An Agency Theory Examination of Information Systems Project Success

Robert C. Mahaney
Northern Kentucky University, Information Systems Department, Kentucky
Tel: (859) 572-5185, Fax: (859) 572-6627, mahaneyr@nku.edu

Albert L. Lederer
University of Kentucky, Decision Science and Information Systems, Kentucky
Tel: (859) 257-22536, Fax: (859) 257-3081, lederr@uky.edu

ABSTRACT

Agency theory offers a potential explanation for the low success rate of information systems (IS) development projects. The theory suggests that the use of appropriate monitoring plus incentives and rewards increases the likelihood of project success. A survey instrument was developed from previously used scales and content analysis of notes taken during twelve 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 agency theory hypotheses related to IS project success.

The study contributes to the understanding of IS project management by showing that contract type, monitoring, goal conflict, shirking, and privately-held information are multi-dimensional constructs and by providing an instrument for future research. It validates existing instruments for measuring task programmability and project success. It provides support for agency theory predictions 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 systems (IS) development projects is alarmingly low (Controllers Update 1996; BusinessWeek 1998). A Standish Group International study in 1994 found that only 16% of all IS projects come in on time and within budget (Cafasso 1994; Johnson 1995). Another study discovered 40% of IS projects were canceled before completion (Field 1997). The problem is so severe that many IS professionals accept project failure as inevitable (Cale and Curley 1987; Hildebrand 1998). This research attempts to answer the question, "Why do some IS development projects succeed more than others?"

AGENCY THEORY

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; Bergen, Dutta and Walker 1992). Agency 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 (Kirsch and Beath 1989). Thus, agency theory offers a potential explanation of project success. In this study, agency theory was used to investigate methods for motivating and compensating developers (Keil and Mann 1997; Keil and Mann 1997; Kirsch 1997; Kirsch, Ko, Sambamurthy and Purvis 1998; Keil, Mann and Rai 2000).

Contract Type

Agency theory suggests that the type of contract, behavior-based or outcome-based, between the principal and agent impacts the quality of the work (Eisenhardt 1989). A behavior-based contract compensates agents with a salary or an hourly rate for completing the tasks, regardless of the outcome, whereas an outcome-based contract compensates agents for achieving certain goals. Companies that tie performance evaluations and merit bonus payments to project success make use of outcome-based contracts (Baker, Jensen and Murphy 1988).

A positive relationship between contract type and successful outcomes has been shown in lab experiments, using students as subjects (Tosi, Katz and Gomez-Mejia 1997) and in production and retail sales settings (Eisenhardt 1988; Banker, Lee, Potter and Srinivasan 1996). Thus, research has shown that the type of contract can influence the degree of success. 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

Another factor that can minimize the agency problem is a feedback system to provide information to the principal regarding the actions of the agent. This allows the principal to monitor the agent's activities to help ensure that the agent works in the best interest of the principal (Bergen et al. 1992).

Several researchers have empirically tested the impact of monitoring. Increased monitoring has been shown to reduce over-commitment, thus lessening failure situations (Kirby and Davis 1998). Research findings indicate that more monitoring will encourage agents to act in the interests of the principal (Tosi et al. 1997). Thus the following hypothesis is suggested.

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

Goal Conflict

Agents may have private goals that conflict with the goals of the principal (Eisenhardt 1989). Thus, agents may act in such a way to achieve their own goals instead of the goals of the principal. Goal conflict can lead to poorer overall results for the firm (Baugh and Roberts 1994). This goal conflict may lead to less project success. 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.

Research has suggested that firms experiencing goal conflict respond by implementing outcome-based contracts (Gomez-Mejia and Balkin 1992). Also, a link between goal conflict and negative outcomes has been found (Harrell and Harrison 1994). Outcome-based contracts have been used to reduce goal conflict (Eisenhardt 1989). 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 shirk their responsibilities and not work toward the goals of the principal (Baiman 1982). Research has shown that IS managers with an incentive to shirk tended to make poorer project continuation decisions (Harrell and Harrison 1994). Thus, shirking can increase the agency problem.

Agency theory predicts that shirking will result from self-interests on the part of the agents. Firms where developers exhibit less shirking are likely to have higher project success. Thus, the following hypothesis is proposed.

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 (Baiman 1982). An agent may misrepresent such information (Eisenhardt 1989). Self-interested agents may misrepresent 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 (Harrison and Harrell 1993; Harrell and Harrison 1994). It has also been shown that privately-held information has a negative impact on outcomes (Guinan, Cooprider 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 specified in advance (Eisenhardt 1989; Stroh, Brett, Baumann and Reilly 1996). The less structured and more complex the activities, the harder it will be for the principal to judge whether the agent is shirking. Principals may use outcome-based contracts in such situations (Eisenhardt 1989; Guinan et al. 1998).

Researchers found a significant correlation between task programmability and the use of outcome-based contracts (Stroh et al. 1996). Others found that as programmability decreases, the use of outcome-based contracts increases (Eisenhardt 1988). 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, monitoring agents' activities becomes less important with an outcome-based contract than with a behavior-based contract (Eisenhardt 1989). Developers' activities do not need to be monitored as closely when their pay is tied to the successful completion of the project. When the developers receive a fixed salary or hourly rate, without incentives for successful project completion, they may shirk their responsibilities. Thus, the project manager must monitor their behavior more closely. Therefore, the following hypothesis is proposed.

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

RESEARCH METHODOLOGY

Many of the studies of agency theory to date have involved student subjects. An empirical study involving IS practitioners should increase the generalizability of the findings. Therefore, a survey format was chosen for this study (Fowler 1993).

The current research surveyed project managers responsible for IS development projects. In addition to the primary responses from the IS project managers, responses were solicited from a secondary member of the project team member on questions relating to project success. Paired responses allowed for detailed analysis of the validity of the measurement of project success.

Survey Instrument

A review of the literature found an instrument for measuring task programmability in the context of IS development projects (Nidumolu 1996). The eight-item scale measured the standardization of behavior control. An instrument for measuring project success was identified (Slevin and Pinto 1986; Pinto and Slevin 1988). This twelve-item scale has been empirically tested and shown to be reliable (Pinto and Mantel 1990). A survey was developed that incorporated the Nidumolu (1996) scale, the Pinto and Slevin (1988) scale, and additional items to measure the five other agency theory variables.

Development of Measurement Scales

Development of the survey instrument followed the steps suggested by Churchill (1979) and Bearden, Netemeyer, and Teel (1989). A pool of sample items was generated by interviewing experts regarding their experiences with IS project management (Straub 1989).

Twelve IS project managers in a Midwestern city were interviewed. Structured interviews were conducted by phone or face to face (Shenhar 1998; Fowler and Walsh 1999). The structured interviews consisted of a series of open-ended questions (Rossi, Wright and Anderson 1983; Eisenhardt 1989), followed by extemporaneous, probing ones. The order of the questions was shuffled in each interview to minimize order bias. The authors assessed the remarks following the techniques of content analysis (Kassarjian 1977; Kolbe and Burnett 1991).

The items were formatted into a Web-based survey.   Nine pilot tests were conducted. Formatting and wording changes were made following each of the first five pilot tests. The last four pilot tests produced no changes to the instrument.

Data were collected in two phases. In the first phase, e-mail notes were sent to members of the PMI Information Systems Specific Interest Group (ISSIG). The Project Management Institute (PMI) is the leading nonprofit professional association in the area of project management, with over 55,000 members worldwide. The members were asked to respond to the survey in terms of the most recent major project with which they were familiar. A reminder was sent ten days later. Of the 7,785 e-mail notes sent, 430 respondents completed the survey, for a 6% response rate.

The second phase of the data collection process gathered data from secondary team members. The survey allowed respondents to provide contact information. Respondents who included this information received a follow-up note requesting they contact a team member and ask that person to complete a shortened version of the survey. The responses from the secondary respondent were paired with the responses from the primary respondent for analysis purposes. One hundred ninety one e-mails were sent to secondary respondents. Sixty five secondary surveys were completed, for a 34% response rate.

DATA ANALYSIS

Early respondents were statistically compared to late respondents to assess the impact of non-response bias (Armstrong and Overton 1977; Fowler 1993). Four of the 87 t-tests were significant at the $p < .05$ level. This is no more than would be expected from chance, suggesting the absence of non-response bias.

The data were randomly split into two halves. The first half was used to assess the dimensionality 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.

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 each loaded on exactly one of the three factors: Assessment (7 items); Approvals (4 items); and Meetings (2 items).

Goal conflict was measured by seven detail items. The respondents were asked to rate their goals on these seven items. They were

then asked to assess the goals of developers on the same items. The absolute value of differences between the two ratings indicated the amount of goal conflict for the items. Two items were dropped. EFA grouped the seven items into two factor: Financial Goals (2 items) and Quality Goals (3 items).

Shirking was measured by thirteen detail items. EFA indicated two factors existed. One item did not load on either factor and was dropped. The two factors are: Loafing (8 items) and Poor Focus (4 items).

Privately-held information was measured by eleven detail items. EFA revealed two factors in the data: Knowledge Sharing (7 items) and Time Reporting (4 items).

Task programmability was measured by eight detail items (Nidumolu 1996). EFA identified one factor. One item was dropped due to low item-to-total correlation. The factor consists of 7 items.

Contract type was measured by fifteen detail items. EFA identified three factors in the contract type data after three items were dropped. The factors are: Favors (6 items); Recognition (3 items); and Advancement (3 items).

Project success was measured by twelve questions. The items were proposed by Pinto and Slevin (1988). Pinto and Mantel (1990) performed EFA and identified three factors: client satisfaction (6 items); perceived quality (3 items); and the implementation process (3 items). An exploratory factor analysis of these items in the current study found nearly identical loadings (Pinto and Mantel 1990), suggesting reliability of the instrument.

Validity Analysis

Further analysis was conducted to test the validity of the dimensions identified above. This was accomplished through confirmatory factor analysis (CFA) (Segars and Grover 1993; Chau 1997) using the second half of data. CFA provides additional statistical tests of validity (Chin and Todd 1995) and can be used to further refine the dimensions of the constructs (Dillon and Goldstein 1984; Bentler 1989; Chau 1996; Howell 1996).

The Kolmogorov-Smirnov test indicated a lack of multivariate normality. Thus the EQS software package, with its ROBUST option, was used for the following analysis (Byrne 1994). The ROBUST option handles data that are not multivariate normal (Bentler 1989; Franke 1996).

Confirmatory factor analysis (CFA) can assess how well the data fit a proposed model (Hatcher 1994). Each detail item is proposed to load on only one factor. Three goodness of fit indices show how well the data matches the model. They are the Bentler-Bonett non-normed fit index (BBNNFI), the comparative fit index (CFI), and the robust comparative fit index (RCFI). A value of 0.9 or greater for all three fit indices indicates the measurement model fits the data. A measure of overall goodness of fit is the ratio of Satorra-Bentler Scaled (SBS) Chi-squared to degrees of freedom (df). The SBS Chi-squared/df 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 data. In four cases, minor modifications of the measurement models were needed. The findings are summarized in Table 1.

Three statistical tests assess discriminant validity. They are the variance-extracted test, the confidence interval test, and the chi-squared difference test. Each variance extracted estimate is greater than the corresponding squared correlation, supporting a claim of discriminant validity. No confidence interval (computed as plus or minus twice the standard errors) contains the value 1, supporting discriminant validity. Finally, each pair-wise Chi-squared difference test supported discriminant validity.

Common method variance (CMV) is variance between variables attributable to the measurement instrument used rather than due to a relationship between the underlying constructs (Campbell and Fiske 1959; Schmitt and Stults 1986). When ratings of two constructs are generated by a single source, the artifactual covariance is said to be due to single-source bias (Avolio, Yammarino and Bass 1991).

Table 1: 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

Researchers can eliminate single-source bias by obtaining measures of the variables from multiple sources (Podsakoff and Organ 1986). The current study utilized two respondents for measuring project success, allowing for a double-informant analysis. Paired t-tests were used to determine whether the answers were consistent from the two respondent groups. None were significant at p < .05 level, suggesting validity of the project success scale. Additionally, a MTMM matrix was produced (Campbell and Fiske 1959; Schmitt and Stults 1986). Inspection of the matrix suggests validity of the scale. The matrix is shown in Table 2.

Table 2: MTMM matrix for project success scale

		Primary Respondent			Secondary Respondent		
		Client Satisfaction [a]	Perceived Quality [b]	Implemen-tation Process [c]	Client Satisfaction	Perceived Quality	Implemen-tation Process
Primary Respon-dent (N=430)	Client Satisfaction	(.89)[*]					
	Perceived Quality	.81	(.91)				
	Implemen-tation Process	.36	.30	(.85)			
Secondary Respon-dent (N=65)	Client Satisfaction	.59	.54	.25	(.90)		
	Perceived Quality	.55	.55	.22	.78	(.88)	
	Implemen-tation Process	.19	.08	.73	.37	.36	(.92)

[*] Cronbach's alpha
[a] Five items in scale
[b] Four items in scale
[c] Two items in scale

Test of Hypotheses

Path analysis was conducted using the EQS software package to test the eight 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. The hypothesized model was tested using EQS. The results are shown in Figure 1.
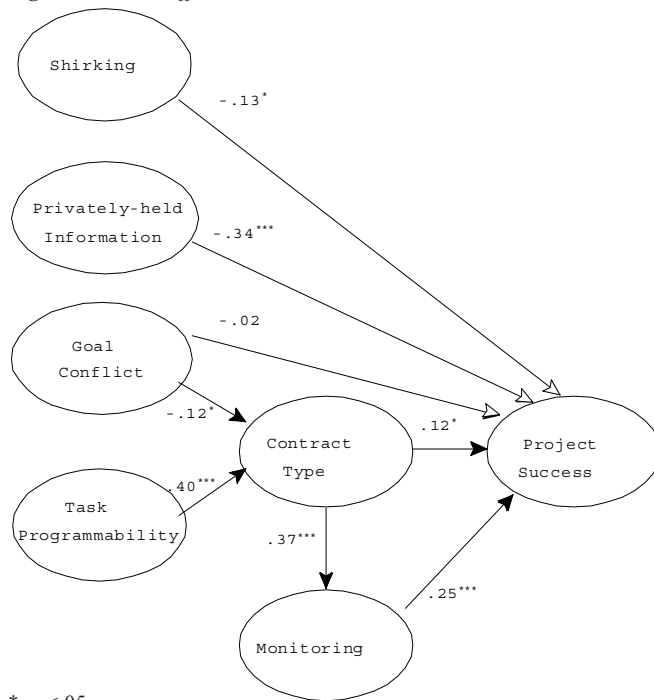
FINDINGS

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.

This study found a positive relationship between outcome-based contracts and project success (beta = 0.12, p < .05). It found a strong relationship between monitoring and project success (beta = 0.25, p < .001). The projects where developers shirked more were less successful (beta = -0.13, p < .05). Additionally, this study found a negative relationship between privately-held information and project success (beta = -0.34, p < .001), consistent with the belief that withholding project information will adversely affect the level of project success.

Figure 1: Path coefficients

Shirking

Privately-held Information

Goal Conflict

Task Programmability

Contract Type

Project Success

Monitoring

-.13*

-.34***

-.02

-.12*

.40***

.12*

.37***

.25***

* p <.05
** p <.01
*** p <.001

Agency theory predicted a negative relationship between goal conflict and project success. However, the relationship between these two constructs was not statistically significant. Professionalism on the part of developers may offset any potentially negative impact of goal conflict.

Agency theory predicted a positive relationship between goal conflict and contract type. However, 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!

The more routine the work of the developers, the easier it is to monitor their work. 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. This sample did not support this prediction. In fact, 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.

IMPLICATIONS

This research provided partial support for the agency theory hypotheses in the context of IS development 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 between these two constructs. However, this study found no such relationship. Future researchers might devise more thorough instruments for measuring goal conflict which may reveal a negative relationship with project variables.

Additionally, future researchers could further investigate the relationship between contract type and monitoring. The findings in this study are opposite those predicted by agency theory. More research into this relationship should be conducted before any modifications are made to the agency theory model.

Implications for Practitioners

This study identified several factors related to project success. Support of H1 suggests that IS 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. When developers are working on the wrong tasks or otherwise being poorly organized, the success of the project may be at risk. It may be difficult for project managers to witness poor focus, but it is still important for managers to understand that poor focus is part of shirking and may lead to lower levels of project success.

CONCLUSIONS

This research attempted to answer the question, "Why do some IS development projects succeed more than others?" Agency theory was used to study this question. A model was proposed that related seven research variables and eight hypotheses. A Web-based survey collected data from 430 IS project managers. Data analysis found partial support for the agency theory hypotheses. This research contributed to the understanding of IS project management by: 1) Showing that contract type, monitoring, goal conflict, shirking, privately-held information, and task programmability are multidimensional constructs, by identifying their dimensions, and by providing an instrument 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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