	5	6	7
78	Overall, managers here are satisfied with the responsiveness of HR services	1	2	3	4	5	6	7
79	Overall, managers are satisfied with the accessibility of HR services	1	2	3	4	5	6	7
80	Overall, managers are not satisfied with the cost of HR services	1	2	3	4	5	6	7
81	Overall, the firm employees are not satisfied with the timeliness of HR services	1	2	3	4	5	6	7
82	Overall, employees here are satisfied with the responsiveness of HR services	1	2	3	4	5	6	7
83	Overall, employees are satisfied with the accessibility of HR services	1	2	3	4	5	6	7
84	Our HR practices are tailored to fit the nature of our business operations	1	2	3	4	5	6	7
85	Solving HR problems in this firm requires knowledge of our business strategy	1	2	3	4	5	6	7
86	In this firm, you have to understand its history and culture before you can help solve HR problems	1	2	3	4	5	6	7
87	You can't solve HR problems here unless you know our business	1	2	3	4	5	6	7

Please indicate to what extent you agree or disagree with the following statements:

		Strongly Disagree	Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Agree	Strongly Agree
88	In this company, HR recognizes and rewards new ideas from HR staff	1	2	3	4	5	6	7
89	The HR department and its staff display flexibility and adaptability	1	2	3	4	5	6	7
90	HR and its staff display a willingness to take risks	1	2	3	4	5	6	7
91	The HR department and its staff display tolerance of failure of new ideas	1	2	3	4	5	6	7
92	The HR department is always moving toward the development of new answers	1	2	3	4	5	6	7
93	The HR department staff provides practical support for new ideas and their application	1	2	3	4	5	6	7
94	Major competitors in our industry utilize high levels of information technology in their HR activities	1	2	3	4	5	6	7
95	Major firms in our geographic regions utilize high levels of IT in their HR activities	1	2	3	4	5	6	7
96	The level of HR-technology present in our major competitors influenced this firm's decision to be more technologically-intensive in its HR operations	1	2	3	4	5	6	7
97	HR technologies in other firms in our region influenced this firm's decision to use more technology for HR operations	1	2	3	4	5	6	7
98	Senior HR executives have a long history of interacting directly with the IS department in this firm	1	2	3	4	5	6	7
99	Senior HR executives possess considerable first-hand experience working on IT projects	1	2	3	4	5	6	7
100	Senior HR executives and HR managers have sufficient IT awareness to recognize available telephony and web-based applications that could benefit the HR department	1	2	3	4	5	6	7
101	Collectively, HR professionals in this firm (including HRIS staff), have sufficient IT competencies to independently implement telephony- and web-based applications for the HR department	1	2	3	4	5	6	7
102	The IS team is well informed about the HR department's operations	1	2	3	4	5	6	7
103	The IS team is well informed about the HR department's long term vision	1	2	3	4	5	6	7
104	In this firm, HR ideas are given due attention in IT planning and implementation	1	2	3	4	5	6	7
105	The IT specialist-HR user relations in our firm are constructive	1	2	3	4	5	6	7

Please provide the following information about the company and the HR department:

106 **Number of employees in domestic operations at the firm?** _____ employees nationally

107 **If a multinational, total number of full-time employees worldwide?** _____ employees world-wide

108 **Company's headquarters are located in:** _____ country

109 **Total number of full-time HR staff in the firm** _____ full-time HR staff

110 **Percentage of HR staff classified as professionals or managers:** _____ % professional HR staff

111 **Percentage of HR staff classified as generalists:** _____ % generalist HR staff

112 **Full-time HRIS staff in the company:** _____ number

113 **Full-time IS staff in the company, dedicated to HR-systems support:** _____ number

114 **Onsite staff supporting HR-systems from IT vendors contracting directly with HR department:** _____ number

115 **Onsite staff supporting HR-systems from IT vendors contracting directly with IS department:** _____ number

116 **How frequently do you work with IS staff or managers during the course of performing your job?**

____ Never ____ 1-2 times a year ____ 1-2 times a month ____ 1-2 times a week _____ 1-2 times a day _____ All the time

117 **What is your company's primary industry?** ***Please check only one:***

____ Agriculture	____ Manufacturing	____ Transportation
____ Mining	____ Pharmaceuticals / Life sciences	____ Energy / Public Utilities
____ Construction	____ Wholesale / Retail	____ Computers / Information Technology
____ Telecommunications	____ Financial Services	____ Management Services
Other _____ (Please write in)		

Section 3. Questions about HR Technologies.

PART A. If your firm has *separate HR applications* for distinct functional activities (e.g., selection, performance appraisal, benefits, etc. aided by computers), please answer the following. Otherwise, please go to PART B, below.

118 **When did the firm acquire the first of these HR applications?** _____ calendar year

119 **What was the primary reason your company implemented HR applications?** ***Please check only one:***

_____ Cost reduction	_____ Service improvement to internal customers
_____ Compliance with company-wide process reengineering	Other: _____ (Please write in)

120 **How successfully have the HR applications met their primary objectives?** ***Please check only one:***

____ Not at all ____ Barely ____ Moderately ____ Totally

121 **How are the HR applications sourced?** ***Please check only one:***

____ Completely outsourced ____ Co-sourced (with vendor/s) ____ In-sourced

122 **Are the following functional activities assisted by these HR applications?** ***Please check all that apply:***

Recruitment	____ Yes	____ No	Selection	____ Yes	____ No
Career Management	____ Yes	____ No	Compensation Administration	____ Yes	____ No
Benefits Administration	____ Yes	____ No	Performance Appraisal	____ Yes	____ No
Other activities _____ (Please write in)					

PART B. If your firm has a *fully integrated HR Software suite* (e.g., PeopleSoft Human Resources, mySAP Human Capital Management, Oracle, etc.), please answer the following. Otherwise, please go to PART C, below.

123 **When did the firm acquire the HR software suite?** _____ calendar year

124 **What was the primary reason your company implemented the HR software suite?** ***Please check only one:***

_____ Cost reduction	_____ Service improvement to internal customers
_____ Compliance with company-wide process reengineering	Other: _____ (Please write in)

125 **How successfully has the HR software suite met its primary objectives?** ***Please check only one:***

____ Not at all ____ Barely ____ Moderately ____ Totally

126 **How is the software suite sourced?** ***Please check only one:***

____ Completely outsourced ____ Co-sourced (with vendor/s) ____ In-sourced

127 **Are the following functional activities assisted by the company's HR suite?** ***Please check all that apply:***

Recruitment	____ Yes	____ No	Selection	____ Yes	____ No
Career Management	____ Yes	____ No	Compensation Administration	____ Yes	____ No
Benefits Administration	____ Yes	____ No	Performance Appraisal	____ Yes	____ No
Other activities _____ (Please write in)					

PART C. **If your firm has *Interactive (or Automated) Voice Response (IVR or AVR; telephony-based)* for HR-related transactions (e.g., benefits enrollment, etc.), please answer the following. Otherwise, please go to PART D, below.**

128 **When did the firm acquire the IVR system for HR purposes?** _____ calendar year

129 **What was the primary reason your company implemented IVR for HR services?** ***Please check only one:***

_____ Cost reduction	_____ Service improvement to internal customers
_____ Compliance with company-wide process reengineering	Other: _____ (Please write in)

130 **How successfully has the IVR system met its primary objectives?** ***Please check only one:***

____ Not at all ____ Barely ____ Moderately ____ Totally

131 **How is the IVR system sourced?** ***Please check only one:***

____ Completely outsourced ____ Co-sourced (with vendor/s) ____ In-sourced

132 **Are the following functional activities assisted by the IVR system?** ***Please check all that apply:***

Benefits enrollment	____ Yes	____ No	Training registration	____ Yes	____ No
Job applications from outside	____ Yes	____ No	Other: _____ (Please write in)		

133 **Percentage of employees who can access IVR that use it at the level desired by the company.** ***Please check only one:***

_____ 10 % or less	_____ 11 – 20 %	_____ 21 – 30 %	_____ 31 – 40 %	_____ 41 – 50 %
_____ 51 – 60 %	_____ 61 – 70 %	_____ 71 – 80 %	_____ 81 – 90 %	_____ 91 – 100 %

PART D. **If your firm has an *HR intranet* (e.g., employee manual, training, etc. by way of a company network), please answer the following. Otherwise, please go to PART E, below.**

134 **When did the firm acquire the HR intranet?** _____ calendar year

135 **What was the primary reason your company implemented its Intranet for HR services?** ***Please check only one:***

_____ Cost reduction	_____ Service improvement to internal customers
_____ Compliance with company-wide process reengineering	Other: _____ (Please write in)

136 **How successfully has the HR intranet met its primary objectives?** ***Please check only one:***

____ Not at all ____ Barely ____ Moderately ____ Totally

137 **How is your company's HR intranet sourced?** ***Please check only one:***

____ Completely outsourced ____ Co-sourced (with vendor/s) ____ In-sourced

138 **How do users access your HR Intranet?** ***Please check all that apply:***

Desktop or laptop access	____ Yes	____ No	Kiosk access	____ Yes	____ No
Other _____ (Please write in)					

139 **Are the following functional activities assisted by the HR intranet?** ***Please check all that apply:***

Benefits enrollment	____ Yes	____ No	Training	____ Yes	____ No
Online applications / job postings	____ Yes	____ No	Employee manual	____ Yes	____ No
Other activities _____ (Please write in)					

PART E. **If your firm has *Employee Self-Service applications (ESS)* (e.g., personal data maintenance, paycheck, financial / retirement services, etc.), please answer the following. Otherwise, please go to PART F, below.**

140 **When did the firm acquire its ESS applications?** _____ calendar year

141 **What was the primary reason your company implemented its Employee Self-Service applications for HR?** ***Please check only one:***

_____ Cost reduction	_____ Service improvement to internal customers
_____ Compliance with company-wide process reengineering	Other: _____ (Please write in)

142 **How successfully have the ESS applications met their primary objectives?** ***Please check only one:***

____ Not at all ____ Barely ____ Moderately ____ Totally

143 **How are the ESS applications sourced?** ***Please check only one:***

____ Completely outsourced ____ Co-sourced (with vendor/s) ____ In-sourced

144 **What actions can users initiate through the ESS applications available in your firm?** ***Please check all that apply:***

Personal data maintenance	____ Yes	____ No	Paycheck services	____ Yes	____ No
Benefits management	____ Yes	____ No	Retirement / financial services	____ Yes	____ No
Online job applications	____ Yes	____ No	Training / competency development	____ Yes	____ No
Other actions _____ (Please write in)					

145 **Percentage of employees who can access ESS applications that use it at the level desired by the company:** ***Please check only one:***

_____ 10 % or less	_____ 11 – 20 %	_____ 21 – 30 %	_____ 31 – 40 %	_____ 41 – 50 %
_____ 51 – 60 %	_____ 61 – 70 %	_____ 71 – 80 %	_____ 81 – 90 %	_____ 91 – 100 %

PART F. **If your firm has *Manager Self-Service applications (MSS)* (e.g., salary, career, succession management, etc.), please answer the following. Otherwise, please go to PART G, below.**

146 **When did the firm acquire its MSS applications?** _____ calendar year

147 **What was the primary reason your company implemented its Manager Self-Service applications for HR?** ***Please check only one:***

_____ Cost reduction	_____ Service improvement to internal customers
_____ Compliance with company-wide process reengineering	Other: _____ (Please write in)

148 **How successfully have the MSS applications met their primary objectives?** ***Please check only one:***

____ Not at all ____ Barely ____ Moderately ____ Totally

149 **How are the MSS applications sourced?** ***Please check only one:***

____ Completely outsourced ____ Co-sourced (with vendor/s) ____ In-sourced

150 **What actions can managers initiate through the MSS applications available in your firm?** ***Please check all that apply:***

Employee change actions	____ Yes	____ No	Management reports	____ Yes	____ No
Salary management	____ Yes	____ No	Career management	____ Yes	____ No
Other actions _____ (Please write in)					

151 **Percentage of employees who can access MSS applications that use it at the level desired by the company:** ***Please check only one:***

_____ 10 % or less	_____ 11 – 20 %	_____ 21 – 30 %	_____ 31 – 40 %	_____ 41 – 50 %
_____ 51 – 60 %	_____ 61 – 70 %	_____ 71 – 80 %	_____ 81 – 90 %	_____ 91 – 100 %

PART G. **If your firm has an *HR extranet* (Internet connections to vendor-based HR applications), please answer the following. Otherwise, please go to PART H, below.**

152 **When did the firm acquire its HR extranet?** _____ calendar year

153 **What was the primary reason your company implemented its HR extranet?** ***Please check only one:***

_____ Cost reduction	_____ Service improvement to internal customers
_____ Compliance with company-wide process reengineering	Other: _____ (Please write in)

154 **How successfully has the HR extranet met its primary objectives?** ***Please check only one:***

____ Not at all ____ Barely ____ Moderately ____ Totally

155 **How are the HR extranets sourced?** ***Please check only one:***

____ Completely outsourced ____ Co-sourced (with vendor/s) ____ In-sourced

156 **What actions can users initiate through the Extranet/s available in your firm?** ***Please check all that apply:***

Personal data maintenance	____ Yes	____ No	Paycheck services	____ Yes	____ No
Benefits management	____ Yes	____ No	Retirement / financial services	____ Yes	____ No
Training / competency development	____ Yes	____ No	Other: _____ (Please write in)		

PART H. **If your firm has an *HR portal* (personalized web-based access to various HR applications), please answer the following. Otherwise, please go to PART I, below.**

157 **When did the firm acquire its HR portal?** _____ calendar year

158 **What was the primary reason your company implemented its HR Portal?** ***Please check only one:***

_____ Cost reduction	_____ Service improvement to internal customers
_____ Compliance with company-wide process reengineering	Other: _____ (Please write in)

159 **How successfully has the HR portal met its primary objectives?** ***Please check only one:***

____ Not at all ____ Barely ____ Moderately ____ Totally

160 **How is the HR portal sourced?** ***Please check only one:***

____ Completely outsourced ____ Co-sourced (with vendor/s) ____ In-sourced

161 **What external links are provided to users through your HR portal?** ***Please check all that apply:***

Information and resources about non-work life concerns (e.g., health, family life)	____ Yes	____ No
External vendors offer discounts on personal goods and services	____ Yes	____ No
Work-related, external databases	____ Yes	____ No
Other links _____ (Please write in)		

PART I. **If your firm has *Wireless Applications* for HR (applications accessible through mobile devices like PDAs, cell phones, etc), please answer the following. Otherwise, please go to PART J.**

162 **When did the firm acquire its wireless applications (for HR)?** _____ calendar year

163 **What was the primary reason your company implemented its Wireless applications for HR?** ***Please check only one:***

_____ Cost reduction	_____ Service improvement to internal customers
_____ Compliance with company-wide process reengineering	_____ Other: _____ (Please write in)

164 **How successfully have the HR wireless applications met their primary objectives?** ***Please check only one:***

____ Not at all ____ Barely ____ Moderately ____ Totally

165 **How are the HR wireless applications sourced?** ***Please check only one:***

____ Completely outsourced ____ Co-sourced (with vendor/s) ____ In-sourced

166 **What HR actions can users initiate through the wireless HR applications available in your firm?** ***Please check all that apply:***

Personal data maintenance	____ Yes	____ No	Training / competency development	____ Yes	____ No
Paycheck / financial services	____ Yes	____ No	Benefits management	____ Yes	____ No
Other actions _____ (Please write in)					

167 **Percentage of employees who can access wireless applications and use it as desired by the company:** ***Please check only one:***

_____ 10 % or less	_____ 11 – 20 %	_____ 21 – 30 %	_____ 31 – 40 %	_____ 41 – 50 %
_____ 51 – 60 %	_____ 61 – 70 %	_____ 71 – 80 %	_____ 81 – 90 %	_____ 91 – 100 %

PART J. You finished the skipping sections! Thank you! Please answer this last part.

168 **For each of the following HR areas, please estimate the percentage of work transactions the HR function is responsible for that has been automated with Information Technology:**

Recruitment (job postings, résumé intake/ management, etc.)	_____ %	External selection (applicant tracking, screening, testing)	_____ %
Training & development (overviews, registration, e-learning)	_____ %	Compensation administration (salary adjustments, job evaluation, surveys)	_____ %
Benefits administration (enrollments, planning, modeling)	_____ %	Performance management (goal setting, appraisals, skills tracking)	_____ %
Career management (succession planning, career planning)	_____ %	Compliance management (demographic tracking, compliance reporting)	_____ %

169 **In which area is your position formally classified?** _____ Human Resources _____ Information Systems

170 **Which of the following best describes your position in the company?** ***Please check only one:***

_____ Top executive	_____ Middle-level manager
_____ Senior manager	_____ Non-managerial generalist or specialist
Other _____ (please specify)	

171 **When did your firm first implement client-server computing (for HR or any other purposes)?** _____ calendar year (e.g., 1998)

172 **When did your firm first implement telephony-based applications (regardless of function)?** _____ calendar year

173 **When did your firm first implement web-based applications (for HR or any other purposes)?** _____ calendar year

174 **When did your firm first implement wireless applications (regardless of function)?** _____ calendar year

175 **How long have you been working for this company?** _____ years

176 **Company's CUSIP number (e.g.,** 594918**) or ticker symbol (e.g.,** MSFT**)** _____ (if applicable)

177 **HR Expenditures for 2001:** _____ **currency?** ___ U.S. dollars ___ U.K. Pounds ___ Euros Other_____

178 **Firm-wide compensation -salaries and wages—expenses (2001):** _____

currency? ___ U.S. dollars ___ U.K. Pounds ___ Euros Other_____

179 **Firm-wide benefit expense (2001):** _____ **currency?** ___ U.S. dollars ___ U.K. Pounds ___ Euros Other_____

180 **Firm-wide training and development expense (2001):** _____ **currency?** ___ U.S. dollars ___ U.K. Pounds ___ Euros Other_____

181 **Total operating expenses (2001):** _____ **currency?** ___ U.S. dollars ___ U.K. Pounds ___ Euros Other_____

182 **Firm revenues in 2001** _____ **currency?** ___ U.S. dollars ___ U.K. Pounds ___ Euros Other_____

183 **Firm absence rate (2001):** _____ absence

184 **Firm turnover rate (2001):** _____ turnover

If you have any comments about this topic or this questionnaire, please use the blank space below to write them down. Finally, as a token of appreciation, I will send a summary report within three weeks of your response. Your contact information will be recorded in a separate file from your responses, and will not be known by anyone outside of this research project or used for any other purpose.

Email address (to receive a PDF file): _____ (e.g. loginname@company.com) **OR:**

Traditional mail address: _____

_____

_____

_____

You have finished the Survey on Information Technologies for Human Resource Departments. I would like you to know that your efforts are very much appreciated. Only with the responses of professionals like you, knowledge in the field can be advanced.

If you have any questions before you send your responses, do not hesitate to call me (412-648-1512), fax me (412-624-2875) or email me (molivas@katz.pitt.edu). My mailing address:

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Pittsburgh, PA
USA 15260-7503

Once again, Thank you very much for your help!

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This research has been reviewed and approved by the Institutional Review Board of the University of Pittsburgh, IRB # 020586.
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