CONTROL OF INFORMATION SYSTEMS DEVELOPMENT: INVESTIGATING THE RELATIONSHIP BETWEEN CONTROL AND PERFORMANCE

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Organizational control, defined as efforts to increase the chances that employees of an organization work toward achieving organizational goals, is believed to have positive effects on performance. However, few studies have tested this assumption. This research draws on theories of control and coordination to investigate the relationship between control and information systems (IS) development performance.

It consists of analyses of two research models, one at the individual level of analysis, and the other at the team level of analysis. The individual-level model investigates how control affects individual effort toward task and individual coordination success, and proposes that these relationships are moderated by controlees' perceptions of how effectively a controller can monitor their work behaviors and outcomes. The team-level model investigates two mediators through which control may affect IS development performance: team effort toward task, and team coordination success. A field survey was conducted, and completed matched survey responses from 106 managers and team members involved in 36 different IS development projects were used to test the hypotheses.

The results suggest that control does have a positive relationship with effort toward task and coordination success. Specifically, clan control was positively associated with coordination success at the individual and team levels, and with team effort toward task. Outcome control was positively associated with individual effort toward task. In addition, the relationship between

outcome control and individual effort toward task was moderated by team member perceptions of the difficulty of observing outcomes. At high levels of difficulty of observing outcomes, high levels of outcome control resulted in higher effort than at low levels of difficulty of observing outcomes.

Control was also positively related to performance outcomes. Behavior control was associated with reduced overruns of resources such as time, budget, and systems and programming effort. Outcome control was positively associated with product performance, which represents the quality, ease-of-use, and functionality of the system developed or enhanced by the project. Clan control was associated with both improved product performance and reduced resource overruns.

No support was found for mediation of the effects of control on performance by effort toward task or coordination success.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS XIII

1.0 INTRODUCTION 1

2.0 LITERATURE REVIEW 5

2.1 MODES OF ORGANIZATIONAL CONTROL 5

2.2 CONTROL MODE ANTECEDENTS 8

2.3 PERFORMANCE EFFECTS OF CONTROL 9

2.4 CONTROL AND COORDINATION 11

3.0 RESEARCH MODELS AND HYPOTHESES 15

3.1 INDIVIDUAL-LEVEL RESEARCH MODEL AND HYPOTHESES 16

3.1.1 Effects of control on effort toward task 17

3.1.2 Effects of control on coordination success 19

3.1.3 Moderating effect of controlees' perceptions of the task context 23

3.1.4 Control variables for individual-level model 27

3.2 TEAM-LEVEL RESEARCH MODEL AND HYPOTHESES 27

3.2.1 Control modes and IS development performance outcomes 28

3.2.2 Relationship of control modes to team effort toward task and team coordination success 29

3.2.3 Team effort toward task and project performance outcomes 30

3.2.4 Team coordination success and project performance outcomes 31

3.2.5 Control variables for team-level model 32

4.0 METHODOLOGY 33

4.1 RESEARCH DESIGN 33

4.2 OPERATIONALIZATION OF RESEARCH CONSTRUCTS 34

4.2.1 Measures for behavior, outcome, and clan control 35

4.2.2 Measures of difficulty of observing behaviors and difficulty of measuring outcomes 36

4.2.3 Measures of effort toward task 37

4.2.4 Measures of coordination success 38

4.2.5 Performance measures 40

4.2.6 Measures of key control variables 41

4.3 PRE-TEST AND PILOT STUDIES 42

4.3.1 Pre-test 42

4.3.2 First pilot study 43

4.3.3 Second pilot study 47

4.4 DATA COLLECTION 49

4.4.1 Data collection procedures 49

4.4.2 Description of final sample 51

4.4.3 Assessment of non-response bias 52

5.0 ANALYSIS AND RESULTS 54

5.1 VALIDATION OF MEASURES 54

5.1.1 Behavior control and outcome control 55

5.1.2 IS development project complexity 58

5.1.3 Difficulty of observing behavior, difficulty of measuring outcomes, and clan control 59

5.1.4 Individual effort toward task, and individual coordination success......... 62

5.1.5 Team effort toward task, and team coordination success.......................... 64

5.1.6 Product performance 66

5.2 INDIVIDUAL-LEVEL ANALYSIS AND RESULTS.................................... 68

5.2.1 Individual-level analysis descriptive statistics 68

5.2.2 Tests of the individual-level research model and hypotheses.................... 69

5.3 TEAM-LEVEL ANALYSIS AND RESULTS 76

5.3.1 Team-level analysis descriptive statistics 76

5.3.2 Tests of the team-level research model and hypotheses............................. 77

6.0 DISCUSSION AND CONCLUSIONS 83

6.1 DISCUSSION OF RESEARCH FINDINGS – INDIVIDUAL LEVEL 83

6.1.1 Effects of control on individual effort toward task 83

6.1.2 Effects of control on individual coordination success 87

6.1.3 Effects of difficulty of observing behaviors and difficulty of measuring outcomes.. 89

6.2 DISCUSSION OF RESEARCH FINDINGS – TEAM LEVEL.................... 91

6.2.1 Effects of control on performance... 92

6.2.2 Mediation through team effort toward task and team coordination success 93

6.3 LIMITATIONS.. 96

6.4 IMPLICATIONS FOR PRACTICE 98

6.5 IMPLICATIONS FOR RESEARCH 100

6.6 FUTURE RESEARCH 102

6.7 CONCLUSION 107

BIBLIOGRAPHY 109

LIST OF TABLES

Table 1: Measurement Items for Behavior Control 35

Table 2: Measurement Items for Outcome Control 35

Table 3: Measurement Items for Clan Control 36

Table 4: Measurement Items for Difficulty of Observing Behaviors 37

Table 5: Measurement Items for Difficulty of Measuring Outcomes 37

Table 6: Measurement Items for Effort Toward Task (Individual Level) 38

Table 7: Measurement Items for Effort Toward Task (Team Level) 38

Table 8: Measurement Items for Coordination Success (Individual Level) 39

Table 9: Measurement Items for Coordination Success (Team Level) 40

Table 10: Measurement Items for Resource Overruns 41

Table 11: Measurement Items for Product Performance 41

Table 12: Measurement Items for Project Complexity 42

Table 13: Revised Items for Individual Effort toward Task 46

Table 14: Revised Items for Team Effort toward Task 46

Table 15: Descriptive Statistics for Constructs in Second Pilot 48

Table 16: Cronbach's Alpha for Constructs in Second Pilot 48

Table 17: Factor Analysis for Constructs in Second Pilot 49

Table 18: Factor Analysis for Behavior Control and Outcome Control 56

Table 19: Factor Analysis for Behavior and Outcome Control after Dropping Items................. 58

Table 20: Factor Analysis for Project Complexity 59

Table 21: Factor Analysis for DOB, DMO, and Clan Control 60

Table 22: Factor Analysis for DOB and DMO, with Two Factors Specified.............................. 61

Table 23: Second Factor Analysis for DOB and DMO, with Two Factors Specified................. 62

Table 24: Factor Analysis for IEFF and ICS 63

Table 25: Factor Analysis for TEFF and TCS.. 65

Table 26: Factor Analysis for Product Performance and Resource Control Items...................... 67

Table 27: Descriptive Statistics of Constructs in Individual-Level Analysis 68

Table 28: Correlations among Constructs in Individual-Level Analysis..................................... 69

Table 29: Regression Results for Individual Effort Toward Task 71

Table 30: Regression Results for Individual Coordination Success 75

Table 31: Summary of Results of Individual-Level Analysis 76

Table 32: Descriptive Statistics of Constructs in Team-Level Analysis 77

Table 33: Correlations among Constructs in Team-Level Analysis 77

Table 34: Summary of Team-Level Analysis Results 82

LIST OF FIGURES

Figure 1: Individual-Level Research Model 16

Figure 2: Team-level Research Model... 28

Figure 3: Interpretation of the Interaction between Outcome Control and DMO 74

Figure 4: Results of PLS Analysis with Product Performance as the Dependent Variable.......... 79

Figure 5: Results of PLS Analysis with Resource Overruns as the Dependent Variable............. 80

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1.0 INTRODUCTION

Despite decades of research and practitioner experimentation, a large percentage of information systems development projects still take longer than anticipated, go over budget, fail to meet the expectations of project stakeholders, or are canceled before their completion (Faraj and Sambamurthy 2006; Mahaney and Lederer 2006). Statistics from two recent Standish Group reports highlight the failure of information systems development projects to reach their goals. The 1999 Standish Group report indicates that only 26% of software development projects are completed on time and within budget, and meet their requirements. And performance is not improving significantly over time, as the 2004 Standish Group report indicates that only 29% of software development projects are completed on time and within budget, and meet their requirements (Standish Group statistics as reported in Aiyer et al. 2006). This is a very important problem, as more than $275 billion is spent every year in the United States on software development (Aiyer et al. 2006). Moreover, much of this total spending is on in-house software development. Total spending on IT outsourcing in the U.S. is approaching $50 billion (Gray 2006), which is a large figure, but still small in comparison to the total amount spent on software development. Offshoring, while an important and growing phenomenon, accounts for still less of total software development expenditures in the United States. The largest offshoring partner of the United States, India, exported only $18 billion in software and services during the fiscal year ending March 31, 2007 (National Association of Software and Service Companies 2007), and this total includes exports to countries other than the United States.

Because so much is being spent on information systems development in the U.S. it is important to consider why software development efforts frequently fail. One possible reason for these failures is that information systems development efforts are not being controlled successfully. Organizational control, or ensuring that employees of an organization work toward achieving the goals of the organization, is one of the fundamental functions of management. In the information systems development context, control is generally conceived of as mechanisms used by upper management and IS management, as representatives of the organization, to help ensure that the developers, analysts, and other individuals who are involved with the development of the information system are acting in agreed-upon ways toward accomplishing organizational objectives (Kirsch 1996). Organizational goals for information systems development typically include producing a system within a specified amount of time and within a specified budget. Moreover, the system produced should be reliable, and its users should be willing and able to use it for its intended purpose. Because control is meant to facilitate the achievement of organizational goals, control efforts that can be considered successful are those that help lead to the achievement of those goals. Given this definition, we can argue that control efforts have not been very successful in the context of information systems development.

Organizational control has been studied for decades, and many business activities seem to be amenable to control by management. Why is it, then, that control efforts do not seem to work as well in the context of information systems development? Are there certain characteristics of the IS development context that make it difficult to control? Through what mechanisms do control efforts affect performance in the IS development context? These are the broad questions that are addressed in this research.

In order to answer these broad questions this dissertation investigates in more detail the mechanisms through which control affects information systems development performance. The relationship between control and performance has not been extensively studied, perhaps because of a prevailing belief that a manager chooses what type of control to utilize based on certain antecedent conditions, and that if the correct control mode is chosen performance will naturally improve. The lack of successful control of IS development projects suggests that this belief needs to be reconsidered. Even if the fit between antecedent conditions and control mode has an effect on performance outcomes it is still useful to consider the mechanisms through which control affects performance outcomes independently of the question of fit between control mode and antecedent conditions. Managers may have other reasons for choosing particular control modes, such as comfort and familiarity, or a desire to impress their own manager. Moreover, projects are ever-changing and a control mode that seems to fit based on an initial assessment of antecedent conditions may no longer fit after the project gets underway and things change. For these reasons we cannot assume that the control mode utilized always fits the conditions of the project.

The mechanisms through which control is expected to affect performance are proposed to work at both the individual level and the team level. Thus the research will be conducted with two separate research models and analyses, one at each level of analysis. The first analysis, at the individual level, investigates how control affects individual effort toward task and individual coordination success, and how these relationships may be moderated by controlees' perceptions of how effectively a controller can monitor their work behaviors and outcomes in the particular task context of the IS development project. The second analysis, at the team level, investigates the effects of control on IS development project performance outcomes. It proposes that team effort toward task and team coordination success play a mediating role in the relationship between control and project performance outcomes. In addition to improving our understanding of control in the specific context of IS development, this dissertation will also contribute to our understanding of the control of complex knowledge work in general.

2.0 LITERATURE REVIEW

2.1 MODES OF ORGANIZATIONAL CONTROL

Organizational control has long been considered one of the primary functions of management, along with planning, organizing, and coordination (Fayol 1949). This research adopts a behavioral view of control. In this view control refers to attempts by management or other organizational stakeholders to increase the probability that individuals in the organization will follow agreed-upon behaviors that lead to the attainment of organizational objectives (Kirsch 1996; Flamholtz et al. 1985; Jaworski 1988).

The modes used to enact control in organizations have been classified in various ways, but most classification schemes have made a general distinction between formal and informal control modes. Formal controls are those that are documented by management, that implicitly assume a discrepancy between the goals of the organization and the goals of its individual members, and that are initiated and maintained by management. Informal controls, by contrast, are typically undocumented, may or may not be in line with the goals of management, and are usually initiated and maintained by the organization's members (Jaworski 1988).

Formal control modes are attempts to control individuals in organizations through the monitoring of behaviors or outputs, comparing behaviors or outputs to some pre-specified standard, and then attempting to adjust the behaviors, and consequently the outputs as well, by administering rewards or sanctions based on how closely they conform to the pre-specified standards. Formal control modes are usually classified into behavior control and outcome control (Ouchi and Maguire 1975; Ouchi 1977). Behavior control involves specifying behaviors for individuals to follow and then applying sanctions or rewards based on their compliance or lack of compliance with the specified behaviors. Outcome control involves specifying desired outcomes and rewarding or sanctioning individuals based on whether or not they attain the desired outcomes.

The classification of formal controls into behavior and outcome control emphasizes the types of phenomena for which goals or targets are being specified, and that are subsequently observed and measured. Another way of looking at behavior and outcome controls focuses on time. Behavior controls are applied while the task is taking place, and outcome controls are applied after the task is completed (Jaworski 1988). This time-based perspective is a useful way to consider formal controls, because it makes the concept of risk more salient. Since outcome controls are applied after the activity is already completed, a manager may not be able to recognize that they are ineffective until it is too late. With behavior control, however, there is less risk as adjustments may be made as the activity is ongoing. This time-based perspective on control is important because it explains a powerful motivator for managers to attempt to implement behavior control rather than outcome control, or to implement outcome control based on intermediate outcomes in addition to final outcomes.

In addition to the formal modes of control, control can also be enacted in organizations through the influence of norms and values established in various social units. These informal modes of control are typically classified according to the level of the social unit (Jaworski 1988). They shape behavior through shared norms and values that members of the social unit internalize through socialization processes, eliminating or reducing the need for explicit formal control mechanisms (Orlikowski 1991). Some examples are cultural control, which operates at the organizational level, social or small group control, which operates at the level of an organizational subunit, and professional control, which can be thought of as operating at the super-organizational level, driven by the norms and practices of a particular profession. Another informal mode of control is clan control. A clan refers to a group of people who share values, beliefs, and agreement among members as to what constitutes proper behavior. The clan can implement control in an organization through rituals and ceremonies that reward those who share the attitudes and values of the clan, and which are supposed by the clan members to be likely to lead to organizational success. An organization can attempt to utilize clan control through selection processes that emphasize hiring individuals who share the goals and values of the organization, and through socialization or indoctrination processes which emphasize these goals and values and attempt to inculcate them into the organization's members (Ouchi 1979). Although the social control modes have been given various names, they all work through similar mechanisms. In the IS development context, clan control has been identified as an important control mode (Choudhury and Sabherwal 2003; Henderson and Lee 1992; Kirsch 1996, 1997, 2004; Kirsch et al. 2002). In addition to the formal modes of control, this study will also examine how clan control affects IS development performance.

The existing conceptualizations of informal controls are not as clear as those for formal control. For example, clan control may be understood as the actions undertaken by an organization to try to develop a clan, as the existence of a clan in the organization, or as the actions that clan members take to control their own behavior and the behavior of others in the clan. One reason conceptualizations of informal control are not as clear may be that they have not been studied as extensively, because business studies tend to focus on the role of managers and what they can do to improve organizational performance. The role of managers in implementing formal controls is much clearer than the role of managers in implementing informal controls. This study will conceive of and measure clan control as the presence of a clan and operation of clan control mechanisms. Specifically, when the project-related behaviors of team members are influenced by shared norms and values and a common vision of the project, and when project team members attempt to be accepted as "regular" members of the project team, clan control is operating. The question of how the clan emerged, and whether or not management played a role in that emergence, will not be addressed in this dissertation.

2.2 CONTROL MODE ANTECEDENTS

Much of the theory and research related to organizational control has focused on the antecedent conditions that lead to the use of the various modes of control. The paradigm adopted by most of this research is inherently rational and prescriptive. That is, the antecedents are believed to determine which control modes will be most effective in various circumstances, and from there it is assumed that the most effective control modes are the ones that will be used. Because control consists of observing and monitoring behavior or outputs and then applying sanctions or rewards based upon how closely the behavior or outputs conform to a pre-specified standard, factors that affect the controller's ability to monitor and pre-specify behavior or outputs have been considered to be important antecedents of the control mode utilized. Antecedents investigated have focused on properties of the task being controlled and the task-related knowledge of the controller. Three key antecedents have been identified: outcome measurability, behavior observability, and the controller's knowledge of the process by which inputs are transformed into outputs. In order for an organization to utilize outcome control, there must be agreement on acceptable outcomes, and these outcomes must be measurable. For behavior control to be utilized, the controller must have or believe he has sufficient knowledge of the process by which inputs are transformed into outputs to specify appropriate behaviors for individuals performing the task. These two antecedents have a long history in the organizational literature (Ouchi 1977; Perrow 1965; Reeves and Woodward 1970; Thompson 1967). Another necessary condition for behavior control is that the behavior of individuals performing the task must be observable so that the controller can monitor behavior for compliance to what he believes is the appropriate behavior for accomplishing the task (Eisenhardt 1985).

Research on control mode antecedents has suggested that informal control modes may be used when it is infeasible to use formal control modes, or may be combined with formal control modes in a portfolio of control modes.

2.3 PERFORMANCE EFFECTS OF CONTROL

The ultimate goal of organizational control efforts is to improve performance. However, there is relatively little research on control in the information systems context that reports relationships between control and performance. Henderson and Lee (1992) examined the effects of managerial behavior and outcome control and team-member self-control and outcome control in teams involved in information systems design. Their conceptualization of managerial behavior and outcome control was similar to what we have discussed as formal behavior and outcome control. Managerial behavior control encompassed the degree to which managers clarified team member roles, defined and provided team members with specific work assignments, and developed procedures to guide the team members' work. Their conceptualization of managerial outcome control emphasized managerial feedback to team members regarding their performance. Team member self-control refers to the degree to which team members have freedom to do their work in their own way, and team member outcome control refers to the degree to which team members provide each other with feedback on their performance. Henderson and Lee examined three performance variables – efficiency, which represented adherence to budgets and schedules, effectiveness, which represented quality work and interactions and ability to meet project goals, and elapsed time, which represented the team's ability to work quickly while maintaining quality. Managerial behavior control was significantly correlated with all three performance variables, while managerial outcome control was significantly correlated with efficiency only. Team member outcome control was significantly correlated with all three performance variables, while team member self-control was significantly correlated only with the effectiveness performance variable. The combination of high managerial behavior control and high team member outcome control resulted in the highest average scores on the three performance variables.

Kirsch and Cummings (1996) performed a post-hoc analysis and found that perceived self-control of both project leaders and IS managers was significantly and positively related to a composite measure of performance that measured whether systems satisfied user requirements, conformed to internal IS standards, and were completed on time and within budget. Their conceptualization of self control was that the IS managers or project leaders had control over or influence on the setting of project goals, were rewarded for working on their own without significant direction from others, and were intrinsically motivated to achieve project objectives.

These studies provide some insights on the performance effects of control in the IS development context, but more work on the relationship between control and performance is needed. Researchers in other business fields have also noted that little research has been conducted linking organizational control to performance consequences (Lawler 1976; Otley 1980; Jaworski 1988), and the results of the research that has been conducted has been equivocal (Challagalla and Shervani 1996).

2.4 CONTROL AND COORDINATION

Along with control, coordination, or the management of dependencies between activities (Malone and Crowston 1994), is another concept that is central to organizational theory. Although they are usually considered separately in contemporary organizational literature, their definitions and the operationalizations with which they are measured frequently overlap, to the point where some studies of control look more like studies of coordination and some studies of coordination look more like studies of control. It may be useful to consider them together and attempt to more clearly understand their relationship, as well as the central ideas which distinguish them from one another.

The close link between coordination and control has its roots in organizational theory. March and Simon (1958) argued that most problem solving activity in organizations is governed by performance programs, which are complex and organized sets of responses to environmental stimuli. If a performance program does not exist for a certain set of environmental stimuli, then the problem solving activity may involve search for alternatives that may involve inventing new performance programs. March and Simon suggest that these performance programs are intended to fulfill two functions, control and coordination. They control employees by specifying standard operating procedures and attaching rewards and penalties to them. They aid coordination by increasing interdepartmental predictability. Further, March and Simon suggest that the ability of performance programs to serve as organizational controls is predicated on their being linked to variables that are observable and measurable. They suggest that program content is a function of the ease of observing job activities, the ease of observing job output, and the ease of relating activities to output. Because of the coordinating function of performance programs, their content should also be linked to the organization's coordination needs. The more closely members of the organization need to coordinate their activities the more likely that programs will specify activity patterns and pacing of activities. However, if members need to coordinate their outputs, then the programs will tend to specify product characteristics.

Galbraith (1974) conceived of organizations as collections of specialist subgroups which utilize resources and perform subtasks that must be integrated to produce outputs. The concern of these subgroups is how to coordinate their interdependent subtasks, given varying levels of uncertainty, in order to achieve organizational goals. The higher the level of uncertainty faced by an organization the greater the need for that organization to process information in order to coordinate the interdependent subtasks. Processing information is done through organizational structures that are referred to as "coordination structures" or "integrating structures." Galbraith (1974) discussed three different coordination structures: 1) rules, routines, and procedures; 2) hierarchy; and 3) goal or target setting.

Rules, routines, and procedures are used to coordinate behavior between interdependent subtasks when situations can be predicted in advance and appropriate behaviors can be specified for those situations. When situations are more uncertain and appropriate behavior cannot be specified in advance the hierarchy is used on an exception basis. Hierarchy refers to centralization of authority to make decisions that resolve uncertainty. As uncertainty increases, the hierarchy can become overloaded and coordination is increasingly enacted through specification of goals or targets. Goal or target setting actually refers to something akin to decentralization of decision-making authority. It refers to managers setting goals or targets and allowing employees at the lower levels of the organization some autonomy in how they meet those goals.

Thus we can see that organizational theorists have recognized that the same organizational structures can affect both coordination and control. Moreover, they have recognized that both coordination and control have antecedents related to the degree to which activities or behaviors can be specified in advance, the degree to which outputs can be observed and measured, and knowledge of the relationship between activities and outputs. However, because they were concerned with organizational structures, the organizational theorists did not clearly distinguish between coordination and control, and did not clearly distinguish coordination and control from organizational structure. They were concerned with organizational structures that facilitated the coordination of interdependent work to achieve organizational goals. Issues of power, decision-making authority, and goal alignment are implicit in this concern.

Ouchi (1977) clearly distinguished control efforts from organizational structure and conceived of control as being enacted through two modes, behavior control and outcome control. Behavior control is based on the monitoring and evaluation of behavior, and outcome control is based on the monitoring and evaluation of outputs (Ouchi and Maguire 1975). Malone and Crowston (1994) synthesize views of coordination from various disciplines, defining coordination as “managing dependencies between activities” (p. 90). This definition, too, clearly distinguishes coordination from organizational structure. However, we can see that elements of Galbraith's view of organizational structures are found in the more contemporary definitions of both coordination and control. Managing of dependencies among tasks, Malone and Crowston's definition of coordination, is central to Galbraith's view. Moreover, we can also see the ideas of behavior control in the idea of coordinating behavior through rules, routines, and procedures which specify behaviors for organizational actors to follow. Outcome control is reflected in Galbraith's ideas on the coordination of actions through the specification of goals or targets.

Although control and coordination have been intertwined in organizational theory, we propose that it is useful to clearly distinguish them conceptually, but to examine them both within the same research model in order to gain a more fine-grained view of how they interrelate, how they are used in organizations, and the effects they have on organizational performance. We have defined control above as attempts by management or other organizational stakeholders to increase the probability that individuals in the organization will follow agreed-upon behaviors that lead to the attainment of organizational objectives (Kirsch 1996; Flamholtz et al. 1985; Jaworski 1988). Typically, control mechanisms are those by which the organization specifies and monitors employee behaviors or outputs, evaluates them, and then provides rewards or sanctions (Ouchi 1977) in order to ensure that employees work toward the goals of the organization. Coordination, on the other hand, involves the management of dependencies between activities (Malone and Crowston 1994), such as shared resource dependencies, producer/consumer constraints, simultaneity constraints, and task/subtask relationships.

3.0 RESEARCH MODELS AND HYPOTHESES

The research questions were addressed by analyzing two separate research models. The first research model is at the individual level of analysis, and investigates the effects of control on effort expended toward the task and on coordination success. Also addressed in the first research model are the role of controlees' perceptions of the observability and measurability of their behaviors and the outcomes of their work. Specifically, difficulty of observing behaviors and difficulty of measuring outcomes are proposed to moderate the effects of behavior control and outcome control, respectively, on effort toward task.

The second research model is at the team level of analysis. In this model relationships between the control modes and performance outcomes are proposed. In addition, effort toward task and coordination success are proposed as mediators in the relationship between control and performance outcomes.

There were several reasons for dividing the research into two research models and two separate analyses. First, both moderation and mediation effects are being tested, and it is difficult to test both within the same research model, particularly when the sample size provided by the research data is expected to be small. Second, some of the constructs of interest used to answer the research questions are best addressed at the individual level of analysis, and some are best addressed at the team level of analysis. For example, performance outcomes such as adherence to budget, schedule, and resource allocations are team-level outcomes. Other constructs, such as the team member's perception of the manager's difficulty of observing his or her behaviors, make more sense as individual-level constructs. Dividing the research into two separate research models and two separate analyses allows each construct of interest to be investigated at the level of analysis that is most suitable for that construct.

3.1 INDIVIDUAL-LEVEL RESEARCH MODEL AND HYPOTHESES

The individual-level research model is presented below in Figure 1. The following sections describe the model in more detail, and introduce the hypotheses that will be tested.

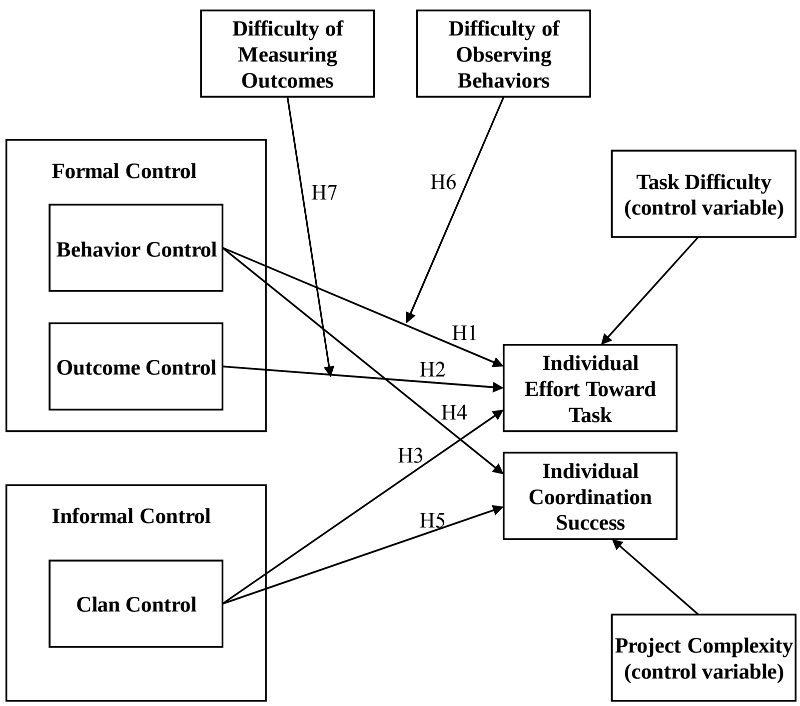

Figure 1: Individual-Level Research Model

3.1.1 Effects of control on effort toward task

In considering organizational outcomes of control, it is useful to think about the mechanisms through which these outcomes occur, in particular the mediating factors through which control processes may have an effect on organizational outcomes. Two primary mediating factors will be examined here. Control efforts are proposed to work through motivating effort toward the task, and by improving the coordination among individual controlees or subsets of controlees. The individual-level research model and analysis will investigate the effects of control on the mediating factors. Whether or not mediation actually occurs will be tested in the analysis of the team-level research model.

Control is thought to affect performance by motivating individuals to work toward the goals of the organization (Flamholtz 1979; Flamholtz et al. 1985). Motivation has been frequently studied in the management literature, and is typically described as encompassing the direction, level, and persistence of effort expended (Jones 1955; Campbell and Pritchard 1976). Other researchers argue that motivation is a psychological state that leads to effort (Brown and Peterson 1994). Thus, the effects of control on performance can be thought of as mediated by effort. Effort can be characterized by its direction, level, and persistence. Direction refers to the target of the effort. For example, an individual can direct his effort towards many activities, such as working on an assigned task, socializing with coworkers, or surfing the net. Level of effort refers to how much of the individual's resources are being expended toward the target of the effort, and persistence of effort refers to how long the effort is maintained.

Control mechanisms can be expected to direct effort toward task-related targets and/or increase the level and persistence of effort expended toward task-related targets. Behavior control works by specifying behaviors that are appropriate for successful completion of the task, and thus are inherently task-related. When individuals believe that a controller is observing their behavior and basing rewards and sanctions on how their behavior complies with what was specified, those individuals will be more likely to direct their effort toward the specified task-related behaviors. This reasoning leads to the following hypothesis:

H1: Behavior control will have a positive relationship with individual effort toward task

Outcome control works through the setting of goals or targets related to task performance. Because of the sanctions or rewards tied to them, these goals can be expected to motivate individuals to direct their effort toward task-related behaviors that will result in their achievement. This leads to the following hypothesis:

H2: Outcome control will have a positive relationship with individual effort toward task

When we consider control of complex, knowledge-intensive activities, taking into account the nature of knowledge work and the antecedents addressed in the literature, it makes sense that informal control modes would serve as important complements to formal control modes. It was argued above that formal behavior and outcome controls can only control a limited set of outputs and behaviors – those that are visible to and understood by the controller, who is typically conceived of as a manager or client liaison. It is likely that many of the behaviors and outputs that are difficult for a controller to observe may be more easily observed by the individuals and team members involved in the activity. In addition, whereas existing control theory focuses on the knowledge of the controller, in the context of complex knowledge work much of the knowledge of how to transform inputs into outputs resides in the controlees. This knowledge should also be considered when determining appropriate control modes. Informal control modes may be important for the control of complex knowledge work because informal control modes utilize the knowledge and ability to observe of the participants in the activity, the controlees. Thus, there is the potential for individual participants in the activity to utilize clan control to control parts of the activity that are not amenable to formal control modes. Because of this, informal control modes can be valuable complements to formal control modes, especially in the case of controlling a complex, knowledge-intensive activity, because they utilize the participants as agents of control, and this takes advantage of their understanding of the transformation process, their ability to observe the behavior of themselves and other participants, and their ability to observe and understand a broader range of relevant task outcomes.

Informal controls such as clan control work also can work through goal congruence rather than through the application of awards and sanctions. This implies that the controlees share the goals of the organization, and the ability of management (the controller) to monitor the controlees' behaviors and outputs are no longer relevant to the amount of effort the controlee expends on the task. The controlee will expend effort toward the task because he or she shares the goal of successful task completion with the organization. Moreover, in the presence of clan control the controlee will be motivated to avoid non-task-related behaviors and dysfunctional behaviors because they decrease the chances of goal attainment. These observations lead to the following hypothesis:

H3: Clan control will have a positive relationship with individual effort toward task

3.1.2 Effects of control on coordination success

Although the definitions we have presented for control and coordination are distinct, those used by organizational researchers have tended to overlap and intertwine. For example, Sherif et al. (2006) note that coordination mechanisms "…serve to increase the likelihood that each agent makes decisions consistent with the overall welfare of the organization" (p. 343), and they list monitoring work processes and rewarding cooperative behaviors, as well as facilitating communication, as mechanisms of coordination. Monitoring and rewarding are fundamental components of control.

Part of the confusion between coordination and control lies in the contemporary researchers' attention to mechanisms, just as earlier organizational theorists focused on organizational structures. Although coordination and control can be considered distinct conceptually, in practice many mechanisms used in organizations can have effects on both coordination and control. For example, Kraut and Streeter (1995) and Faraj and Sproull (2000) investigated coordination in software development projects. Kraut and Streeter operationalized formal impersonal coordination procedures as the use of project documents and memos, project milestones and delivery schedules, modification request and error tracking procedures, and data dictionaries. Formal interpersonal coordination procedures were operationalized as status review meetings, design review meetings, and code inspections. Faraj and Sproull, drawing on Kraut and Streeter's measure, operationalized administrative coordination as the extent of the project's use of formal policies and procedures for coordinating the team's work, project milestones and delivery schedules, project documents and memos, regularly scheduled team meetings, requirements/design review meetings, and design inspections. These measures of coordination rely on measuring the use of certain mechanisms in organizations. However, the same mechanisms have also been used as measures of control. For example, Kirsch (1997) includes meetings, progress reports, walk-throughs, and project plans as mechanisms of behavior control. Thus, although control and coordination are distinct concepts, they may be implemented through overlapping sets of mechanisms. Because of this we propose that control efforts can affect performance through improving coordination.

This effect of control efforts on coordination may occur because controlling complex work tasks requires them to be made more visible through the production of an artifact or a concrete representation of the work. Such representations of work may make the work of individuals more visible to other individuals with whom their work is interdependent, and this visibility of work should facilitate coordination. Control mechanisms may also serve to pace the progress of work, which may help to temporally coordinate the actions of various parties involved in the information systems development process. Finally, some control mechanisms, such as meetings, may facilitate task-related communication among parties involved in information systems development. This communication helps to improve coordination. Each of these possibilities is examined in more detail below.

Behavior control mechanisms rely on specifying, monitoring, and evaluating behavior. In order to monitor and evaluate behavior it must be made visible in some way to the controller. Many behavior control mechanisms make behavior or outcomes visible in some way, or require the production of a representation of work. This visibility can also be used to support coordination. Alternatively, the information used for control may actually arise from mechanisms implemented to influence coordination. Suchman (1995, p. 59) notes that "technologies designed for the coordination of complex distributed activities are commonly used as well for reporting on those activities, as a basis for centralized assessments of the efficiency and correctness of the local operations in which the technologies are embedded. In this way technologies for the local coordination of work become incorporated into interests of global control."

Behavior control mechanisms can also improve coordination by specifying the pace of work, and providing natural synchronization points such as scheduled milestones and meetings.

Finally, control efforts may influence coordination by providing opportunities for task-related interaction among individuals whose work is interdependent. Both Kraut and Streeter (1995) and Faraj and Sproull (2000) consider two dimensions of coordination. Kraut and Streeter make a distinction between formal and informal coordination, and Faraj and Sproull make a distinction between administrative coordination and expertise coordination. Formal or administrative coordination is usually mandated from a higher level in the organizational hierarchy and may involve the coordination of more tangible or economic resources such as office space, time, and financial resources. Kraut and Streeter's informal coordination, contrastingly, is operationalized by group meetings and collocation, which provide opportunities for individuals to communicate with each other and coordinate their work. Similarly, Faraj and Sproull's expertise coordination involves individuals having knowledge of each others' expertise, knowing where that expertise is needed in the group process, and bringing it to bear. Thus informal coordination and expertise coordination are not as closely tied to organizational structure, but are more micro interaction processes that occur between individuals. Gittell (2002) refers to these micro coordination processes as relational coordination. Behavior control mechanisms may also require people working on the same project to attend meetings together. This offers them an opportunity to interact and coordinate with each other in informal ways.

H4: Behavior control will have a positive relationship with individual coordination success

Clan control is also expected to positively influence coordination success. When clan control is operating task-related behavior is influenced by shared goals and values, and a common vision of the project. In addition, individuals attempt to be accepted as "regular" members of the team. Shared goals and values and a common vision of the project can be expected to improve coordination success because they increase the likelihood that team members work in similar ways, and that team members understand the ways that other team members work. In addition, team members who are attempting to be accepted as "regular" members of the project team will likely make efforts to make their work understood by other, and to understand the work of others, so that they can avoid being perceived as a poor worker or an obstacle. This reasoning leads to the following hypothesis:

H5: Clan control will have a positive relationship with individual coordination success

3.1.3 Moderating effect of controlees' perceptions of the task context

The nature of the task, as characterized by its behavior observability and outcome measurability, is central to theory on organizational control. The current framework for understanding of control modes and their antecedents, which informs much of the existing research on control, was developed in the context of relatively simple industrial tasks and was meant to be applicable to line workers and their managers (Cardinal 2001). However, complex work tasks, particularly those that involve knowledge work, have become increasingly common and important to business firms. Information systems development is such a task. Knowledge work is defined as work that produces information and knowledge (Machlup 1962; Stehr 1994), involves manipulation of abstractions and symbols (Fuller 1992), requires creativity and is difficult to routinize (Drucker 1993). The changing nature of work, particularly the increasing prevalence of knowledge work, should motivate us to modify and extend our understanding of organizational control (Walsh et al. 2006).

The current understanding of the role of task characteristics in control theory treats task characteristics such as behavior observability and outcome measurability as antecedents to control mode choice. Along with the controller's knowledge of the process by which inputs are turned into outputs, these characteristics of the task are thought to determine the appropriate control type or types to be used to control the task. In addition, it is assumed that if a controller is able to observe behavior, then he will be able to determine whether or not the behavior conforms to what has been specified.

This simplistic view of task and focus on the knowledge possessed by the controller, typically understood to be a manager, is adequate when applied to relatively simple tasks. However, in complex tasks involving knowledge work, such as information systems development, tasks are accomplished through a range of behaviors, some of which are easily observable and some of which are difficult to observe. Moreover, simple observation of behavior may be inadequate for the manager to make a determination of whether or not the behavior is conforming to what has been pre-specified. For example, coding is one of the fundamental activities of information systems development. However, it would be very difficult and costly for a manager to pre-specify appropriate coding behaviors, and then monitor the coding behavior to make sure it conforms to the pre-specified behaviors. It is possible to observe that an individual is coding, but difficult to observe whether or not the individual is writing code that will be efficient and effective. In order to do so, the manager would have to read and comprehend the code himself. Thus, while it may be easy to observe whether or not an individual is coding, it is very difficult to pre-specify appropriate coding behaviors and determine whether or not they are being followed.

Moreover, complex tasks may have some facets that are well-understood by the controller and others that are not well-understood by the controller. For example, systems development, at least for the development of large systems, is an activity that requires the coordination of many interdependent actors. Systems are usually too large and complex for any one person to completely understand, and the domain knowledge necessary to build a system is usually spread throughout an organization (Curtis et al. 1988; Walz et al. 1993). Thus, while an individual may have a good understanding of the processes in general which are used to create systems, the detailed knowledge of how a specific system works is distributed among many individuals.

Similarly, outcomes associated with a complex task have varying levels of measurability. In the information systems development context some outputs, such as the function of the system, may be measured through testing, but others, such as system quality or extensibility, are more difficult to observe and measure.

Thus, whereas the traditional way of looking at control treats the task as a monolithic entity and answers the question of what type of control should be used to control the task, given the task's characteristics, when we are studying the performance outcomes of control in a complex knowledge work task context where the manager may be unable to observe, comprehend, and measure all of the different types of behaviors and outcomes that are associated with such a task context, a more appropriate question to ask may be how effective will different modes of control be, given the task's characteristics. To answer this question we need to turn our attention away from choice of control mode and instead focus on the mechanisms through which control may affect performance, and how those mechanisms may be affected by different task characteristics. To do so we must also turn our attention away from the manager's control mode choice, and instead consider the role of the controlee in more detail.

We have proposed effort toward task as one of the primary mediators of control's effect on performance, and proposed that control has the effect of increasing effort toward task. The ability of control efforts to influence individual effort is expected to be moderated by task characteristics because task characteristics affect the controlees' perceptions of how difficult it is for the controller to observe and/or comprehend their behaviors or measure the outcomes of their work. That is, if the controlee believes that the controller is not able to effectively observe many of the behaviors associated with his or her work and determine whether or not they meet pre-specified standards, then behavior control may be expected to be less effective. Similarly, if the controlee believes that many of the outcomes associated with the project are difficult for the controller to accurately measure, then this limits the ability of outcome control mechanisms to motivate the controlee. This is because the controlee knows that under these conditions his work is unlikely to be rewarded, since the controller will have difficulty observing his work behaviors and measuring his outcomes. Moreover, the controlee has an incentive to free ride, because under these conditions his lack of effort and the outcomes of his lack of effort are also difficult to observe and measure.

Ouchi (1979) points out that extensive use of formal control modes may alienate employees by offending their sense of autonomy and self control and lead to unenthusiastic, perfunctory work. Perfunctory work may be understood as creating the illusion of working on a task, but not actually expending much effort toward the task. Jaworski (1988) adds that control systems that consist of imperfect measurement systems may result in dysfunctional behaviors such as gaming, smoothing, focusing, and invalid reporting. These effects may be particularly likely in the context of knowledge work, where the difficulty of observing behaviors and the controller's lower knowledge of the transformation process make any control efforts more likely to be based on imperfect measurement systems. Because of the imperfect measurement systems on which the formal control efforts are based, the control mechanisms are limited in their ability to encourage effort toward task. In addition, the imperfect measurement systems provide individual employees more latitude to allocate effort toward non task-related pursuits or toward perfunctory or even subversive behaviors. Since effort is not an unlimited resource, more latitude to engage in non-task-related behaviors or dysfunctional behaviors can be expected to decrease the amount of effort given to task. This leads to the following hypotheses:

H6: The more difficult the controlee believes it is for the controller to observe behaviors, the weaker the positive effect of behavior control on individual effort toward task

H7: The more difficult the controlee believes it is for the controller to measure outcomes, the weaker the positive effect of outcome control on individual effort toward task

3.1.4 Control variables for individual-level model

In addition to the main study variables, task difficulty and project complexity are included as control variables. Task difficulty is expected to affect individual effort toward task, and project complexity is expected to affect individual coordination success.

3.2 TEAM-LEVEL RESEARCH MODEL AND HYPOTHESES

The team-level research model is presented in Figure 2 on the following page. The model is explained in more detail in the sections that follow, and specific hypotheses are developed.

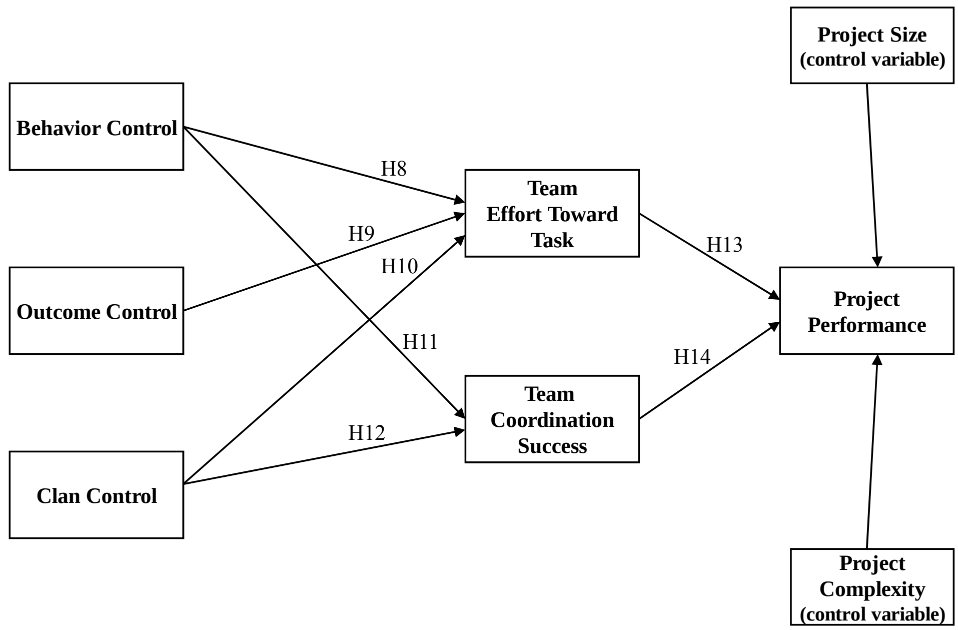

Figure 2: Team-level Research Model

3.2.1 Control modes and IS development performance outcomes

The objective of control systems is improved performance. However, systems development performance is a multidimensional concept, including dimensions such as adherence to schedules and budgets, quality of the system produced, knowledge gained during the project, and whether or not the system is being used and providing value to the business. Moreover, different stakeholders often hold varying views of the success of an information systems development project (Nelson 2005). This wide range of performance outcomes reflects everything about the project, from conception and evaluating the business case for the project, through development, to implementation and subsequent use. However, some of the decisions that determine these outcomes are made outside of the scope of the immediate project team and their manager. For example, whether or not a project provides value to a business is determined not only by the effectiveness of the development process and the quality of the system produced, which are under the scope of the project manager and project team, but also by the quality of the business case made for the project, the care with which that business case was evaluated, and the implementation strategy, all of which may be beyond the scope of the project manager and project team. Because this study examines specifically the effects of control efforts on project performance, we will only consider dimensions of performance that directly result from how the project was controlled and executed by the project manager and project team. Two such dimensions were identified by Nidumolu (1995) in a study of IT projects: product performance and process performance. Product performance includes such factors as ease of use, quality, and customer satisfaction with the product produced or enhanced by the project. Process performance refers to how well the project made use of its resources, such as time, human resources, and financial resources. Typical process performance indicators include adherence to schedule, work hour, and budget estimates. In this study both of these dimensions of project performance will be considered. The effects of control on both product performance and resource overruns will be examined.

3.2.2 Relationship of control modes to team effort toward task and team coordination success

The next five hypotheses are parallel to H1 through H5 in the individual-level model. The only difference is that in the team-level model effort toward task and coordination success are conceptualized and measured at the team level of analysis. The reasoning behind these hypotheses is the same as that for H1 through H5 in the individual-level model, presented in section 3.1.

H8: Behavior control will have a positive relationship with team effort toward task

H9: Outcome control will have a positive relationship with team effort toward task

H10: Clan control will have a positive relationship with team effort toward task

H11: Behavior control will have a positive relationship with team coordination success

H12: Clan control will have a positive relationship with team coordination success

3.2.3 Team effort toward task and project performance outcomes

Team effort toward task, in turn, is expected to improve performance. The direct link between effort and work performance has been suggested by several management studies, most of which have examined the effects of various personal characteristics on effort, and subsequently on performance. For example, Brown and Peterson (1994) investigated the effects of competitiveness, instrumentality, role conflict, and role ambiguity on sales performance and job satisfaction. They found that instrumentality and role conflict affected performance only through effort, which had a positive and statistically significant relationship to performance. Similarly, Ingram et al. (1989) investigated the relationship of various types of commitment and motivation to sales performance. Extrinsic motivation and job commitment were found to have effects on sales performance that were mediated by effort, which had a positive and statistically significant relationship to sales performance. Outside of the sales context, Blau (1993) found a direct effort to performance relationship with a sample of 258 bank tellers, and Terborg and Miller (1978) tested 60 subjects with an experimental construction task, finding that effort had a direct effect on performance.

These studies suggest a direct relationship between individual effort toward task and individual performance. In the information systems development context most typical measures of performance are at the team or project level. Even though team performance may not be a simple additive function of individual team member effort toward task, it can still be reasonably expected to be a function of team effort toward task. Therefore, team effort toward task can be expected to have a positive effect on project performance, which leads to the following hypothesis:

H13: Team effort toward task will have a positive relationship with performance, mediating the effects of behavior control, outcome control, and clan control on performance

3.2.4 Team coordination success and project performance outcomes

Coordination success is also expected to improve project performance. Kraut and Streeter (1995) performed a survey study of the use of formal and informal coordination mechanisms in software development. Their definition of coordination was multifaceted. It included sharing information, coordinating activities, and developing a shared understanding. They found that formal mechanisms of coordination are positively associated with managerial assessments of project performance, while informal mechanisms of coordination were more closely associated with team member and user assessments of project outcomes.

Nidumolu (1995) studied the effects of administrative coordination and informal coordination on software development performance. Although there is not an exact correspondence between Nidumolu’s categories and those of Kraut and Streeter, the results are similar. Administrative or formal coordination methods were found to be associated with project performance through the intervening mechanism of residual project risk, or the uncertainty about project outcomes that remains late in the project. More informal coordination modes, Nidumolu found, led to improved project performance as well, but did not work through reduction of residual project risk.

Faraj and Sproull (2000) examined expertise coordination in software development. They defined expertise as specialized knowledge and skills and expertise coordination as knowing the location of expertise, knowing where it is needed, and bringing it to bear. Expertise coordination, their study demonstrated, has a positive effect on project performance above and beyond the effect of simply having expertise present on the team.

Finally, Tiwana and McLean (2005) examined expertise integration and its effect on team creativity in software development. In findings similar to those of Faraj and Sproull (2000), Tiwana and McLean demonstrated that other project factors thought to lead to project success, such as absorptive capacity, relational capital, and expertise heterogeneity, do so only through the mediating factor of expertise integration.

These studies suggest that improvements in coordination have a positive effect on information systems development project performance. This leads to the following hypothesis:

H14: Team Coordination success will have a positive relationship with performance, mediating the effects of behavior control and clan control on performance

3.2.5 Control variables for team-level model

In addition to the study variables, project size and project complexity are included as control variables, since in prior research studies these variables have been associated with IS development project performance.

4.0 METHODOLOGY

This chapter presents the details of the research design used to test the individual-level and team-level research models. The main topics addressed in this chapter include the design of the field survey, operationalization of the research constructs, description of the pre-test and pilot tests, and a description of the data collection process.

4.1 RESEARCH DESIGN

The research models were tested empirically with a field survey. Questionnaires were solicited from the project manager and team members who took part in recently-completed IS development projects in business and academic organizations. Separate questionnaires were developed for each group of respondents so that each responded to items that they were most qualified to provide responses to, and also to reduce the potential for common source bias.

Project managers, defined as the individuals with the role of controlling and overseeing the work of the project team members, responded to items measuring the formal control modes, performance outcomes, and project complexity. In addition, demographic variables related to the project, such as project size and budget, were assessed from the project manager questionnaires. The project manager is an appropriate choice to respond to these items because, as the controller, the project manager is the implementer and potentially the designer of the formal control structures, and should be familiar with them. In addition, since the objective of the study is to explore the performance effects of control modes, which are typically implemented by management, it is appropriate to measure them from management's perspective. In addition, the project manager also may be expected to have a clearer picture of the project's time and budget goals, as well as its performance relative to those goals.

Project team members, including developers and analysts, responded to items measuring clan control, difficulty of measuring outcomes, difficulty of observing behaviors, effort toward task, and coordination success at the individual and team levels. Since it is the controlee's perceptions of the difficulty of observing behaviors and measuring outcomes that are hypothesized to moderate the relationships between the formal control modes and effort toward task, it is appropriate to measure the manager's difficulty of observing behaviors and measuring outcomes from the controlee's perspective. In addition, only the controlees are qualified to give an accurate assessment of their effort toward task, and the degree to which their work was coordinated with that of other team members.

4.2 OPERATIONALIZATION OF RESEARCH CONSTRUCTS

The following sections describe the sources of the measurement items chosen to measure the study constructs. In cases where new items were developed for this research, the concepts underlying the development of the items are presented.

4.2.1 Measures for behavior, outcome, and clan control

The measures for the formal control modes, behavior and outcome control, are new items adapted from Kirsch (1996) and Kirsch et al. (2002). Table 1 presents the measurement items for behavior control. The measurement items for outcome control are presented in Table 2.

Table 1: Measurement Items for Behavior Control

To what extent did you use the following strategies when evaluating the performance of project team members?	
BC1	When assessing project team member performance, I placed significant weight on project-related behaviors
BC2	I held project team members accountable for how they behaved during the project
BC3	I expected project team members to follow an understandable, written sequence of steps to accomplish project goals
BC4	I assessed the extent to which existing, written procedures and practices were followed during the development process
BC5	I strictly enforced adherence to written rules and procedures

Table 2: Measurement Items for Outcome Control

To what extent did you use the following strategies when evaluating the performance of project team members?	
OC1	I used pre-established targets as benchmarks for performance evaluations of project team members
OC2	I placed significant weight upon timely project completion
OC3	I placed significant weight upon project completion within budget
OC4	I placed significant weight upon project completion to the satisfaction of the client
OC5	I evaluated performance by the extent to which project goals were accomplished, regardless of how the goals were accomplished
OC6	Project team member rewards were linked to results

The measure for the informal control mode, clan control, is adapted from Kirsch et al. (forthcoming). The items for the clan control measure are presented in Table 3 below.

Table 3: Measurement Items for Clan Control

To what extent do the following statements accurately describe your relationship with the project team?	
CC1	Shared norms and values among the project team members influenced their project-related behaviors
CC2	A common vision of the project influenced how the project team members behaved during the project
CC3	All project team members attempted to be "regular" members of the project team

4.2.2 Measures of difficulty of observing behaviors and difficulty of measuring outcomes

Difficulty of observing behaviors and difficulty of measuring outcomes are closely related theoretically to behavior observability and outcome measurability, for which there are existing measures in the literature. However, in this study difficulty of observing behaviors and difficulty of measuring outcomes are meant to reflect the project team members' perceptions of how well the project manager can observe and evaluate their behavior and outcomes of their work, and the existing measures focus more on actions taken by controllers to observe behavior or observe outcomes. Because of this, new measures were developed for these constructs. The items for difficulty of observing behaviors and difficulty of measuring outcomes reflect the project team members' perceptions of the manager's ability to observe their work behavior and measure their work outcomes. The items for difficulty of observing behaviors are shown in Table 4, and the items for difficulty of observing outcomes are shown in Table 5.

Table 4: Measurement Items for Difficulty of Observing Behaviors

Please indicate your level of agreement with the following statements:	
DOB1	My manager could not tell how well I was contributing to the project simply by observing my actions
DOB2	It was easy for my manager to determine whether or not I was doing what I was supposed to be doing by observing my behavior
DOB3	It was difficult for my manager to determine whether I was slacking off or working very hard on the project
DOB4	My behaviors on the project were difficult for my manager to evaluate

Table 5: Measurement Items for Difficulty of Measuring Outcomes

Please indicate your level of agreement with the following statements:	
DMO1	It was difficult for my manager to determine whether I achieved specified outcome targets
DMO2	It was difficult for my manager to measure the specific performance outcomes of my work on the project
DMO3	The outcomes of the work I did on the project were easy for my manager to specify
DMO4	The outcomes of my work on the project were difficult for my manager to evaluate

4.2.3 Measures of effort toward task

The measurement items used in this research to measure effort will be adapted from the intensity dimension of Brown and Leigh's (1996) effort measure. Brown and Leigh also included a time commitment dimension in their effort measure, and the target of the effort is reflected in the wording of the items that measure intensity of effort. Brown and Leigh's duration of effort dimension will not be used here because it measures mainly the hours at the office and emphasizes the perspectives of clients and peers. Then number of hours spent at the office does not necessarily reflect effort toward task, and such a measure might also reflect effectiveness at impression management rather than actual hours of work. For this study, the intensity dimension of Brown and Leigh's measure was adapted so that it refers to the project as the target of effort.

The adapted items are shown below in Table 6 (individual effort toward task) and Table 7 (team effort toward task). As a result of the pilot tests, these measures were further revised before the main data collection effort. The revised measures are presented in Table 13 (individual effort toward task) and Table 14 (individual effort toward task) on page 46.

Table 6: Measurement Items for Effort Toward Task (Individual Level)

Please indicate your agreement with the following statements in relation to the specific project you are reporting on in this survey. If you were not assigned to the project full-time, answer with respect to the portion of your time when you were assigned to be working on the project	
IEFF1	When there was a project-related task to be completed, I devoted all my energy to getting it done
IEFF2	I worked on my project-related tasks with intensity
IEFF3	I worked at my full capacity in all of my job duties related to the project
IEFF4	I strived as hard as I could to be successful in my work on the project
IEFF5	I really exerted myself working on the project

Table 7: Measurement Items for Effort Toward Task (Team Level)

Please indicate your agreement with the following statements in relation to the team as a whole, and its work on the specific project you are reporting on in this survey.	
TEFF1	When there were project-related tasks to be completed, the team devoted all its energy to getting them done
TEFF2	The team worked on their project-related tasks with intensity
TEFF3	The team worked at its full capacity in all of its job duties related to the project
TEFF4	The team strived as hard as it could to be successful in its work on the project
TEFF5	The team really exerted itself working on this project

4.2.4 Measures of coordination success

Malone and Crowston (1994) define coordination as the management of dependencies between tasks, and they classify the dependencies into several types, including shared resource dependencies, producer/consumer dependencies, simultaneity constraints, and task/subtask dependencies. In addition, since information systems development is knowledge work, many of the dependencies between subtasks are knowledge or expertise dependencies. Faraj and Sproull

(2000) demonstrate that expertise coordination is very important to software development project success. They define expertise coordination as “knowing where expertise is located, recognizing where it is needed, and bringing it to bear” (p. 1556). In developing a measure of coordination success, each of these types of constraints should be considered and reflected in the measure. As noted by Malone and Crowston (1994, p. 90) “Good coordination is nearly invisible, and we sometimes notice coordination most clearly when it is lacking.” Thus, a measure of coordination success can measure both the presence of indicators of good coordination and the absence of indicators of poor coordination. Table 8 below shows the items developed for measuring coordination success at the individual level, and Table 9 shows the items developed for measuring coordination success at the team level.

Table 8: Measurement Items for Coordination Success (Individual Level)

Please indicate your agreement with the following statements in relation to the specific project you are reporting on in this survey.	
ICS1	Resources I needed to do my work on the project were available when I needed them
ICS2	When I was dependent on other team members to finish something before I could begin my work they finished on time
ICS3	It was easy to integrate my work with that of other team members
ICS4	I understood what parts of the task I was responsible for and how those parts of the task related to the parts that were the responsibility of other team members
ICS5	When I needed to access the specialized knowledge or expertise of other team members, I was able to do so
ICS6	I often was left with nothing to do because I had to wait for other team members to finish their work
ICS7	Overall, my work was successfully coordinated with that of other team members

Table 9: Measurement Items for Coordination Success (Team Level)

Please indicate your level of agreement with the following statements in relation to the specific project you are reporting on in this survey. Your answers should reflect your assessment of the project team as a whole.	
TCS1	Resources team members needed to do their work on the project were available when they needed them
TCS2	When team members were dependent on other team members to finish something before they could begin their work the other team members finished on time
TCS3	It was easy for team members to integrate their work with that of other team members
TCS4	Team members understood what parts of the task they were responsible for and how those parts of the task related to the parts that were the responsibility of other team members
TCS5	When team members needed to access the specialized knowledge or expertise of other team members, they were able to do so
TCS6	Team members were often left with nothing to do because they had to wait for other team members to finish their work
TCS7	Overall, the work of each team member was successfully coordinated with the work of the other team members

4.2.5 Performance measures

Both objective and perceptional performance measures were utilized, and performance was assessed from the perspective of both the project managers and the team members. Items adapted from Nidumolu (1995) to measure resource overruns are shown in Table 10 on the following page.

Table 10: Measurement Items for Resource Overruns

RESOV1	By approximately what percentage, if any, did actual costs for the project overrun originally budgeted costs? (Indicate underrun by a negative sign. For example, enter 20% if the project was 20% over budget, or -10% if the project was 10% under budget)
RESOV2	By approximately what percentage, if any, did actual completion time for the project overrun originally budgeted completion time? (Indicate underrun by a negative sign. For example, enter 30% if the project was 30% over time, or -10% if the project finished 10% earlier than expected)
RESOV3	By approximately what percentage, if any, did actual systems and programming effort for the project overrun originally budgeted effort? (Indicate underrun by a negative sign. For example, enter 10% if the project used 10% more person days than expected, or -10% if the project used 10% less than expected)

An additional measure of project performance is the product performance construct from Ravichandran and Rai (1999). While the resource overruns measure focuses on the performance of the project against its budget, schedule, and resource use goals, the product performance measure is included to reflect the success of the information system developed or enhanced by the project in meeting the needs of its users. The items measuring product performance are presented in Table 11 below.

Table 11: Measurement Items for Product Performance

Please indicate your agreement with the following statements in relation to the specific project you are reporting on in this survey.	
PRODP1	Users perceive that the project deliverable meets intended functional requirements
PRODP2	The information provided by the project deliverable meets user expectations
PRODP3	The project deliverable meets user expectations with respect to ease of use
PRODP4	Users are satisfied with the overall quality of the project deliverable

4.2.6 Measures of key control variables

Key control variables for the study include project size and complexity, as these variables have been demonstrated in prior research to be related to IS project performance. Project size was measured with an item that asks project managers to indicate the number of team members who worked on the project. Other potential measures of project size, such as project budget and duration, are also included on the survey questionnaire.

Complexity of the IS development project was measured with items from Xia and Lee (2005). These items, shown in Table 12 below were developed to measure structural organizational complexity and structural IT complexity.

Table 12: Measurement Items for Project Complexity

Please indicate your agreement with the following statements in relation to the specific project and system you are reporting on in this survey.	
ISDPC1	The project team was cross-functional
ISDPC2	The project involved multiple external contractors and vendors
ISDPC3	The project involved coordinating multiple user units
ISDPC4	The system involved real-time data processing
ISDPC5	The project involved multiple software environments
ISDPC6	The project involved multiple technology platforms
ISDPC7	The project involved a lot of integration with other systems

4.3 PRE-TEST AND PILOT STUDIES

A pre-test and two small pilot studies were conducted prior to the main data collection to further refine the measurement items and data collection procedures.

4.3.1 Pre-test

A pre-test of the proposed measurement items was conducted to test whether the measurement items were clear to respondents, and whether they reflected the conceptual definitions of the constructs they were intended to measure.

To conduct the pre-test, first a document listing the proposed items and their sources was distributed to four IS researchers and one marketing researcher familiar with the study, and they were asked to review the items for clarity and face validity. Based on their feedback, several small changes to the wording of some items were made. Following these changes the survey was implemented online using the Qualtrics survey software, and the original reviewers, along with two IS doctoral students, were asked to review the items again. Feedback from this second review indicated that no further changes were needed to the measurement items.

4.3.2 First pilot study

Following the pre-testing of the survey items and online instrument, a pilot study was conducted to test the data collection strategy. For the pilot study, several people who manage IS development projects were contacted and asked to complete the survey for a specific project and then forward the survey URL to the team members who had worked for them on the project. As an incentive for the pilot study, the IS managers were informed that all respondents who were part of a complete project set (includes completed surveys from a person in a managerial role and multiple team members who they supervised on that project) would be included in a drawing for ten $25 gift certificates.

Despite the incentives, it was very difficult to collect data for the pilot study. Twelve individuals who manage IS projects were contacted and asked to participate in the pilot by responding to the survey for one or more of the projects that they manage. In total, only 8 completed responses were received. They were associated with 4 different projects in 3 different organizations. There were 3 responses from project managers and 5 responses from team members.

Several factors contributed to the difficulty of gathering pilot data. First, the survey design places the burden of effort on the person who manages the IS project, because that person must fill out the survey for a project, and then also identify the team members involved in the project, forward the survey URL to them, and ask them to complete the survey. So, not only does the manager have to spend his or her time responding to the survey, he or she also must ask others to spend time doing so. Second, the current economic recession has led to layoffs in many business organizations, and the employees who remain are reluctant to participate in a survey. Finally, the survey took longer to fill out than anticipated, contributing to the number of respondents who started the survey but did not finish it. Project Managers needed on average 17 min. 41 seconds to complete the survey (ranging from 15:28 – 21:22). Team members took an average of 16 min. 10 seconds to complete the survey (ranging from 7:17 to 29:55).

Because of the difficulty of acquiring pilot data, changes were made to the data collection procedure for the main study. The first change was to make the survey instrument shorter by removing some redundant measures and simplifying the measure for ISDP functional complexity, a control variable, by including only two of its dimensions. In the pilot test there were two types of redundancy in the measures. First, some constructs were measured from both the project managers and the team members. The number of these was reduced. Second, some of the performance measures overlapped with each other. In these cases one measure was chosen. The effect of these changes was to reduce the project manager survey from 75 items to 50 items, and the team member survey from 76 items to 57 items.

The second change to the data collection procedure was to increase the incentive drawings and to provide a small incentive payment of a $10 gift certificate to the project managers of each completed project set. It was hoped that this additional incentive for the project managers would help to overcome the burden caused by their dual role of having to fill out the survey and also ask the team members who worked for them on the project to do so.

The third change to the data collection procedure was to make an attempt to contact large groups of individuals who manage IS development projects by distributing information about the study to groups such as the Project Management Institute's IS Special Interest Group (PMI-ISSIG), the Association of Information Technology Professionals, and several local PMI chapters.

Because the pilot study yielded so little data it was not practical to perform statistical tests of the measurement model or to do any hypothesis testing. However, examination of the responses to the survey items indicated potential problems with the measures for individual effort toward task and team effort toward task. Of the 5 team member responses received in the pilot, 4 of the 5 respondents indicated 7 ("strongly agree") for all of the individual and team-level effort toward task items. The other respondent had some variability in the individual measure (two 7s, one 6, two 5s), but indicated 6 for every team-level effort toward task item.

It is likely that these skewed responses to the items measuring effort toward task were caused by social desirability bias, since the items ask the respondent how hard he or she worked on project tasks. Respondents may exaggerate the level of their effort in order to give a response that they feel is socially desirable. Moreover, this effect may have been magnified in the pilot by the nature of the sample. The researcher knows many of the pilot study respondents personally, so the respondents could have been conscious of the fact that even though the survey is anonymous, at least one person they knew would be able to see their responses. The respondent with some variability in his responses to the items was someone who the researcher does not know personally. This lack of variability in the effort toward task measures suggested that the data collection procedure be changed to encourage the respondents to be honest in their responses, and to give respondents a greater sense of trust that their responses are truly anonymous. Changes were made to the survey items and instructions to attempt to do so.

The lack of variability in the effort toward task measures may also have been caused by properties of the items themselves. The items are stated in the positive, and they ask respondents to agree or disagree with the statement. This could have biased the responses to be higher than they should have been. To address this problem, the measures were revised to ask respondents to rate their level of effort, rather than agreeing or disagreeing to statements stated in the positive. In addition, respondents were asked to rate their level of effort not absolutely, but relative to their level of effort on other projects on which they had worked in a professional setting. Table 13 (individual level) and Table 14 (team level) below show the new, revised effort toward task measures. Both of these measures use a 7-point Likert scale ranging from very low to very high.

Table 13: Revised Items for Individual Effort toward Task

Please rate the following for the specific project you are reporting on in this survey compared to other projects you have worked on in professional settings. Please answer honestly. Your responses are strictly confidential:	
IEFF1	Amount of energy I expended toward project-related tasks
IEFF2	The intensity of my effort on project-related tasks
IEFF3	My effort toward making the project a success
IEFF4	My total level of exertion on the project

Table 14: Revised Items for Team Effort toward Task

Please rate the following in relation to the team as a whole, and its work on the specific project you are reporting on in this survey. Please answer honestly. Your responses are strictly confidential:	
TEFF1	Amount of energy the team expended toward project-related tasks
TEFF2	The intensity of the team’s effort on project-related tasks
TEFF3	The team’s effort toward making the project a success
TEFF4	The team’s total level of exertion on the project

During the pilot study the researcher also became aware of the need for a new control variable that measured respondents' perceptions of the difficulty of the task. This control was included to account for variability in effort toward task caused by the difficulty of the task for a particular respondent. It is a one-item measure that asks respondents: "How difficult for you were the project tasks you were assigned?", and asks them to respond on a 7-point Likert scale ranging from "very easy" to "very difficult".

Because of the revision of the instructions and items for the effort toward task measures, a second pilot study was conducted to test these measures.

4.3.3 Second pilot study

For the second pilot study, an online survey was created with the new effort toward task measures the new single-item task difficulty measure, and the measures for difficulty of observing behaviors and difficulty of measuring outcomes, since those measures were new measures developed for this research and required further testing. Students in the Introduction to MIS course at University of Pittsburgh were asked to take the survey, reporting on a particular project that they had been involved with either at work, at an internship, or, if they had no work experience, a class project. The questionnaire was completed by 26 students.

Descriptive statistics for the measures indicate that the new effort toward task measures exhibit greater variability than the old measures. The descriptive statistics for the constructs included in the second pilot study are shown on Table 15 on the following page.

Table 15: Descriptive Statistics for Constructs in Second Pilot

Construct	Mean	Standard Deviation	Min	Max
Difficulty of Observing Behaviors	4.06	1.59	1.75	7.00
Difficulty of Measuring Outcomes	3.59	1.44	0.25	6.25
Individual Effort toward Task	5.57	.80	3.75	7.00
Team Effort toward Task	5.03	1.03	1.00	7.00

Reliability of the new measures was also assessed by calculating Cronbach's alpha for each construct. As shown below in Table 16, the Cronbach's alpha values suggest that the new measures are reliable.

Table 16: Cronbach's Alpha for Constructs in Second Pilot

Construct	Cronbach's Alpha
Difficulty of Observing Behaviors (DOB)	.87
Difficulty of Measuring Outcomes (DMO)	.84
Individual Effort toward Task (IE)	.93
Team Effort toward Task (TE)	.95

Finally, a factor analysis was conducted to test whether or not the new measures exhibit convergent and discriminant validity. The factor analysis was conducted using principle component analysis as the extraction method and varimax rotation. The number of factors was not specified beforehand. Four factors with eigenvalues greater than 1.0 emerged, explaining 82.06% of the variability in the items. Although there is some significant cross loading with item DOB4, all the items loaded most highly on the construct which they were intended to measure. This factor analysis suggests that the new measures exhibit adequate convergent and discriminant validity. The results of the factor analysis are displayed in Table 17 below.

Table 17: Factor Analysis for Constructs in Second Pilot

Item	Factor 1	Factor 2	Factor 3	Factor 4
IE1	.138	**.936**	.108	-.010
IE2	-.061	**.918**	-.098	.032
IE3	-.020	**.896**	-.085	.113
IE4	.026	**.906**	.044	.072
TE1	**.923**	.011	-.062	-.075
TE2	**.932**	.146	-.070	.188
TE3	**.915**	-.052	-.020	.069
TE4	**.938**	-.009	-.119	.052
DOB1	-.210	-.062	**.869**	.075
DOB2	-.177	-.101	**.880**	.087
DOB3	.010	.166	**.820**	.375
DOB4	.358	-.053	**.609**	**.512**
DMO1	-.152	.168	.079	**.841**
DMO2	-.021	.099	.438	**.733**
DMO3	.259	.073	.402	**.799**
DMO4	.136	-.053	-.002	**.740**

4.4 DATA COLLECTION

4.4.1 Data collection procedures

The survey was implemented online via the Qualtrics survey software. There was one online questionnaire that branched to different sets of items based on whether the respondent was a manager or a team member. For the main data collection effort individuals likely to have a managerial or supervisory role related to IS development projects were contacted and provided with information about the study and a link to a web page with information on the study, as well as a direct link to the online survey itself. They were asked to fill out the survey for a particular project completed during the last two years, and then to forward the study URL to the team members who worked for them on the project and ask them to fill out the survey for that project. Managers were also asked to instruct team members to use the same names they used for the project and organization in order to facilitate matching of the responses.

To encourage participation, three different types of incentives were provided to respondents. First, a summary of study results was promised to participants upon request. Second, project managers of completed project sets, including the manager survey and surveys from multiple team members, were awarded a $10 Amazon.com gift certificate via email. Finally, all respondents who were part of completed project sets were entered into multiple drawings for prizes. In the first two drawings, multiple Amazon.com gift certificates in $50, $25, and $10 denominations were awarded. In the final drawing, which has not yet been completed, fifteen $100 Visa cards will be awarded.

Early in the data collection process several potential respondents expressed concern that participating in the survey would cause them to have to share confidential data. To alleviate this concern, on the study information web page and in email communications, potential participants were instructed that they could use fictional names for their project and organization, as long as all respondents for a particular project or organization used the same fictional names.

Study respondents were reached through several different approaches. The researcher contacted IS managers in three different organizations in which he had worked as a developer and asked them to participate in the survey. He also asked several other personal contacts known to have a supervisory or managerial role related to IS development projects to participate. These contacts were, in turn, asked to share information about the study with their own contacts who had a supervisory or managerial role related to IS development projects.

In addition to personal contacts, efforts were made to ask for participation from members of the Project Management Institute (PMI), the PMI Information Systems Special Interest Group (PMI-ISSIG), and the Pittsburgh chapter of the Association of Information Technology Professionals (AITP-Pittsburgh). The researcher attended several PMI meetings, and also gained permission to send an email describing the study to the members of PMI-ISSIG, the members of AITP-Pittsburgh, the members of the Pittsburgh PMI chapter, and the members of the Northeast Ohio PMI chapter.

During the data collection effort, emails were sent periodically to manager respondents to let them know how many team members had responded for their project, to encourage them to ask the team members to respond if they had not responded yet, and to encourage them to fill out the survey for a second project.

4.4.2 Description of final sample

In the final sample used for the dissertation analysis 84 completed surveys were received from managers. Of these, 37 were matched with one or more corresponding surveys received from team members. In total, 87 completed surveys were received from team members, with 73 of them matched to a corresponding manager survey. A project dataset was considered to be complete if at least one complete manager survey and one complete team member survey was received for that project. In total, there were 37 projects for which both a complete manager survey and one or more complete team member surveys were received. The following summary statistics refer to these 37 complete project datasets.

The average time since project completion was 6 months. The average number of team member responses per project was 2.03. Managers were asked to report the total number of team members involved with the project. The completed projects ranged from 2 to 250 team members (avg 17.86; stdev 40.37). Managers were also asked to report the total number of team members they personally had responsibility for managing on the project. This measure ranged from 2 – 150 team members (avg 10.89; stdev 24.60). From the sampling procedure it is impossible to determine whether the teams in the sample are co-located or distributed teams. However, effects of team proximity are likely to be captured in the individual study model by the variables difficulty of measuring outcomes and difficulty of observing behaviors.

4.4.3 Assessment of non-response bias

Because the survey questionnaires were distributed electronically to several different organizations and professional groups, as well as by word-of-mouth, it is impossible to calculate an accurate response rate. However, it is still appropriate to perform diagnostic tests to determine the likelihood of non-response bias. In order to test for non-response bias in the study dataset, t-tests were conducted to compare construct scores for all study variables between early responders and late responders. The bulk of the survey responses were received between mid-March and mid-April 2009. Emailed reminders resulted in a few more surveys trickling in between April 29, 2009 and May 18, 2009. Accordingly, early responders were defined as those who completed the survey before April 29, 2009. Surveys received on April 29,2009 and after were defined as late responders. The only variable for which significant differences were found in the construct scores between early and late responders was clan control. Early responders averaged 4.95 and late responders averaged 5.69. The difference was statistically significant ($p = .039$). There were no significant differences between early and late responders on any of the other study variables.

In addition, t-tests were also conducted to compare the demographic variables age, gender, and number of years in IS between early responders and late responders. There were no significant differences in these variables. Because only one study variable showed a significant difference between early and late respondents, these assessments suggest that the conclusions of this study are not likely to be significantly affected by non-response bias.

5.0 ANALYSIS AND RESULTS

5.1 VALIDATION OF MEASURES

For each of the measures convergent and discriminant validity were tested using exploratory factor analyses, and reliability was tested by calculating Cronbach's alpha. All completed survey responses were used in the validation of the measurement model. Factor analyses were conducted using principle components extraction with varimax rotation. In the first stage of each factor analysis the number of factors was not specified, to see how many factors with eigenvalues over 1.0 emerged.

Because of the relatively small sample size, and because different constructs were measured from different respondents, several separate factor analyses were conducted. In general, the factor analyses are grouped such that independent variables measured from the project managers are included together in one factor analysis, and independent variables measured from the team members are included together in a factor analysis. Similarly, dependent variables measured from the project managers and dependent variables measured from the team members are grouped together. There were some minor adjustments made to this strategy to attempt to ensure that the ratio of respondents to items for each factor analysis was at least 5, which has been suggested as the minimum ratio necessary for reliable factor analysis.

5.1.1 Behavior control and outcome control

All the items measuring behavior control and outcome control were included together in a factor analysis. As shown in Table 18 on the following page, four factors emerged with eigenvalues greater than 1.0. These factors together explained 66.64% of the variance in the items.

Table 18: Factor Analysis for Behavior Control and Outcome Control

Item	Item Text	Factor 1	Factor 2	Factor 3	Factor 4
OC1	I used pre-established targets as benchmarks for performance evaluations of project team members	.379	**.591**	-.034	-.165
OC2	I placed significant weight upon timely project completion	-.078	**.553**	.030	.476
OC3	I placed significant weight upon project completion within budget	.178	-.001	.037	**.890**
OC4	I placed significant weight upon project completion to the satisfaction of the client	.246	.061	**.642**	.160
OC5	I evaluated performance by the extent to which project goals were accomplished, regardless of how the goals were accomplished	-.150	-.070	**.820**	-.082
OC6	Project team member rewards were linked to results	-.073	**.751**	-.159	.116
BC1	When assessing project team member performance, I placed significant weight on project-related behaviors	.245	**.693**	.348	-.019
BC2	I held project team members accountable for how they behaved during the project	**.567**	.373	.364	-.077
BC3	I expected project team members to follow an understandable, written sequence of steps to accomplish project goals	**.872**	.057	.073	.047
BC4	I assessed the extent to which existing, written procedures and practices were followed during the development process	**.891**	.078	-.075	.125
BC5	I strictly enforced adherence to written rules and procedures	**.872**	.036	.075	.087

The outcome control items do not load cleanly onto one factor, but based on the items that load on it, Factor 2 seems to represent best the conceptual definition of outcome control. OC1 contains the ideas of pre-established targets being used as benchmarks for performance evaluations, and OC6 reflects team member rewards being linked to results. These are both key concepts of outcome control. OC2 reflects that significant weight is put on timely project completion. Item BC1, although originally intended to measure behavior control, loads most strongly on factor 2. This is likely because it contains a strong sense of evaluating performance, which to respondents may be associated with the end of a project, and "performance" is likely to be interpreted as outcomes by respondents.

The behavior control items load cleanly onto one factor, with the exception of BC1. This factor contains the ideas of holding team members accountable for their behavior, and of enforcing adherence to written policies and procedures. These concepts are reflective of behavior control.

Items OC3 through OC5 were dropped because they did not load onto the factors that were identified as measuring behavior control or outcome control. After dropping these items a second factor analysis was performed for the remaining behavior and outcome control items, specifying two factors. The results of the second factor analysis are shown below in Table 19. In this factor analysis, 60.21% of the variance in the items was explained by the two specified factors, and each item loads cleanly on one factor. With item BC1 included in the scale for outcome control Cronbach's alpha for behavior control is .85 and for outcome control Cronbach's alpha is .60.

Table 19: Factor Analysis for Behavior and Outcome Control after Dropping Items

Item	Item Text	Factor 1	Factor 2
OC1	I used pre-established targets as benchmarks for performance evaluations of project team members	.397	**.524**
OC2	I placed significant weight upon timely project completion	-.034	**.637**
OC6	Project team member rewards were linked to results	-.080	**.731**
BC1	When assessing project team member performance, I placed significant weight on project-related behaviors	.314	**.707**
BC2	I held project team members accountable for how they behaved during the project	**.623**	.368
BC3	I expected project team members to follow an understandable, written sequence of steps to accomplish project goals	**.877**	.027
BC4	I assessed the extent to which existing, written procedures and practices were followed during the development process	**.882**	.045
BC5	I strictly enforced adherence to written rules and procedures	**.875**	.012

5.1.2 IS development project complexity

The items used to measure IS development project complexity were entered into a factor analysis. One factor emerged that explained 50.28% of the variance in the items. Results of the factor analysis are shown in Table 20 on the next page.

Table 20: Factor Analysis for Project Complexity

Item	Item Text	Factor 1
ISDPC1	The project team was cross-functional	**.599**
ISDPC2	The project involved multiple external contractors and vendors	**.603**
ISDPC3	The project involved coordinating multiple user units	**.710**
ISDPC4	The system involved real-time data processing	**.536**
ISDPC5	The project involved multiple software environments	**.830**
ISDPC6	The project involved multiple technology platforms	**.835**
ISDPC7	The project involved a lot of integration with other systems	**.787**

All items loaded strongly on the one factor that emerged from the factor analysis, so all items were retained in the measure. The Cronbach's alpha for this measure is .82.

5.1.3 Difficulty of observing behavior, difficulty of measuring outcomes, and clan control

The original factor analysis for difficulty of observing behaviors (DOB), difficulty of measuring outcomes (DMO) and clan control is shown in the Table 21 on the following page. With all items included, two factors emerged, explaining 64.79% of the variance in the items.

Table 21: Factor Analysis for DOB, DMO, and Clan Control

Item	Item Text	Factor 1	Factor 2
DOB1	My manager could not tell how well I was contributing to the project simply by observing my actions	**.722**	-.178
DOB2	It was easy for my manager to determine whether or not I was doing what I was supposed to be doing by observing my behavior	**.677**	-.073
DOB3	It was difficult for my manager to determine whether I was slacking off or working very hard on the project	**.650**	-.088
DOB4	My behaviors on the project were difficult for my manager to evaluate	**.826**	-.020
DMO1	It was difficult for my manager to determine whether I achieved specified outcome targets	**.833**	-.216
DMO2	It was difficult for my manager to measure the specific performance outcomes of my work on the project	**.858**	-.063
DMO3	The outcomes of the work I did on the project were easy for my manager to specify	**.746**	-.135
DMO4	The outcomes of my work on the project were difficult for my manager to evaluate	**.761**	-.229
CC1	Shared norms and values among the project team members influenced their project-related behaviors	-.024	**.892**
CC2	A common vision of the project influenced how the project team members behaved during the project	-.262	**.889**
CC3	All project team members attempted to be “regular” members of the project team	-.133	**.798**

The clan control items load cleanly onto one factor. The Cronbach's alpha for the 3-item clan control scale is .85. The difficulty of observing behavior and difficulty of measuring outcomes items, however, also load onto only one factor. A second factor analysis was conducted with the difficulty of observing behavior (DOB) and difficulty of measuring outcomes (DMO) items, specifying two factors, to see if the items could be distinguished into two scales. The two specified factors explain 67.88% of the variance in the measures. The results of this factor analysis are shown in Table 22 below.

Table 22: Factor Analysis for DOB and DMO, with Two Factors Specified

Item	Item Text	Factor 1	Factor 2
DOB1	My manager could not tell how well I was contributing to the project simply by observing my actions	**.718**	.288
DOB2	It was easy for my manager to determine whether or not I was doing what I was supposed to be doing by observing my behavior	**.827**	.056
DOB3	It was difficult for my manager to determine whether I was slacking off or working very hard on the project	.122	**.894**
DOB4	My behaviors on the project were difficult for my manager to evaluate	.434	**.763**
DMO1	It was difficult for my manager to determine whether I achieved specified outcome targets	**.705**	.494
DMO2	It was difficult for my manager to measure the specific performance outcomes of my work on the project	**.606**	**.612**
DMO3	The outcomes of the work I did on the project were easy for my manager to specify	**.677**	.369
DMO4	The outcomes of my work on the project were difficult for my manager to evaluate	**.722**	.363

DOB3 and DOB4 load cleanly onto one factor, and these two items capture the spirit of the DOB construct in a way that is clear and concise. They will be used as the DOB scale. In turn, DOB1, DOB2, DMO1, DMO3 and DMO4 load cleanly onto one factor and capture the spirit of the DMO construct. Since DMO2 loads strongly on both factors it was excluded from the analysis, and a second factor analysis specifying two factors was conducted. The results of this factor analysis are shown in Table 23 below.

Table 23: Second Factor Analysis for DOB and DMO, with Two Factors Specified

Item	Item Text	Factor 1	Factor 2
DOB1	My manager could not tell how well I was contributing to the project simply by observing my actions	**.724**	.291
DOB2	It was easy for my manager to determine whether or not I was doing what I was supposed to be doing by observing my behavior	**.825**	.064
DOB3	It was difficult for my manager to determine whether I was slacking off or working very hard on the project	.156	**.921**
DOB4	My behaviors on the project were difficult for my manager to evaluate	.464	**.750**
DMO1	It was difficult for my manager to determine whether I achieved specified outcome targets	**.724**	.443
DMO3	The outcomes of the work I did on the project were easy for my manager to specify	**.698**	.323
DMO4	The outcomes of my work on the project were difficult for my manager to evaluate	**.743**	.324

The two factors explain 70.17% of the variance in the items. The Cronbach's alpha for the resulting DOB scale is .77, and for DMO is .86.

5.1.4 Individual effort toward task, and individual coordination success

When all the items for individual effort toward task (IEFF) and individual coordination success (ICS) were loaded into a factor analysis, two factors emerged with eigenvalues over 1.0. These two factors explain 69.63% of the variance in the measurement items. Results of the factor analysis are presented in Table 24 on the next page.

Table 24: Factor Analysis for IEFF and ICS

Item	Item Text	Factor 1	Factor 2
IEFF1	Amount of energy I expended toward project-related tasks	.083	**.913**
IEFF2	The intensity of my effort on project-related task	.235	**.885**
IEFF3	My effort toward making the project a success	.139	**.883**
IEFF4	My total level of exertion on the project	-.020	**.942**
ICS1	Resources I needed to do my work on the project were available when I needed them	**.808**	-.126
ICS2	When I was dependent on other team members to finish something before I could begin my work they finished on time	**.814**	.162
ICS3	It was easy to integrate my work with that of other team members	**.846**	-.076
ICS4	I understood what parts of the task I was responsible for and how those parts of the task related to the parts that were the responsibility of other team members	**.640**	.451
ICS5	When I needed to access the specialized knowledge or expertise of other team members, I was able to do so	**.709**	.231
ICS6	I often was left with nothing to do because I had to wait for other team members to finish their work	.368	.353
ICS7	Overall, my work was successfully coordinated with that of other team members	**.826**	.321

The individual effort items all load cleanly onto one factor. Together, they also exhibit excellent reliability, with a Cronbach's alpha of .94.

Item ICS6 is dropped from the analysis because it doesn't load cleanly onto any one factor, and because it may confuse respondents because it has two concepts included in it – having nothing to do, and the state of having nothing to do being caused by waiting for other team members to finish their work. It is likely that individuals would have other work to do while waiting for team members to finish their work, and thus might be confused about how to respond to this item.

After dropping ICS6, the resulting scale for individual coordination success has a Cronbach's alpha of .88.

5.1.5 Team effort toward task, and team coordination success

When all the team effort toward task (TEFF) and team coordination success (TCS) items were loaded into a factor analysis, two factors emerged, explaining 68.70% of the variance in the items. The results of this factor analysis are displayed in Table 25 on the following page.

Table 25: Factor Analysis for TEFF and TCS

Item	Item Text	Factor 1	Factor 2
TEFF1	Amount of energy I expended toward project-related tasks	.094	**.868**
TEFF2	The intensity of my effort on project-related task	.208	**.931**
TEFF3	My effort toward making the project a success	.315	**.849**
TEFF4	My total level of exertion on the project	.167	**.907**
TCS1	Resources I needed to do my work on the project were available when I needed them	**.727**	.002
TCS2	When I was dependent on other team members to finish something before I could begin my work they finished on time	**.739**	.310
TCS3	It was easy to integrate my work with that of other team members	**.768**	.183
TCS4	I understood what parts of the task I was responsible for and how those parts of the task related to the parts that were the responsibility of other team members	**.742**	.348
TCS5	When I needed to access the specialized knowledge or expertise of other team members, I was able to do so	**.773**	.361
TCS6	I often was left with nothing to do because I had to wait for other team members to finish their work	.495	.011
TCS7	Overall, my work was successfully coordinated with that of other team members	**.845**	.240

As expected, the factor structure is very similar to the individual-level items. As with the individual-level items, all four team effort toward task items will be retained. The measure has a Cronbach's alpha of .93.

For the team coordination success measure, TCS6 will be dropped from the analysis, because it does not load strongly on the factor that all the other items load onto. The Cronbach's alpha for the resulting scale is .89.

5.1.6 Product performance

The items for product performance were entered into a factor analysis along with three items measuring the project's control over its resources. This factor analysis is shown in Table 26 on the next page. Although the three project resource control items are not used in the analyses to test the study hypotheses, they are included in the factor analysis to test the discriminant validity of the product performance items. Two factors emerge with eigenvalues over 1.0, and the loadings line up cleanly by construct. All items from the product performance scale will be retained in the analysis.

Table 26: Factor Analysis for Product Performance and Resource Control Items

Item	Item Text	Factor 1	Factor 2
PRODP1	Users perceive that the project deliverable meets intended functional requirements	**.890**	.270
PRODP2	The information provided by the project deliverable meets user expectations	**.890**	.247
PRODP3	The project deliverable meets user expectations with respect to ease of use	**.914**	.180
PRODP4	Users are satisfied with the overall quality of the project deliverable	**.932**	.211
RESC1	Control over project costs	.161	**.846**
RESC2	Control over project schedule	.238	**.905**
RESC3	Overall control exercised over the project	.267	**.894**

Cronbach's alpha for the product performance scale is .95, and for the resource control scale is .89.

5.2 INDIVIDUAL-LEVEL ANALYSIS AND RESULTS

5.2.1 Individual-level analysis descriptive statistics

Table 27 below shows the descriptive statistics for the constructs in the individual-level analysis. Correlations between these constructs are shown in Table 28 on the next page.

Table 27: Descriptive Statistics of Constructs in Individual-Level Analysis

Construct	Mean	Standard Deviation	Min	Max
Behavior Control	4.73	1.50	1.00	7.00
Outcome Control	4.72	1.30	1.00	7.00
Clan Control	5.19	1.36	1.00	7.00
Difficulty of Observing Behaviors	2.47	1.28	1.00	6.00
Difficulty of Measuring Outcomes	2.57	1.15	1.00	6.40
Individual Effort toward Task	5.75	1.02	2.75	7.00
Individual Coordination Success	5.66	.99	1.67	7.00

Table 28: Correlations among Constructs in Individual-Level Analysis

	BC	OC	CC	DOB	DMO	IEFF	ICS
Behavior Control (BC)	1.00						
Outcome Control (OC)	.375(**)	1.00					
Clan Control (CC)	-.022	-.090	1.00				
Difficulty of Observing Behaviors (DOB)	.006	.061	-.174	1.00			
Difficulty of Measuring Outcomes (DMO)	.088	-.024	-.329(**)	.544(**)	1.00		
Individual Effort toward Task (IEFF)	.115	.136	.138	-.407(**)	-.315(**)	1.00	
Individual Coordination Success (ICS)	-.164	-.059	.585(**)	-.259(*)	-.465(**)	.287(*)	1.00

** = significant at the .01 level (2-tailed)
*   = significant at the .05 level (2-tailed)

5.2.2 Tests of the individual-level research model and hypotheses

In order to test the hypotheses in the individual-level model, two separate regressions were performed, one for each of the dependent variables. For the first regression, individual effort toward task was the dependent variable, and the independent variables were entered hierarchically into the regression: first the control variable, task difficulty, then the independent variables, and finally the interaction terms.

Standard pre-requisites for regression analysis were checked, and all requirements are met for standard OLS regression. A plot of the residuals shows that they are approximately normally distributed. In addition, plots of the dependent variable vs each independent variable reveal that the relationships between them are linear. Finally, tolerance and variance inflation factors were calculated, and neither indicated any problems with multicollinearity in the data. Outlier tests were conducted, and four outlier data points were excluded from the analysis. The sample size for the regression after removing the outliers was 70 cases.

Table 29 on the following page presents the results of the hierarchical regression analysis with individual effort toward task as the dependent variable.

Table 29: Regression Results for Individual Effort Toward Task

	Step 1: Control Var			Step 2: Independent Vars			Step 3: Interaction Term	
	Std β	Std Err		Std β	Std Err		Std β	Std Err
Constant	**4.240(***)**	.519		**4.864(***)**	.603		**5.150(***)**	.556
Task Difficulty	**.303(***)**	.102		**.219(**)**	.098		**.173(*)**	.091
Behavior Control				.053	.077		.070	.071
Outcome Control				**.195(*)**	.083		**.218(**)**	.076
Clan Control				-.061	.091		-.077	.084
Difficulty of Observing Behaviors (DOB)				**-.294(**)**	.115		**-.330(**)**	.108
Difficulty of Measuring Outcomes (DMO)				**-.268(*)**	.128		-.205	.118
DOB*BC							.117	.057
DMO*OC							**.309(***)**	.069
Adj R^2		.107			.343			.453
Δ Adj R^2		.107			.236			.110
F Change		8.749			5.610			6.917
Significance		.004			< .001			.002

*** = significant at the .01 level
** = significant at the .05 level
* = significant at the .10 level

The first step of the hierarchical regression analysis examines the effect of the control variable, task difficulty, on individual effort toward task. This regression is significant ($F = 8.749$, $p < .01$), and the adjusted R^2 is 10.7%. The control variable, task difficulty, is shown to be positively related to individual effort toward task ($\beta = .303$, $p < .01$), which was expected, as more difficult tasks should require a greater level of effort to accomplish.

In the second step of the hierarchical regression analysis the main study variables were added to the regression equation, including all variables that will be part of interaction terms in the third step. In order to facilitate the interpretation of interaction terms in the final step, all variables that are part of interaction terms were mean-centered prior to performing the analysis. The addition of the main study variables resulted in an increase in adjusted R^2 of 23.6%, and the change is statistically significant ($\Delta F = 5.610$, $p < .001$). The first three hypotheses predict that each of the three modes of control (behavior control, outcome control, and clan control) will have a positive relationship with individual effort toward task. Only H2 is supported, as outcome control is shown to have a positive relationship to effort toward task ($\beta = .195$, $p < .10$). In addition, in this step difficulty of observing behaviors ($\beta = -.294$, $p < .05$) and difficulty of measuring outcomes ($\beta = -.268$, $p < .10$) were also shown to be significantly related to effort toward task, suggesting that as behaviors become more difficult to observe and outcomes become more difficult to measure, effort toward task decreases.

In the final step of the hierarchical regression the interaction terms were entered into the equation. The interaction terms are included to test H6 and H7, which predict that as behaviors become more difficult to observe behavior control will have a smaller effect on effort toward task, and as outcomes become more difficult to measure outcome control will have a smaller effect on effort toward task. Adding the interaction terms increases adjusted R^2 by 11.0% ($\Delta F =$

6.917, $p < .01$), and adjusted R^2 for the full model is 45.3%. In this regression all the variables that were significant in prior steps remain significant. The interaction between behavior control and difficulty of observing behaviors is not significantly related to effort toward task, so H6, which posits that the more difficult it is to observe behaviors the less behavior control will affect effort toward task, was not supported. The interaction between difficulty of measuring outcomes and outcome control, however, is shown to be significantly related to effort toward task (β = .309, $p < .01$). This interaction term tests H7, which predicts that the effect of outcome control on effort toward task becomes weaker as difficulty of measuring outcomes increases.

To further interpret the interaction between outcome control and difficulty of measuring outcomes a graph was constructed following the procedures outlined by Aiken and West (1991). The graph shown in Figure 3 below shows the relationship between outcome control and effort toward task at high levels of difficulty of measuring outcomes and low levels of difficulty of measuring outcomes. For the purposes of this analysis, high and low levels of outcome control and difficulty of measuring outcomes were defined as one standard deviation above and below the means for those constructs, respectively. Figure 3 suggests that at high levels of difficulty of measuring outcomes (DMO), higher outcome control (OC) is associated with higher effort toward task, while at lower levels of difficulty of measuring outcomes higher outcome control is associated with lower effort toward task. This effect is opposite to what was hypothesized. Thus, H7 is not supported.

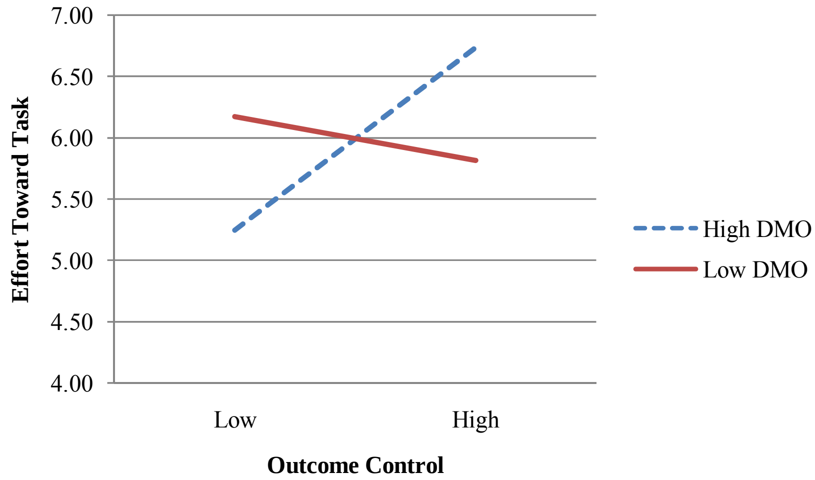

Figure 3: Interpretation of the Interaction between Outcome Control and DMO

H4 and H5 predict that behavior control and clan control will have a positive relationship with coordination success. A second regression was used to test these hypotheses. In this regression, the independent variables are behavior control and clan control, along with a control variable, IS development project complexity (ISDPC). The dependent variable is individual coordination success. As with the first regression, the standard prerequisites for OLS regression were checked before proceeding with the regression analysis. Table 30 below presents the results of the regression analysis. The sample size for this regression was 73 cases.

Table 30: Regression Results for Individual Coordination Success

	Std β	Std Err
Constant	**3.683(***)**	.539
Complexity	.111	.083
Behavior Control	**-.205(*)**	.072
Clan Control	**.577(***)**	.070
Adj R^2	.348	
Significance	< .001	

*** = significant at the .001 level
* = significant at the .10 level

The regression equation is statistically significant, with adjusted R^2 of 34.8% ($F = 13.807$, $p < .001$). The control variable, IS development project complexity, is not significantly related to coordination success. Behavior control is significantly related to coordination success ($\beta = -.205$, $p < .10$), but H4 is not supported because the relationship between behavior control and coordination success is opposite to what was hypothesized. That is, as behavior control increases coordination success decreases. H5, however, is supported. There is a statistically significant and positive relationship between clan control and coordination success ($\beta = .577$, $p < .001$). Table 31 below summarizes the results of the individual-level analysis.

Table 31: Summary of Results of Individual-Level Analysis

	Hypothesis	Result
H1	Behavior control will have a positive relationship with effort toward task	Not supported
H2	Outcome control will have a positive relationship with effort toward task	Supported
H3	Clan control will have a positive relationship with effort toward task	Not supported
H4	Behavior control will have a positive relationship with coordination success	Not supported; Relationship exists, but in opposite direction
H5	Clan control will have a positive relationship with coordination success	Supported
H6	The more difficult the controlee believes it is for the controller to observe behaviors, the weaker the positive effect of behavior control on effort toward task	Not supported
H7	The more difficult the controlee believes it is for the controller to measure outcomes, the weaker the positive effect of outcome control on effort toward task	Not supported; Relationship exists, but in opposite direction

5.3 TEAM-LEVEL ANALYSIS AND RESULTS

5.3.1 Team-level analysis descriptive statistics

The team-level analysis examines the impact of control on performance, proposing that the effects of control on performance are mediated by their effects on effort toward task and coordination success. Table 32 on the next page presents the descriptive statistics for the constructs in the team-level analysis, and Table 33 presents the correlations among them.

Table 32: Descriptive Statistics of Constructs in Team-Level Analysis

Construct	Mean	Standard Deviation	Min	Max
Behavior Control	4.56	1.48	1.00	7.00
Outcome Control	4.53	1.31	1.00	7.00
Clan Control	5.12	1.29	1.33	7.00
Effort Toward Task	5.47	.85	4.00	7.00
Coordination Success	5.40	.88	3.17	6.83
Product Performance	5.92	.93	1.75	7.00
Resource Overruns	.15	.25	-.42	.97

Table 33: Correlations among Constructs in Team-Level Analysis

	BC	OC	CC	TEFF	TCS	PRODP	RESOV
Behavior Control (BC)	1.00						
Outcome Control (OC)	.347(*)	1.00					
Clan Control (CC)	-.042	.022	1.00				
Effort Toward Task (TEFF)	-.048	.090	.370(*)	1.00			
Coordination Success (TCS)	-.143	-.050	.658(**)	.546(**)	1.00		
Product Performance (PRODP)	.112	.233	.379(*)	-.062	.189	1.00	
Resource Overruns (RESOV)	.185	-.169	-.238	.054	-.167	-.273	1.00

** = significant at the .01 level (2-tailed)
*   = significant at the .05 level (2-tailed)

5.3.2 Tests of the team-level research model and hypotheses

Partial-Least-Squares analysis (PLS) was used to test the hypotheses in the team-level research model. The dataset for analysis is small, with data on only 36 project teams, and PLS is appropriate for exploratory research with small datasets. In the PLS analysis, path coefficients, which are similar to regression coefficients, were determined by running the PLS algorithm. In order to determine the statistical significance of the path coefficients, a bootstrapping procedure was used which randomly duplicated and replaced data in the original dataset to come up with 200 separate samples of 100 cases each. Two separate PLS models were set up and analyzed. The first used the product performance perceptual measure as the dependent variable. The second used the objective resource overruns variable as the dependent variable. In each model direct paths were included between the three modes of control and performance in order to test whether or not their effects on performance are mediated by team effort toward task and team coordination success, as hypothesized in H13 and H14.

The following figures demonstrate the results of the PLS analysis. Paths that are statistically significant are shown with bold lines, and non-significant paths are shown with dotted lines. Figure 4 on the next page shows the results of the PLS analysis with product performance as the dependent variable. Product performance is a variable meant to reflect whether or not the system produced or enhanced by the project met the needs of its users in terms of quality, ease of use, and fulfilling requirements. This model explains 28.2% of the variance in the product performance construct.

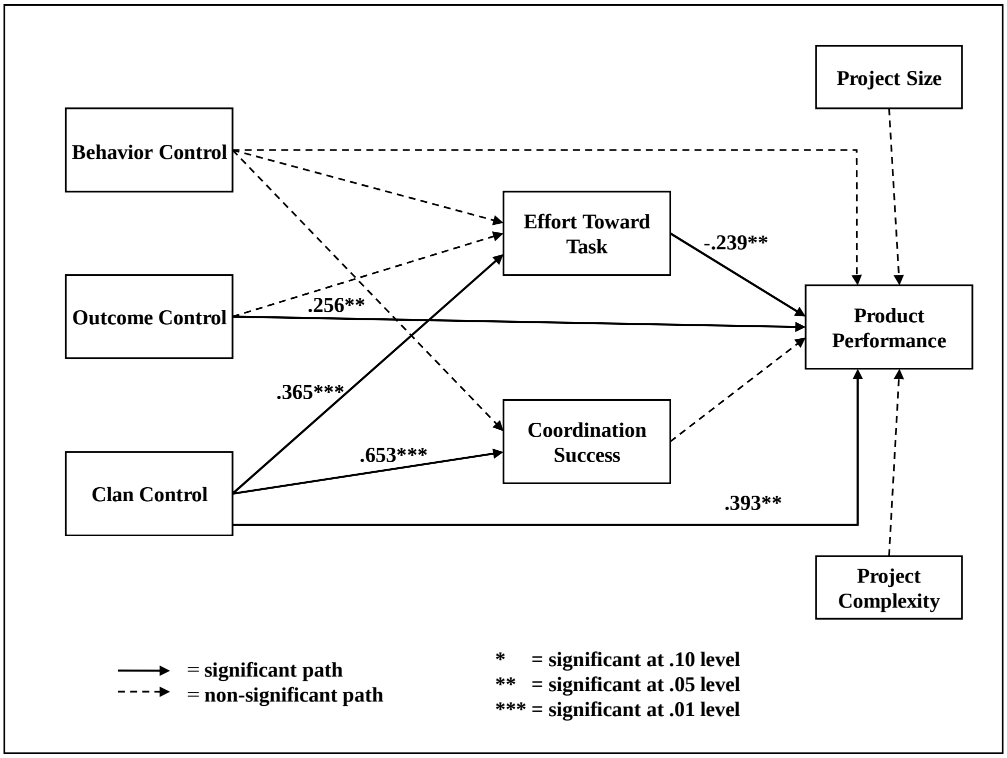

Figure 4: Results of PLS Analysis with Product Performance as the Dependent Variable

Figure 5 on the next page shows the results of the second PLS analysis, in which resource overruns was the dependent variable. Resource overruns, an objective measure, was measured as the average percentage of budget, schedule, and systems and programming effort overrun or underrun for the project. As such, this measure reflects the success of the project in terms of meeting goals for budget, schedule, and programming effort use. Because overruns are considered poor performance, a negative relationship between an independent variable and resource overruns means that that independent variable is associated with improved performance. This model explains 18.5% of the variance in the resource overruns variable.

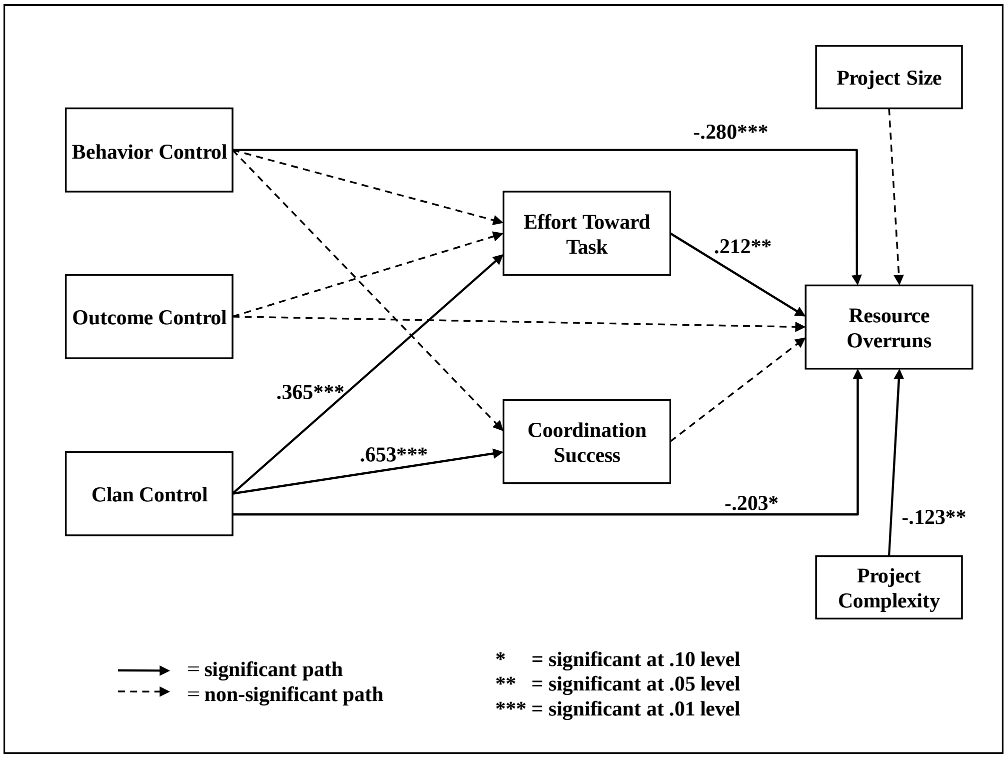

Figure 5: Results of PLS Analysis with Resource Overruns as the Dependent Variable

The direct paths between the control modes and the performance-related dependent variables demonstrate some direct effects of control on performance in the two PLS analyses. Behavior control is not significantly related to product performance, but is significantly related to improved performance in the form of reduced resource overruns ($\beta = -.280$, $p < .01$). In contrast to behavior control, outcome control has a positive and significant relationship with product performance ($\beta = .256$, $p < .05$), but no significant relationship to resource overruns. Clan control is shown to have a statistically significant relationship to both product performance ($\beta = .393$, $p < .05$) and resource overruns ($\beta = -.203$, $p < .10$).

H8 through H12 propose the effects of the control modes on the mediators in the model, effort toward task and coordination success. H8 and H9, which propose that behavior control and outcome control will both have a positive relationship with effort toward task, are not supported.

H11, which proposes that behavior control will have a positive relationship with coordination success, is also not supported. Thus, there are no statistically significant relationships demonstrated in the PLS analysis between the formal modes of control and either effort toward task or coordination success. The relationship between clan control and effort toward task (β = .365, $p < .01$) and coordination success (β = .653, $p < .01$) are both statistically significant, however, providing support for H10 and H12.

As part of the proposed mediated effects of control on performance, effort toward task and coordination success were proposed in H13 and H14 to be positively associated with performance. Neither hypothesis was supported. Contrary to H13 and H14, effort toward task was shown to have a significant negative relationship to product performance (β = -.239, $p < .05$) and a significant positive relationship to decreased performance in the form of increased resource overruns (β = .212, $p < .05$). There is no significant relationship demonstrated between coordination success and either performance variable.

Table 34 on the next page summarizes the results of the team-level analysis.

Table 34: Summary of Team-Level Analysis Results

	Hypothesis	**Result**
H8	Behavior control will have a positive relationship with effort toward task	Not supported
H9	Outcome control will have a positive relationship with effort toward task	Not supported
H10	Clan control will have a positive relationship with effort toward task	Supported
H11	Behavior control will have a positive relationship with coordination success	Not supported
H12	Clan control will have a positive relationship with coordination success	Supported
H13	Team effort toward task will have a positive relationship with performance, mediating the effects of behavior control, outcome control, and clan control on performance	Not supported; Team effort was shown to have a negative relationship with both performance dimensions
H14	Team coordination success will have a positive relationship with performance, mediating the effects of behavior control and clan control on performance	Not supported

6.0 DISCUSSION AND CONCLUSIONS

6.1 DISCUSSION OF RESEARCH FINDINGS – INDIVIDUAL LEVEL

Although only two of the seven hypotheses tested in the individual-level analysis were clearly supported, the analysis still has several interesting results that can contribute to our understanding of control and coordination of IS development projects. In addition, the measurement model challenges and the surprising findings that were counter to what was hypothesized provide interesting insights and questions for further research.

The individual-level regressions proved to be fairly robust. The adjusted R^2 values of 45.3% for the regression on individual effort toward task and 34.8% for the regression on individual coordination success suggest that the study models were able to explain a significant amount of variation in these variables. In the following sections the results of the individual-level analysis will be discussed in more detail.

6.1.1 Effects of control on individual effort toward task

Behavior control, outcome control, and clan control were all hypothesized to have a positive relationship with individual effort toward task. Only outcome control, however, was significantly related to individual effort toward task in the analysis.

Behavior control was expected to be positively related to individual effort toward task because behavior control works through the specification of behaviors that are appropriate for successful completion of a task, and then basing rewards or sanctions on compliance with the specified behaviors. It was hypothesized that an individual in an organization would attempt to gain rewards or avoid sanctions by complying with the specified behaviors. This, in turn, would keep the individual on task, thus increasing individual effort toward task. The analysis showed no significant relationship between behavior control and individual effort toward task. It is possible that this lack of a significant relationship between behavior control and individual effort toward task is the result of measurement issues, conceptual issues related to the nature of behavior control, or with failure to account for the effect of roles in the study conceptualization.

The measurement of behavior control may have contributed to its lack of a significant relationship to individual effort toward task. Behavior control was measured from the perspective of the project manager in this study. In retrospect, it would have made sense to measure control from the perspective of the team members, because it is their perception of control that affects their behavior. Regardless of the degree to which the manager feels he is using behavior control, it cannot be expected to motivate controlee behavior unless the controlees also perceive that behavior control is being used. That is, the controlees must perceive that they will be rewarded or sanctioned based on their compliance with specified behaviors. From the perspective of the statistical analysis, we would not expect the manager's perception of level of behavior control used to be related to the team member's individual effort toward task unless the team member's perception of the level of behavior control was highly correlated with the manager's perception of the level of behavior control.

From a conceptual standpoint, the link between behavior control and effort may not be expected to be as strong as the link between outcome control and effort. Since behavior control works through specifying behaviors for controlees to follow, it may have more of an effect on *how* the controlees work, rather than *how hard* they work. It was hypothesized that behavior control would increase effort toward task by keeping individuals on task, but perhaps it only serves to control *how* they work on task when they are on task. Moreover, in retrospect behavior control could also conceivably decrease effort toward task by decreasing the amount of search activities and decision-making activities that must be undertaken by team members. Since behavior control involves the written specification of appropriate behaviors and procedures, team members following the specified procedures would not have to make as many choices as if procedures were not specified, and they would not have to expend effort in trying to discover appropriate procedures. Thus, after more in-depth conceptualization of the relationship between behavior control and effort toward task we might expect the relationship to be indeterminate.

Another possibility is that the relative roles of the respondents in this study, managers and team members, carries an implicit expectation of evaluation and reward or sanction that overwhelms the specific effect of behavior control. In manager – team member relationships there is typically a formal structure in which the controller is responsible for evaluating the performance of the controlee in some way. The data collection process specifically sought these types of manager – team member relationships by asking people with a supervisory or managerial role with respect to a specific IS development project to fill out the manager survey, and then, in turn, to ask the people who worked for them on the project to fill out the survey. Controller-controlee relationships of this type generally come with an expectation of performance evaluation, which can lead to career benefits and sanctions, regardless of whether or not the behavior evaluation and rewards and sanctions are made explicit through a formal behavior control mechanism. That is, in typical manager – team member relationships there is a general sense that a manager or supervisor will be observing the employees who work for him and making evaluations based on those observations, and that rewards and sanctions are tied to those observations. It is possible that this general sense based on relative roles is more salient to the team members than the manager's perception of the level of behavior control utilized, and that in the statistical analysis the effect of relative roles overwhelms any variability in the manager's perception of behavior control utilized. The controlee may perceive behavior control based on role as a given, rather than perceiving variability in a manager's use of specific behavior control mechanisms.

Outcome control was expected to be significantly related to individual effort toward task because outcome control consists of setting goals or targets related to task performance, and then applying rewards or sanctions based on whether or not the goals are met. Individuals who want to gain rewards or avoid sanctions are expected to work harder to ensure that they accomplish the goals that are set for them as part of the outcome control mechanism. As expected, outcome control had a statistically significant positive relationship with individual effort toward task. This relationship was consistent and robust, remaining statistically significant when various different combinations of items were used to measure outcome control.

As with behavior control, outcome control was measured from the manager's perspective, but this is less likely to pose a problem with outcome control. It is likely that the controlee's perception of outcome control was similar to the controller's perception of outcome control, since the items carry a strong sense of using explicit, pre-specified goals or targets, and tying those goals or targets to performance evaluations and rewards. Because the goals and targets are explicit and pre-specified, they are visible to the controlee.

Clan control was expected to be positively associated with individual effort toward task because the shared norms and values and common vision that influence behavior in clan control may also serve to keep team members on task. Moreover, the desire to be accepted as a "regular" member of the team was expected to motivate team members to work harder in order to be seen as contributing members of the team. However, there was no relationship demonstrated between clan control and individual effort toward task in the analysis. Perhaps clan control, like behavior control, has more of an effect on *how* team members work rather than *how hard* they work. This possibility is supported by the strong relationship between clan control and individual coordination success, which will be discussed in the next section.

6.1.2 Effects of control on individual coordination success

Both behavior control and clan control were proposed to have a positive relationship with individual coordination success. Both were shown to have a significant relationship with individual coordination success, but behavior control was associated with decreased individual coordination success, which was opposite to what was hypothesized.

Clan control had a very strong relationship to individual coordination success in the analysis, supporting the idea that when shared norms and values, and a common vision of the project influence project-related behaviors it helps team members involved with the project to coordinate their work.

Behavior control was expected to improve individual coordination success because behavior control often requires or relies on the production of artifacts that are representations of the work that is being done. The written guidelines or procedures, schedules, walk-throughs, progress reports, and meetings that are typically associated with behavior control serve to make the work of team members more visible to each other, which in turn was expected to aid team members in coordinating their work. These mechanisms also may serve to improve coordination by pacing the progress of work, enabling temporal coordination. Finally, presenting and discussing the artifacts may also increase communication, which was expected to improve the success of coordination.

In the regression analysis there was a statistically significant relationship between behavior control and coordination success, but it was a negative relationship, counter to what was hypothesized. One possible explanation for this result is that the items measuring behavior control in this study focus mainly on written rules and procedures, and may not adequately reflect the use of the behavior control mechanisms that were expected to influence coordination success, such as progress reports, walk-throughs, and meetings. However, even written rules and procedures were expected to improve coordination success through their effect on making work more visible. Another possibility is that the reliance on written rules and procedures that are part of behavior control actually served to hinder coordination efforts by forcing team members to adhere to formal processes that were not the best ways to accomplish the task. In complex knowledge work, such as IS development, complexity may make it difficult to specify appropriate steps beforehand, and the dynamic nature of IS development projects may require a level of flexibility that is inconsistent with rigid specifications of specific behaviors.

6.1.3 Effects of difficulty of observing behaviors and difficulty of measuring outcomes

It was proposed that the effects of the various control modes on effort toward task would be moderated by the difficulty of observing behaviors and difficulty of measuring outcomes. The reasoning behind this expectation was that behavior control and outcome control rely on observability of behavior and measurability of outcomes in order to function properly. In the case of behavior control, if a controller cannot evaluate what the controlee is doing, or determine if what the controlee is doing is contributing to the project simply by observing the controlee's behavior, then the controller will encounter difficulty in determining whether the controlee should be rewarded or sanctioned for his behavior. The controlee recognizes this difficulty, and thus may not work as hard, because he knows that the controller's ability to observe and evaluate his actions is limited, and that the application of a reward or sanction cannot be directly determined through observation of behavior.

Similarly, in the case of outcome control rewards and sanctions are tied to the achievement of specific outcomes. If the controlee believes that the controller will have difficulty measuring or specifying outcomes, then the controlee will not work as hard, because he knows that the reward or sanction cannot be easily determined through the measurement of outcomes associated with his work on the project.

The interaction of behavior control and difficulty of observing behaviors was not a significant predictor of effort toward task in the regression analysis. Moreover, there was no main effect of behavior control on effort toward task. However, there was a statistically significant main effect of difficulty of observing behaviors on effort toward task. Difficulty in observing behaviors was associated with decreased effort toward task. Although this effect was not hypothesized, it is consistent with the conceptualization that motivated hypotheses on the moderation effect. As discussed above in section 6.1.1 on the relationship of control and effort toward task, the relative roles of managers and team members in organizations imply a general sense of behavior control. That is, it is generally understood that a manager or supervisor will observe the employees who work for him, and make performance evaluations based on those observations. Given this role-based general expectation of behavior control, then, the negative effect of difficulty of observing behaviors on effort toward task can be seen as moderating the effect of this general sense of behavior control on effort toward task, much in the same way as the proposed moderating relationship between difficulty of observing behaviors and behavior control. A team member expects some level of observation and evaluation by his or her supervisor based on their relative roles, and this expectation can be expected to motivate effort toward task. However, if the team member perceives that it is difficult for the supervisor to observe behavior, then the general expectation of observation and evaluation based on relative roles is not as effective at motivating effort toward task, and effort toward task decreases. This general expectation based on relative roles was not measured in this study, so the effect shows up in the analysis as a main effect of difficulty of observing behaviors on individual effort toward task.

The interaction between outcome control and difficulty of measuring outcomes was significantly related to individual effort toward task, but in a direction opposite to what was hypothesized. When it was more difficult to measure outcomes, higher levels of outcome control actually led to even higher levels of effort, rather than the lower levels that were hypothesized. One possible explanation for this result is that team members worked harder to try to overcome the manager's difficulty in measuring outcomes. Higher levels of outcome control imply that pre-specified goals, targets, and other results will be strongly tied to performance evaluations.

Perhaps team members who perceive that managers will have difficulty measuring or evaluating outcomes will fear that their performance evaluation will be inaccurate because of the manager's difficulty measuring or evaluating outcomes, and will try to work harder to either make the results or outcomes more obvious, or to send a secondary signal of performance in order to influence the performance evaluation. That is, team members may feel that if the outcomes cannot be easily measured, they should work harder to make the outcomes more obviously positive. Or, team members may decide that if outcomes are difficult to measure they will work harder, and the supervisor will notice their hard work and reward them appropriately.

6.2 DISCUSSION OF RESEARCH FINDINGS – TEAM LEVEL

The results for the team-level analysis was not as robust as those for the individual level. Because of the difficulty of collecting matched sample data, at the time of the analysis data was only collected from 36 teams. After the removal of an outlier, only 35 cases were used in the analysis. A popular guideline for PLS analysis suggests that the adequate sample size for PLS analysis should be ten data points for each arrow pointing to the construct with the most arrows pointing to it. The performance variables in the team-level research models have seven arrows pointing to them, suggesting that a sample size of 70 would be ideal. At 35, the team-level sample size is very small, and the significance of the path coefficients is very sensitive to the parameters chosen for the bootstrapping procedure. Smart PLS Version 2.0.M3 (Ringle et al. 2005) was used for the PLS analyses.

6.2.1 Effects of control on performance

Hypotheses H8 through H10 propose that behavior control, outcome control, and clan control will all have a positive relationship with performance. The PLS analyses provide partial support for hypotheses H8 and H9. Behavior control was associated with reduced resource overruns, but not to product performance. Conversely, outcome control was positively related to product performance, but not to resource overruns. H10 was fully supported, as clan control was positively related to product performance and negatively related to resource overruns. These results suggest that different modes of control may have different effects on performance. They also suggest that informal control modes such as clan control may be effective options for controlling complex tasks such as IS development.

Behavior control was associated with reduced resource overruns, which was measured by asking project managers to indicate the percentages by which the project exceeded or fell short of budgeted time, money, and resource effort. The measure of behavior control used in this study focused on the use of written procedures and practices being an important part of the evaluation of team members, as well as holding team members accountable for their behavior during the project. It is likely that the behavior control mechanisms reflected by this measure are written plans and procedures that are part of a formalized systems development methodology, or some other formal planning system, and that team members were evaluated in part based on how closely they adhered to the formal methodology. This resulted in reduces reduced resource overruns, which reflects effective control of budget, schedule, and human resources. However, formal behavior control did not lead to improved product performance, which represents the functionality, quality, and ease of use of the system produced or enhanced in the project.

The relationship of outcome control to the performance variables was opposite to that of behavior control. Outcome control, or evaluation of team members based on results and their performance relative to pre-established targets, was not associated with resource overruns. It was, however, associated with improved product performance. Thus, linking evaluation and rewards to pre-established targets and results was associated with producing a better product. It is possible that some of the pre-established targets or results that were used to evaluate team members may have been related to user satisfaction, or to fulfilling a certain set of user requirements, and that this explains why evaluating team member performance based on those targets improved product performance.

Clan control was significantly associated with improved product performance and with reduced resource overruns. When clan control is operating, shared norms and values influence project-related behaviors, a common vision of the project influences behavior, and team members attempt to be accepted as "regular" members of the project team. The analysis suggests that this resulted in both better control of project process variables, and also the production of a higher-quality product that better met the needs and expectations of its users.

6.2.2 Mediation through team effort toward task and team coordination success

The effects of the control modes on performance were expected to be at least partially mediated by team effort toward task and team coordination success. Accordingly, H8 through H12 propose that behavior control, clan control, and outcome control will have a positive relationship with team effort toward task and team coordination success, and H13 and H14 propose that team effort toward task and team coordination success will be positively associated with performance outcomes, mediating the effects of behavior control, outcome control, and clan control.

The results of the analyses do not support either partial or full mediation of the effects of control on performance by either team effort toward task or team coordination success. Only clan control is significantly related to either of the proposed mediators. It has a positive and statistically significant relationship to both team effort toward task and team coordination success. Behavior control and outcome control are not significantly related to either mediator variable. Moreover, team coordination success is not significantly related to product performance or resource overruns, and team effort toward task is significantly related to both performance variables, but with a negative association. That is, team effort toward task decreases product performance and increases resource overruns.

It is significant that, even with the small sample size, clan control had a highly significant and positive relationship to both team effort toward task and team coordination success. This suggests that when project-related behaviors are influenced by shared norms, values, and a common vision of the project, and when team members try to be accepted as regular members of the team, that this motivates them to work harder toward the task at hand, and also facilitates the coordination of their work.

It is surprising that outcome control was not significantly related to team effort toward task, since it was positively associated with individual effort toward task in the individual-level analysis. One possibility for the lack of a significant relationship between outcome control and team effort toward task in the team-level analysis is that the sample size for the analysis was too small, and there is likely more error in the team effort toward task measure than in the individual effort toward task measure. In the team-level measure, team member respondents were asked to assess the effort level of the team as a whole, and it is possible that this may have been difficult for the team members to assess, since it may be difficult to gauge the average effort level of other individuals on the project team, especially if the project has a large number of team members. It may be more appropriate to average the team members' assessments of their individual effort toward task, and use the average for the team effort toward task value. This was attempted in a post-hoc analysis. Behavior control was still unrelated to effort toward task, but outcome control had a positive relationship with effort toward task that was close to being statistically significant (t-value = 1.57).

Behavior control was not significantly related to team effort toward task in the main analysis, or in the post-hoc analysis using the average of the individual effort toward task scores of the team members. As mentioned in the individual-level study results, it is possible that behavior control can have two different effects on effort toward task. It could increase effort toward task through specifying behaviors that keep individuals on task, or through motivation by creating a sense that on-task effort will be rewarded. However, behavior control could also conceivably decrease effort toward task by decreasing the amount of search activities and decision-making activities that must be undertaken by team members. Thus, we might expect the relationship between behavior control and effort toward task to be indeterminate.

The effort toward task construct has a similar problem. The construct reflects the amount and intensity of energy expended on project-related tasks. However, this could reflect both "bad" and "good" effort. That is, effort expended toward project-related tasks could reflect an increased effort to make the project a success, or could reflect effort that was necessary to overcome problems caused by internal or external factors that complicated the project. For example, changes in the competitive environment could necessitate a change in requirements that complicates the project and causes team members to have to expend more effort just to reach an acceptable level of performance. Similarly, a poor design decision could cause problems later on in the development process that require extra effort to fix. In both these examples, the extra effort is not caused by motivation, and, while it could be expected to improve resource overruns all else being equal, it also reflects other unmeasured factors that can be expected to increase resource overruns. Thus, it is not surprising that team effort toward task was associated with decreased product performance and increased resource overruns.

Another potential problem with the effort toward task construct is that the control modes could also potentially influence an individual's perception of their own effort in ways opposite to those hypothesized. For example, if the control modes are successful in motivating an individual, the individual may get excited about the project and perceive their own effort level as being lower than it actually is. Or, if clan control is operating and the individual may perceive his own effort as less and attribute the effort more to the team.

Team coordination success was also not related to performance outcomes. This is surprising. Similar to the team effort toward task measure, perhaps the measure of team coordination success has significant error caused by difficulty team members have in assessing the coordination outcomes of other team members. In a post-hoc analysis the average of team members' individual coordination success measures was used to represent team coordination success. With this measure of team coordination success the analysis does show significant mediation of the effect of clan control on product performance through coordination success.

6.3 LIMITATIONS

There are several limitations that should be considered when reviewing the conclusions of this research. First, the research was conducted with a cross-sectional survey. Although the theory motivating the hypotheses implies a direction to the relationships among the study constructs, this directionality cannot be confirmed through analysis of the study data. Another limitation of the cross-sectional survey design is that it requires respondents to report on a project that took place at some point in the past. This could introduce random error into the study through the inability of the respondents to remember accurately what happened during the project. An attempt was made to limit this source of error by asking respondents for data on projects that had been completed within the past two years. The retrospective nature of the survey responses could also introduce systematic error because the end result of the project could possibly bias the respondents' view of events that took place during the project.

Another concern with cross-sectional survey studies is the potential for common method bias. One type of common method bias is common source bias, which can be caused by assessing independent and dependent variables from the same respondents. In this study, the potential for common source bias was limited by measuring key independent and dependent variables from different respondents. In addition, to limit the effect of bias caused by implicit theories about relationships between the study constructs that may have been held by respondents, dependent variables were assessed earlier in the survey, and then independent variables were assessed later in the survey. Variables that are hypothesized to have direct relationships were separated from each other on the survey.

Bias can also be introduced into a study by measuring all variables through the same method. In this study most of the variables were measured with 7-point Likert scales. One key dependent variable, resource overruns, was measured using a continuous scale consisting of an objective report of the project's performance versus its budget, time, and resource use goals.

Including an objective measure for a key study variable has been demonstrated to reduce common method bias (Podsakoff et al. 2003).

In addition to the limitations of the cross-sectional survey design, there are also some limitations that are unique to this particular study. It proved very challenging to collect matched survey responses from IS project teams and their managers. As a result, the dataset used to test the hypotheses is fairly small, making it difficult to detect any relationships with small effect sizes, and limiting the range of statistical techniques that may be used to test the hypotheses. In order to increase the sample size, a second round of data collection is warranted.

6.4 IMPLICATIONS FOR PRACTICE

The results of this research provide several implications that may be useful to managers responsible for controlling IS development projects. First, the three modes of control examined, behavior control, outcome control, and clan control, all had some positive effects on intermediate outcomes, such as effort toward task and coordination success, as well as on performance outcomes such as product performance and resource overruns. This suggests that managers should make use of a portfolio of control modes in order to have a positive effect on a broad range of intermediate and ultimate performance outcomes. In particular, managers should be aware of the broad positive effects of clan control on their projects.

Clan control and outcome control were demonstrated to have a positive effect on effort toward task, so managers who wish to ensure that members of their teams are working hard toward project tasks should utilize outcome controls and try to encourage clan control. Clan control was also strongly associated with coordination success. This suggests that managers who are facing projects that potentially offer coordination challenges because of their complexity, size, or geographic distribution should consider making efforts to build clan control in the team. Clan control can be facilitated through team member selection by selecting team members who know each other and have worked well together on past projects, and by team-building activities and social interventions that help team members to develop social capital, which has been shown to be an important antecedent of clan control (Kirsch et al. forthcoming). Managers can also encourage clan control by encouraging project team members to act as a team, not as individuals.

Clan control and outcome control also were shown to have positive effects on product quality. Managers who wish to build information systems that exhibit quality, usability, and meet the needs of their users should facilitate clan control, and institute outcome controls that explicitly tie evaluation and rewards to product-related outcomes.

Clan control and behavior control were also associated with improved project performance in the form of decreased resource overruns. This suggests that managers who wish to improve their projects' performance with respect to budget, time, and resource use goals should facilitate clan control on their teams, link performance evaluations to adherence to written rules and procedures, and hold team members accountable for their behavior on the project.

In addition to these implications for the use of control modes, this study demonstrates the importance of team member perceptions of the observability of their work and the measurability of its outcomes. The results suggest that when team members perceive that their behaviors are observable by managers, they expend more effort toward project tasks. Managers should take advantage of this by making efforts to communicate to team members that their activities are being monitored and evaluated.

While the measurability of outcomes did not have a direct effect on effort, it did interact with outcome control to affect effort toward task. When managers utilized outcome control, but team members perceived that the outcomes of their work were difficult for managers to measure, team members worked harder. It is likely that this increased effort was an attempt by team members to make outcomes of their work more salient to managers, or to send a secondary signal that could favorably impact their manager's evaluation of their work, even if the outcomes were difficult to measure. This suggests that outcome control can be a useful motivator, even if managers are not sure that they will be able to accurately measure the outcomes.

6.5 IMPLICATIONS FOR RESEARCH

In addition to its implications for practicing managers, this study also makes significant contributions to research on organizational control, particularly in the context of IS development projects.

Existing research on organizational control provides theoretical arguments about the applicability of different control modes to different circumstances, and examines the controller's choice of control mode based on antecedent conditions that include the controller's knowledge of the production process, the observability of behavior, and the measurability of outcomes. The theory behind this research assumes that controller's are rational, and that they will attempt to choose the control modes that will be most effective, given their own level of knowledge of the production process, and the levels of behavior observability and outcome measurability in the task context. The two analyses reported on in this dissertation extend this stream of literature by testing the theory of organizational control in a more direct fashion, not by assuming rational managers and examining their control choices based on antecedent conditions, but by directly measuring the effects of control modes on a range of outcomes, while taking into account the effects of behavior observability and outcome measurability. The range of outcomes investigated in this study includes the intermediate outcomes effort toward task and coordination success, and project outcomes including product performance and resource overruns. By investigating both intermediate and ultimate outcomes, and by proposing and testing the mediating role of the intermediate outcomes, this study provides insight into the mechanisms through which control efforts affect IS development project performance.

Another way in which the study reported on in this dissertation contributes to understanding of the mechanisms through which organizational control works is by examining the effects of control on controlees, and by taking the controlees' perceptions of observability of behaviors and measurability of outcomes into account. Ultimately, control works through its effects on the behaviors of controlees, so it is important to begin to investigate these behavioral effects, and how they are moderated by controlee perceptions of their work context, such as the difficulty of observing behaviors and difficulty of measuring outcomes.

More specifically, the study reported in this dissertation provides evidence that control does have an effect on intermediate outcomes and performance outcomes, and that different modes of control affect different outcomes. Given the paucity of research demonstrating a relationship between control and performance outcomes, this evidence is valuable.

Existing theory on organizational control posits that the effectiveness of control depends on behavior observability and outcome measurability. The individual-level analysis provides support for existing theory by demonstrating that these contextual variables are important. They have direct effects on effort toward task, and outcome measurability moderates the effect of outcome control on effort toward task. In a surprising result from the individual-level analysis, however, the moderating effect of outcome measurability on effort toward task works counter to what was hypothesized. Instead of decreasing the effectiveness of outcome control, difficulty of measuring outcomes actually increased the effectiveness of outcome control at motivating effort.

Finally, this study introduces new measures for individual and team coordination success that are grounded in coordination theory, adapted for complex tasks, and that exhibit good convergent and discriminant validity, as well as excellent reliability.

6.6 FUTURE RESEARCH

During the course of designing, carrying out, and analyzing the results of the study reported in this dissertation many challenges were faced. Nevertheless, it still provides some interesting results that contribute to the literature. The challenges and the interesting results provide insight and guidance for future research, as future research should attempt to overcome the challenges faced by the current research, as well as build on the results of the current research.

The first area that provided challenges to the current research and should be addressed in future research is the conceptualization and measurement of formal control. The measures originally developed for behavior control and outcome control were based on existing research, but they did not exhibit convergent or discriminant validity, or adequate reliability. After dropping and recombining the items, measures for behavior control and outcome control were constructed that had acceptable convergent and discriminant validity, but the reliability of the outcome control measure was still weak, just reaching the .60 Cronbach’s alpha threshold for exploratory research. Although these measures were sufficient to reach some interesting results in the current research, there is a need to develop improved measures for future research. Behavior control and outcome control are complex constructs, and after the dropping and recombining of items for this study it is unclear whether the measures still reflect all the concepts that make up behavior control and clan control. In the measure for behavior control, for example, three of the four items measure whether evaluations of team members are linked to adherence to written steps, rules, and procedures. While adherence to written guidelines is an important part of behavior control, behavior control also includes other concepts that were not reflected in the final measure. Because of this, the behavior control measure is lacking in face validity.

The outcome control measure, besides having marginal reliability, also has diminished face validity because it includes an item that was originally intended to measure behavior control.

There is a need for future research to develop measures that cover the entire conceptual range of behavior control and outcome control. As part of this effort it might be useful to develop an exhaustive list of control mechanisms used in practice, and then attempt to code which facet or facets of behavior or outcome control are represented by each mechanism. Then, examining patterns of mechanism use can then help us to determine whether behavior control and outcome control are implemented as unitary constructs, or in smaller conceptual pieces. This is an important empirical question, because it is uncertain whether practicing managers perceive behavior control and outcome control as two distinct things which they implement as part of their management practice. It is possible that managers, instead, think in terms of specific mechanisms as part of their management practice. The factor analysis for the behavior control and outcome control items developed for the current research revealed four factors. This suggests that the constructs behavior control and outcome control may be too broad, and need to be divided into smaller constructs. Alternatively, it is possible that behavior control and outcome control should be modeled as second order constructs consisting of several different components.

Future research should also carefully consider whether behavior control and outcome control are measured from the controller's or the controlee's perspective. The study reported here measured behavior control and outcome control from the perspective of the controller. This is because the research takes an instrumental view of behavior control and outcome control as tools that can be manipulated by managers in order to achieve desired results. If measured from the controlee's perspective, it is more difficult to figure out how a manager can manipulate these variables in practice. However, the controlee's perspective would also be relevant if the objective of the research is to investigate how control affects behavior in organizations. There is evidence that the perspectives of the controller and controlee do differ. The measures for behavior control and clan control proposed for this dissertation were originally developed for another study, in which IS project team members responded to the items. The factor analysis results of the items from that dataset are significantly different from the factor analysis results in this dissertation. When the team members were used to measure behavior control and outcome control only two factors emerged, and the items loaded onto factors differently from how they do in the current study, in which the behavior control and outcome control items were measured from the project managers. This suggests that managers and team members perceive of control in different ways.

The individual-level analysis demonstrated that team member perceptions of the difficulty of observing their behavior and measuring the outcomes of their work have significant effects on their project-related behavior. To investigate these effects in more detail the measures for difficulty of observing behaviors and difficulty of measuring outcomes also should be improved.

The significant relationships between outcome control and individual effort toward task in the individual-level analysis and between clan control and team effort toward task in the team-level analysis suggest that control does have an effect on motivation. However, the results of these analyses also suggest that effort toward task may be too broad a construct, with too many confounds to be useful in future research. The construct appears to capture a broad range of types of effort, including effort that is the result of increased motivation, effort required to conform to process requirements, and effort required to overcome difficulties caused by internal or external factors. Although most of these types of effort can be expected to improve performance outcomes, some of them also reflect factors that can be expected to have significant negative effects on performance outcomes, which makes it likely that the relationship between effort toward task and project performance will be indeterminate and more closely related to idiosyncratic aspects of specific projects than to any general theoretical factors. For example, consider a project in which outcome control has been implemented, and team member evaluation and reward is specifically tied to the achievement of a broad range of process-related and product-related outcomes. This type of outcome control can be expected to motivate team members and increase their effort toward task. This increased effort, in turn, is expected to improve performance. Now imagine that the same project runs into problems because of poor design decisions, or because of changes in the environment. These problems also necessitate a higher level of effort by team members in order to be overcome. This effort can be expected to improve project performance to a higher level than it would have been if the effort was not expended. However, the effort also reflects the problems, which can be expected to reduce project performance. If the effects of the idiosyncratic elements overwhelms the positive effects of effort, then effort toward task could have a negative relationship with performance outcomes, as it does in the team-level analysis.

In addition, an individual's perceptions of their own effort may not be an accurate reflection of their actual effort. If an individual is motivated and excited about the project he may perceive his own effort level as lower than it actually is. Or, if the individual is part of a team in which clan control is operating the individual may attribute more of the effort to the team, and thus underestimate his own effort level.

Future research should attempt to solve these challenges by taking a step back on the causal chain and measuring the effects of control on motivation rather than on effort, or by attempting to measure different types of effort so that the "good" effort may be separated from the "bad" effort.

Future research should also address the surprising interaction effect between outcome control and difficulty of observing outcomes. Contrary to what was hypothesized, outcome control was associated with higher effort toward task when outcomes were difficult to measure. This suggests that team members, rather than slacking off because the outcomes of their work were difficult to measure, worked harder in order to make the outcomes more visible, or to send a secondary signal of their work performance since they questioned the ability of their manager to measure the outcomes. This is interesting because it suggests that imperfect control systems, which have been thought to have only negative consequences, may also have some positive consequences.

This study also suggested that different types of control have different types of effects on performance. Outcome control was associated with increased product quality, while behavior control was associated with a reduction in resource overruns. Clan control was associated with both positive performance outcomes. Future research should examine these differential effects in more detail.

Finally, although there was no relationship between behavior control and coordination success in the analyses reported here, the theoretical arguments for the relationship are strong, and deserve a second look after better measures for behavior and outcome control are developed.

6.7 CONCLUSION

Research on organizational control has focused on the controller's choice of control mode, assuming that the controller will choose the control mode that is most effective, given the controller's level of knowledge, the observability of behavior, and the measurability of outcomes. The research reported here haa attempted to test the assumption that observability of behavior and measurability of outcomes moderate the effectiveness of control by testing whether or not the effects of control on effort toward task and coordination success depend on team member perceptions of the difficulty of observing behaviors or difficulty of measuring outcomes. Moreover, they have attempted to increase understanding of the mechanisms through which control works by investigating whether effort toward task and coordination success mediate the effects of control on performance outcomes.

The results, though somewhat limited by small sample size and measurement challenges, suggest that difficulty of observing behaviors and difficulty of measuring outcomes have important direct effects on effort toward task, and that the ability of outcome control to increase effort toward task is related to the difficulty of measuring outcomes. Moreover, the results demonstrate that control does affect performance outcomes in significant ways.

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