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AN AGENCY THEORY ANALYSIS OF INFORMATION TECHNOLOGY PROJECT SUCCESS

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Abstract

Agency theory offers a potential explanation for the low success rate of information technology (IT) projects. The theory suggests that appropriate monitoring and the use of incentives and rewards increases the likelihood of project success. A survey instrument was developed from previously used items and new items developed from structured interviews. Four hundred thirty project managers completed a Web-based survey. After analysis for reliability and validity, the data were used to test eight hypotheses related to IT project success. The study contributes to the understanding of IT project management by showing that contract type, monitoring, goal conflict, shirking, and privately-held information are multi-dimensional constructs and provides instruments for their measurement. It validates existing instruments for measuring task programmability and project success. It suggests that more outcome-based contracts, more monitoring, less shirking, and less misrepresentation of privately-held information lead to project success. Finally, it contradicts expectations that more goal conflict and more task programmability lead to more outcome-based contracts and that more outcome-based contracts lead to less monitoring.

Introduction

The success rate of information technology (IT) projects is low. A Standish Group International study in 1994 found that only 16% of all IT projects are completed on time and within budget (Johnson 1995). The problem is so severe that many IT professionals even accept project failure as inevitable (Cale and Curley 1987).

A potential explanation of the lack of project success lies in the management of the project team (Rasch and Tosi 1992). Agency theory suggests that the type of contract between a principal (such as a manager) and agents (i.e., team members) affects the quality of the agents' work (Eisenhardt 1989). This study applied that theory to investigate methods for motivating, compensating, and monitoring developers. The central research question for the study was, "Why do some IT projects succeed more than others?"

IT Project Success

Observers have offered a variety of ways to define project success (Saarinen 1996). Some have suggested that projects be rated as successful when they are completed within the estimated schedule and budget and when they produce an acceptable level of performance (Martinez 1994). Others have argued that user satisfaction is more important (Bailey and Pearson 1983; Pinto and Slevin 1988; Li 1997; Gelderman 1998). Still others contend that the most important measure is whether the project improves profitability.

One approach, for which a research instrument has been developed and validated, identifies three distinct aspects of project success (Pinto and Slevin 1988; Pinto and Mantel 1990). They are: the implementation process itself; the perceived quality of the project; and client satisfaction with the delivered project. Agency theory provides a framework for achieving project success.

Agency Theory

Agency theory deals with the employment relationship that occurs when one party (the principal) hires another party (the agent) to perform some work on the former's behalf (Baiman 1982). The theory suggests that the type of contract (i.e., behavior-based or outcome-based) between a principal and an agent may impact the quality of the work (Eisenhardt 1989). It further implies that monitoring, goal conflict, shirking, and privately-held information may influence the success of the work. Previous research suggests the more outcome-based the contract of the developers, the more monitoring by the project manager, the less shirking by the developers, and the less privately-held information by developers, the more successful the project should be (Kirsch 1997; Keil, Mann and Rai 2000).

Contract Type

Agency theory suggests that the type of contract between the principal and agent impacts the quality of the work (Eisenhardt 1989). A behavior-based contract compensates agents for behaving in a certain way regardless of the outcome from those behaviors. An outcome-based contract compensates agents for achieving certain goals and may take the form of a commission. The rewards of an outcome-based contract can take other forms, including praise from superiors and co-workers, future promotion opportunities, feelings of self-esteem, public recognition, favors, and financial rewards (Baker, Jensen and Murphy 1988). A positive relationship between contract type and successful outcomes has been shown in lab experiments, using students as subjects (Cocco 1995; Tosi, Katz and Gomez-Mejia 1997). Therefore, the following hypothesis is proposed.

H1: The more outcome-based the contract between a project manager and developers, the more successful the project.

Monitoring

A feedback system that provides information to the principal regarding the actions of the agent can minimize the agency problem (Bergen, Dutta and Walker 1992). With outcome-based contracts, such an information feedback system is not necessary because compensation is based solely on results. However, with a behavior-based contract the principal may need to monitor the activities of the agent.

Several researchers have empirically tested the impact of monitoring, where boards of directors act on behalf of shareholders to monitor the decisions of executives. Increased monitoring has been shown to lessen failure (Kirby and Davis 1998). The following hypothesis is suggested.

H2: The more the project manager monitors the activities of the developers, the more successful the project.

In addition to incentives and monitoring reducing the agency problem, several factors may increase the problem. Among them are goal conflict, shirking, privately-held information, and low task programmability.

Goal Conflict

Agents may have goals that conflict with the goals of the principal (Eisenhardt 1989). Thus, agents may strive to achieve their own goals instead of the goals of the principal. Goal conflict can lead to poorer overall results for the firm. This suggests the following hypothesis.

H3: The more the goals of the project manager conflict with the goals of the developers, the less successful the project.

Using an outcome-based contract, where the agent is compensated for successfully achieving the outcomes desired by the firm, can minimize this conflict. Outcome-based contracts have been used to decrease the agency problem by reducing goal conflict (Gomez-Mejia and Balkin 1992). Therefore, the following hypothesis is proposed.

H4: The more the goals of the project manager conflict with the goals of the developers, the more outcome-based the contract.

Shirking

Agents may not spend effort working toward the goals of the principal, but instead may shirk their responsibilities. Shirking can increase the agency problem (Baiman 1982). Firms where developers exhibit less shirking are likely to have higher project success. Thus, the following hypothesis is suggested.

H5: The more shirking there is by developers, the less successful the project.

Privately-Held Information

The agency problem is magnified when the agent has privately-held information that the principal does not have. An agent may misrepresent such information or even provide false information to the principal (Eisenhardt 1989). Research has shown that agents with privately-held information were more likely to act in ways that were contrary to the best interests of the principal and can have a negative impact on outcomes (Guinan, Coopriider and Faraj 1998). Thus, the following hypothesis is proposed.

H6: The more developers misrepresent privately-held information, the less successful the project.

Task Programmability

Programmability is the degree to which appropriate behavior by the agent can be precisely defined in advance (Eisenhardt 1989). The less structured and more complex the activities, the more difficult it will be for the principal to judge whether the agent is shirking. Researchers found a significant correlation between task programmability and the use of outcome-based contracts (Eisenhardt 1988; Stroh, Brett, Baumann and Reilly 1996). The following hypothesis is suggested.

H7: The less programmable the tasks of developers, the more outcome-based the contract.

Monitoring and Contract Type

Agency theory suggests that with an outcome-based contract, monitoring agents' activities becomes less important than with a behavior-based contract (Eisenhardt 1989). Developers' activities do not need to be monitored as closely when their pay is tied to successful outcomes. When the developers receive a fixed salary or hourly rate, without incentives for successful project completion, the project manager must monitor their work more closely. Therefore, the following hypothesis is proposed.

H8: The more outcome-based the contract, the less monitoring of developers.

Research Methodology

The current research surveyed professional project managers responsible for IT development projects. In addition to the primary responses from the IT project managers, responses were solicited from a second member of the project team on items measuring project success. Paired responses allowed for validity analysis of the project success instrument.

Survey Instrument

A review of the literature found very few survey instruments for measuring to the six agency theory variables. Only one instrument was found for measuring task programmability in the context of IT projects (Nidumolu 1996). The study used an eight-item scale to measure the standardization of behavior control in such projects.

An instrument for measuring project success was found (Slevin and Pinto 1986; Pinto and Slevin 1988). This twelve-item scale was empirically tested and is reliable (Pinto and Mantel 1990). A survey was developed that incorporated the Nidumolu (1996) scale and the Pinto and Slevin (1988) scale with additional items to measure the other agency theory variables.

Development of Measurement Scales

Twelve IT project managers in a Midwestern city were interviewed by phone or face to face. The structured interviews consisted of a series of open-ended questions (Eisenhardt 1989). The order of the questions was shuffled in each interview to minimize order bias. The interviews lasted an average of 57 minutes.

Notes were taken during each interview and were content analyzed for common phrases and themes (Kolbe and Burnett 1991). Key concepts were identified and compiled into a pool of sample items for the agency theory variables (Churchill 1979; Straub 1989). The process created 99 detail items for the five variables. In addition to these items, fifty-seven items were drafted based on a review of the literature to create a total of 156 items. The items were reworded and refined, ambiguous items were dropped and duplicate items were combined, then formatted into a Web-based survey. Nine pilot tests were conducted, yielding formatting and wording changes to the instrument.

Data Collection

Data were collected in two phases. In the first phase, members of the Project Management Institute (PMI) Information Systems Specific Interest Group (ISSIG) were asked to respond in terms of the most recent major project with which they were familiar. A reminder e-mail was sent ten days later.

The second phase of the data collection process gathered data from a team member other than the project manager. The project managers who included their e-mail address in the first phase were contacted asking them to select a member of the project team to complete a shortened version of the survey. The responses from the secondary respondent were paired with the responses from the primary respondent for validity and reliability analysis.

Out of 7,785 PMI-ISSIG members, 430 completed the survey, for a 6% response rate from the primary respondents. One hundred ninety one e-mails were sent in the second phase. Sixty-five secondary surveys were completed, for a 34% response rate from the secondary respondents, providing 65 paired responses.

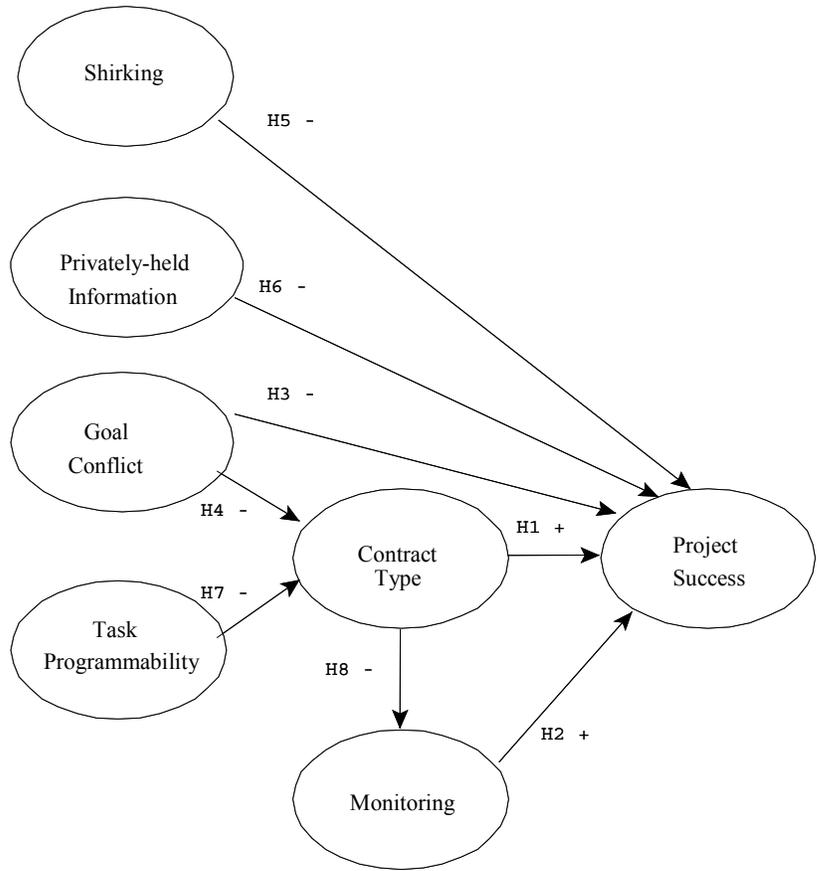


Figure 1. Research Model

Table 1. Monitoring Factor Loadings

Item	Assessment	Approvals	Meetings
A project plan	.73		
Periodic comparison of project progress to schedule	.71		
Periodic computation of the percentage completed	.59		
Project management software	.56		
Project progress reports	.55		
Gantt charts	.51		
Internal posting of project progress for all developers' review	.50		
Software change management		.70	
Structured walkthroughs		.60	
Periodic comparison of actual costs to estimated costs		.52	
Testing of modules by project manager for completeness		.51	
Periodic project team meetings			.97
Periodic project review sessions			.61
Eigenvalue	5.85	1.31	1.15
Percent of Variance Explained	41.8%	9.3%	8.2%
Cronbach's alpha	.84	.73	.68*
Items Dropped	Reason		
Periodic audit by external auditors	did not load on any factor		
Time reports periodically produced by developers	did not load on any factor		
Post-completion audit of the project	did not load on any factor		
Project manager sign-off on deliverables as completed	cross-loaded on two factors		
Periodic comparison of actual results to planned results	cross-loaded on two factors		
User sign-off on deliverables as completed	cross-loaded on two factors		
Analysis of major risk factors	cross-loaded on two factors		
Critical path analysis	cross-loaded on two factors		

*Pearson correlation was computed in place of Cronbach's alpha for dimensions with two items.

Data Analysis

Unidimensionality Analysis

The phase-one data were randomly split into two groups. The first group was used to assess the unidimensionality of each construct. The second group was used to validate those results and to test the eight hypotheses. Exploratory factor analysis (EFA) using SPSS, principal axis extraction with Varimax rotation, and the eigenvalue-one rule identified underlying dimensions within the constructs. The scree plots supported the decision to use the minimum eigenvalue rule.

Monitoring

EFA was performed on the 21 monitoring items. During successive EFAs, eight items were dropped due to low loadings or cross loadings. The remaining items loaded on one of the three factors: assessment, approvals and meetings. The loadings are shown in Table 1.

Goal Conflict

Goal conflict was measured by seven items. The respondents were asked to rate their goals and to assess the goals of developers on the items. The differences between the two ratings indicated the amount of goal conflict. EFA grouped the seven items into two factors: financial goals and quality goals. Two items were dropped. The loadings are shown in Table 2.

Table 2. Goal Conflict Factor Loadings

Item	Financial Goals	Quality Goals
Project completion within budget	.87	
The favorable financial impact of the project	.66	
The production of an error-free system		.82
The satisfaction of client's needs		.55
The production of a high quality system		.49
Eigenvalue	2.0	1.4
Percent of Variance Explained	39.1%	28.1%
Cronbach's alpha	.59*	.63
Items dropped	Reason	
Professional advancement of developers	did not load on either factor	
Project completion on-time	did not load on either factor	

*Pearson correlation was computed in replace of Cronbach's alpha for dimensions with two items.

Table 3. Shirking Factor Loadings

Item	Loafing	Poor Focus
Taking excessive breaks	.79	
Taking long lunches	.77	
Surfing the Internet	.73	
Sending e-mail jokes	.73	
Talking on the phone	.71	
Playing computer games	.62	
Socializing	.62	
Calling in sick when healthy	.56	
Working on wrong tasks		.89
Working on enjoyable, less important tasks		.72
Spending time on tasks other than their assigned duties		.64
Being poorly organized		.55
Eigenvalue	6.32	1.39
Percent of Variance Explained	52.7%	11.5%
Cronbach's alpha	.91	.83
Item dropped	Reason	
Claiming not to understand the requirements	did not load on either factor	

Shirking

Shirking was measured by thirteen items. EFA indicated two factors existed: loafing and poor focus. One item was dropped. The factor loadings are shown in Table 3.

Privately-Held Information

Privately-held information was measured by eleven items. EFA revealed two factors: knowledge sharing and time reporting. The loadings are shown in Table 4.

Table 4. Privately-held Information Factor Loadings

Item	Knowledge Sharing	Time Reporting
Openly discussed project problems in status reporting	.79	
Openly provided their project knowledge	.72	
Readily shared critical project status information	.61	
Openly discussed problems they believed they could correct quickly	.55	
Accurately reported project status	.54	
Openly described issues to auditors	.53	
Reported task completion statuses that were unexaggerated	.45	
Correctly reported their hours worked		.82
Readily reported their hours worked		.73
Meticulously reported their hours worked on task		.58
Honestly reported their hours worked on tasks		.49
Eigenvalue	4.58	1.48
Percent of Variance Explained	41.6%	13.5%
Cronbach's alpha	.83	.78
Items dropped	Reason	
None		

Task Programmability

Task programmability was measured by eight items (Nidumolu 1996). EFA identified one factor. One item was dropped for low item-to-total correlation. The factor loadings are shown in Table 5.

Table 5. Task Programmability Factor Loadings

Item	Life Cycle Methodology
Techniques or tools for system design	.76
Techniques or tools for generating requirements	.71
Techniques or tools for data administration	.69
Techniques or tools for installing software	.66
Techniques or tools for testing software	.66
Techniques or tools for coding software	.57
Techniques or tools for software source selection	.57
Eigenvalue	3.62
Percent of Variance Explained	51.8%
Cronbach's alpha	.84
Items dropped	Reason
Techniques or tools for project management	low item-to-total correlation

Contract Type

Contract type was measured by fifteen items. Three items were dropped. EFA identified three factors: favors, recognition and advancement. The loadings are shown in Table 6.

Table 6. Contract Type Factor Loadings

Item	Favors	Recognition	Advancement
Newer technology (i.e., PC or laptop)	.70		
Flexible work schedule	.60		
Opportunity to work at home	.58		
Technical training	.54		
Private office space	.54		
Time off	.52		
Public praise		.91	
Project completion celebration		.72	
Sense of contribution to organization		.70	
Favorable annual performance appraisals			.64
Choice of future assignment			.61
Job promotion			.58
Eigenvalue	4.68	1.60	1.13
Percent of Variance Explained	39.0%	13.4%	9.4%
Cronbach's alpha	.79	.85	.72
Items dropped	Reason		
Financial bonus	did not load on any factor		
Job security	cross-loaded on two factors		
Pride	cross-loaded on two factors		

Project Success

Project success was measured by twelve questions proposed by Pinto and Slevin (1988). Pinto and Mantel (1990) performed EFA and identified three factors: client satisfaction; perceived quality of the project; and the implementation process. An exploratory factor analysis of these items in the current study found nearly identical loadings, suggesting reliability of the instrument. The loadings are shown in Table 7.

Validity Analysis

Confirmatory factor analysis (CFA) tested the validity of the dimensions identified above (Segars and Grover 1993) using the second half of the data (Chin and Todd 1995). The Kolmogorov-Smirnov test indicated a lack of multivariate normality. Thus, the EQS software package, with its ROBUST option, was used (Franke 1996).

Three goodness of fit indices show how well the data matches the model. They are the Bentler-Bonett non-normed fit index (BB NNFI), the comparative fit index (CFI), and the robust comparative fit index (RCFI). A measure of overall goodness of fit is the ratio of Satorra-Bentler Scaled (SBS) Chi-squared to degrees of freedom (df). The ratio should be less than 3.0 (Carmines and McIver 1981). CFA analysis was performed on each of the seven constructs and their dimensions using the second half of the data. The findings are summarized in Table 8.

Three statistical tests verified discriminant validity: the variance-extracted test, the confidence interval test, and the chi-squared difference test. Each variance extracted estimate was greater than the corresponding squared correlation, no confidence interval contained the value 1, and each pair-wise Chi-squared difference test supported discriminant validity.

The study utilized two respondents for measuring the project success items to test for common method variance bias (Podsakoff and Organ 1986). Sixty-five secondary team members completed the shortened survey, allowing for a double-informant analysis of the project success items. None of the 65 paired t-tests were significant at $p < .05$ level, suggesting validity of the project success scale.

Table 7. Project Success Factor Loadings

Item	Client Satisfaction	Perceived Quality	Implementation Process
Important clients, directly affected by this project, will make use of it	.82		
The project is used by its intended users	.76		
The project has directly benefited the intended users either through increasing efficiency or employee effectiveness	.67	.58	
The project that has been developed works	.58		
We are confident that non-technical start-up problems will be minimal, because the project will be accepted by its intended users	.48		
Given the problem for which it was developed, this project seems to do the best job of solving that problem, i.e., it was the best choice among the set of alternatives	.46		
The results of this project represent a definite improvement over the way clients used to perform these activities		.80	
This project will have a positive impact on those who make use of it		.77	
Use of this project has directly lead to improved or more effective decision making or performance for the clients		.64	
This project came in within its original budget			.84
This project came in within its original schedule			.79
I was satisfied with the process by which this project was completed			.56
Eigenvalue	6.42	1.44	0.89
Percent of Variance Explained	53.5%	12.0%	7.4%
Cronbach's alpha	.89	.90	.82

Table 8. Confirmatory Factor Analysis

Constructs and Model Modifications	Bentler-Bonett Non-normed Fit Index	Comparative Fit Index	Robust Comparative Fit Index	Satorra-Bentler Scaled Chi-squared to Degrees of Freedom Ratio
Monitoring	.92	.94	.96	1.46
Goal Conflict	1.00	1.00	1.00	0.93
Shirking	.90	.91	.94	2.07
Privately-held Information	.90	.93	.93	2.11
Task Programmability	.92	.95	.97	1.89
Contract Type	.91	.93	.95	1.64
Project Success	.91	.94	.91	2.66

Test of Hypotheses

Individual items were averaged to create measures for each sub-dimension. Then, the sub-dimension values were averaged to create measures for each of the seven constructs. Path analysis was conducted using the EQS software package to test the eight hypotheses. The results are shown in Figure 2.

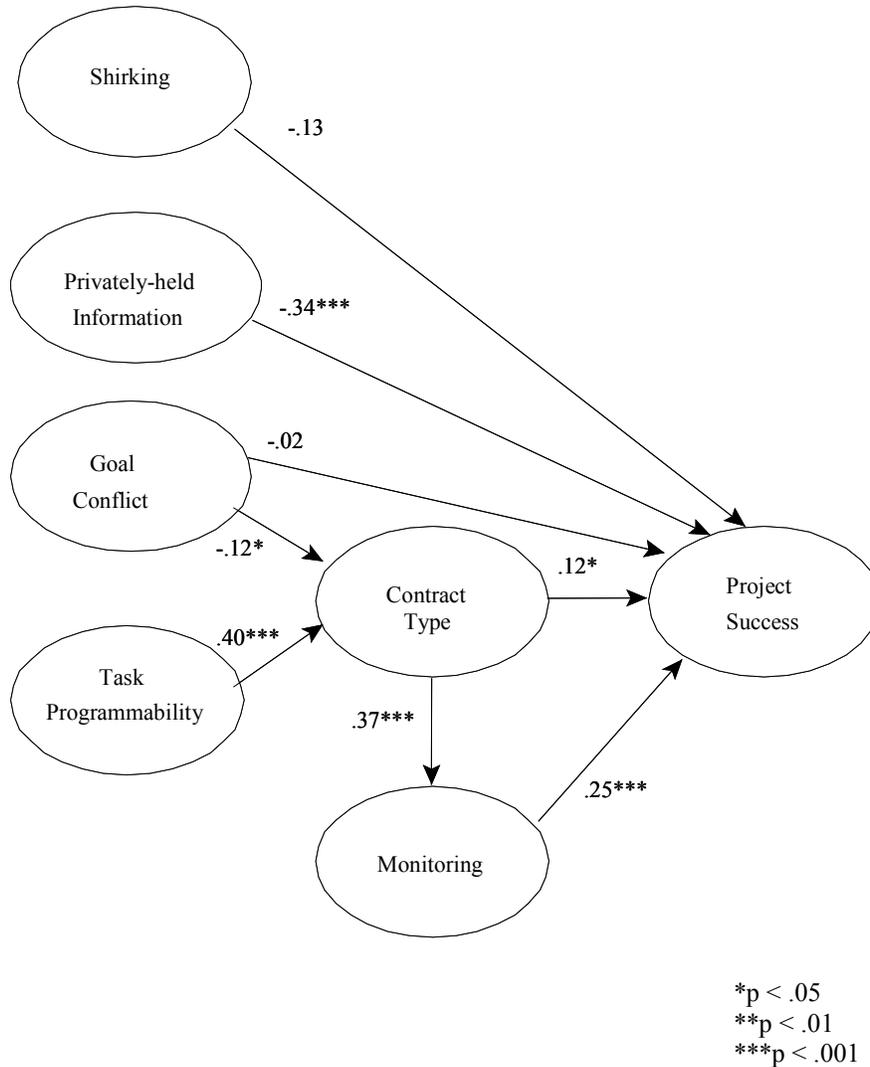


Figure 2. Path Coefficients

Findings

This study provided partial support for the agency theory hypotheses. Four of the hypotheses (H1, H2, H5, and H6) were statistically significant in the predicted direction. One (H3) was not statistically significant. The remaining three (H4, H7, and H8) were statistically significant in the direction opposite that predicted by agency theory.

As expected, this study found a positive relationship between outcome-based contracts and project success (beta = 0.12, $p < .05$); a strong relationship between monitoring and project success (beta = 0.25, $p < .001$); a negative relationship between shirking and project success (beta = -0.13, $p < .05$); and a negative relationship between privately-held information and project success (beta = -0.34, $p < .001$). These findings are consistent with the theory.

Agency theory predicted a negative relationship between goal conflict and project success. However, such a relationship was not supported in this study. The relationship between these two constructs was not statistically significant. Professionalism of developers may offset any negative impact of goal conflict.

Agency theory predicted a positive relationship between goal conflict and contract type. Instead, this study found that an outcome-based contract is related to less goal conflict (beta = -0.12, $p < .05$). Thus, by offering an outcome-based contract, firms may be

reducing the amount of goal conflict! When developers receive compensation based on outcomes their goals may become more aligned with the goals of the project manager and goal conflict is reduced.

When tasks are routine, agency theory predicts the use of behavior-based contracts; when tasks are complex and non-routine, agency theory predicts the use of outcome-based contracts. However, this study found the opposite relationship ($\beta = 0.40$, $p < .001$)! Firms which implemented tools and techniques to increase task programmability were more likely to make use of outcome-based contracts.

Agency theory predicted that the more outcome-based the contract, the less monitoring would be performed. The opposite relationship was found ($\beta = 0.37$, $p < .001$). The current study suggests that when agents are paid based on their outcomes, there is more monitoring. Project managers may employ higher levels of monitoring in order to more accurately assess the outcome of the project. Thus, the complexity and subjectiveness of measuring the success of a project may lead to more monitoring.

Limitations

A limitation is that with the exception of project success the variables were measured using a single respondent. Multiple respondents from each organization might provide more accurate measures. This study may be limited by the small response rate. The response rate may be similar to other email-based surveys, but it is lower than general survey results.

Implications

This research provided partial support for the agency theory hypotheses in the context of IT projects. The results are useful for researchers and practitioners.

Implications for Researchers

Future researchers may wish to examine the relationship between goal conflict and project success. Agency theory predicted a negative relationship. However, this study found no such relationship. Researchers might devise more thorough instruments for measuring goal conflict which may reveal a negative relationship with project variables. Additionally, researchers may uncover intermediary variables that mitigate the impact of goal conflict on project success. For instance, professionalism of developers may mediate a relationship between goal conflict and project success. This study provided empirical evidence of multidimensionality of five of the agency theory constructs. Thus, within the context of IT projects, they are more complex than previously reported and may need to be extended.

Implications for Practitioners

Information systems project managers will benefit from this research. This study identified several factors related to project success. Support of H1 suggests that IT managers may wish to put more of developers' pay at risk.

This study found a significant negative relationship between shirking and project success. Project managers should be aware of loafing as well as poor focus on the part of developers.

Conclusion

This research used agency theory to answer the question, "Why do some IT development projects succeed more than others?" Data analysis found partial support for the agency theory hypotheses. This research contributed to IT project management by: 1) Showing that contract type, monitoring, goal conflict, shirking, and privately-held information are multidimensional, by identifying their dimensions, and by providing instruments for their measurement; 2) Providing validation for existing instruments for measuring project success and task programmability; 3) Providing support for expectations that more outcome-based contracts, more monitoring, less shirking, and less misrepresentation of privately-held information lead to project success; and 4)

Contradicting expectations that more goal conflict and more task programmability lead to more outcome-based contracts, and that more outcome-based contracts lead to less monitoring.

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