

# THE RELATIONSHIP BETWEEN INFORMATION TECHNOLOGY CRITICAL SUCCESS FACTORS AND PROJECT PERFORMANCE

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## Abstract

In this exploratory research study the critical success factors resulting in Information Technology (IT) project performance were assessed. Previous research supported associations between critical success factors and information technology project performance. A survey of 116 different projects at firms in the United States was used as the context to examine the critical success factors in project performance. The examination of the data analysis showed the size of the project, clarity of goals and mission, availability of required technology, and client acceptance of the project had a significant impact on project performance.

**Keywords:** Critical success factors, project management, Information Technology performance, project size

## 1. INTRODUCTION

In 2004, 28% of information technology projects were successful compared to 34% of projects in the previous year, and 18% of projects were prematurely terminated (Hayes, 2004; Standish Group, 1994). When project management best practices are followed, the success rates of information technology projects increase dramatically (Ildefonso, 2007; Woodward, 2007). Woodward (2007) and Ildefonso (2007) both concluded that personnel who follow project management best practices experience dramatic increases in information technology project success. Regardless of Woodward's and Ildefonso's conclusions, project success rates are of concern where Lee and Hirshfield (2006) reported falling success rates

with health-care software implementations that go over budget, run late, and fail to meet functional requirements and to deliver the system.

Kerzner (2003) noted modern project managers adhere to project methodologies to influence project success and to mitigate the effect of failing to plan. Project management involves consolidating project elements based on experience and techniques and helps to accomplish project objectives by organizing project elements and monitoring project tasks (Heldman et al., 2005). Project managers are responsible for the proper application of project management techniques (Heldman et al.). Consistent empirical data are lacking for the associations between information technology, project performance,

and critical success factors. Empirical data are also lacking for the effect on these associations after controlling for project size or organizational size. To address the gap in the literature, this study will examine the associations between critical success factors and information technology project performance.

Hyväri (2006) and Shenhar and Wideman (2000) conducted a literature review and discovered disagreement in the project management literature on what constitutes a successful project. Gallegos, Senft, Manson, and Gonzales (2004) defined project performance as project delivery that meets stakeholders' requirements on a negotiated date and within the negotiated budget. The Project Management Institute (2004), which is the standard-setting organization for the project management industry, supported Gallegos et al.'s definition. Pinto & Prescott (1988) agree on expressing project performance based on a budget, a target completion date, and accomplishing objectives through interdependent tasks. Since the 1960s, researchers have contributed to define a single comprehensive factor set to predict project success, but have consistently disagreed on one or more of these factors (Cooke-Davies, 2002) where Pinto and Prescott (1988) discussed that research prior to 1988 was theory based without empirical data.

Cooke-Davies (2002) indicated a gap exists in the project management literature and the business literature with respect to the comprehensive factors supporting project performance (Cooke-Davies, 2002; Hyväri, 2006). Slevin & Pinto (1987) discussed associations between critical success factors to information technology project success that have not been consistently established with empirical data in the literature. Organization size (Hyväri, 2006) and project size (Brown, 2006) might affect relationships between critical success factors and project performance, but the effect has not been consistently observed in empirical data. The current research study contains new knowledge regarding establishing relationships between the critical success factors and information technology performance.

The current study involved an examination of the associations among critical success factors and information technology project

success. This student was conducted on 116 different projects at firms in the United States.

## 2. CRITICAL SUCCESS FACTORS

Pinto (1986) established the dynamic importance of strategy factors compared to tactic factors at different life-cycle phases within a project. Pinto (1986) confirmed critical success factors demonstrated statistically significant relationships with project success. As a project progressed through execution and termination phases, tactic factors demonstrated importance for project performance, with strategy demonstrating more importance in early phases and tactics increasing to equal importance later in the project life cycle (Pinto, 1986). Pyle (1986) explored projects to implement management information systems by studying relationships among factors with project performance and concluded that key success factors are communication, user-led implementations, multidisciplinary teams, collocated team members, top management-led objectives, user-led training, six-month stabilization following implementation, and simulated production environment pilot testing. Pinto and Prescott (1988) observed associations between these success factors and large integrated MRP system project success.

Biehl (2007) noted global information systems (GIS) project success factors included elements related to top management urgency for the project and top management project approval. Biehl also noted increases in GIS project success rates related to the project manager's ability to respond to difficult situations.

## 3. RESEARCH QUESTION

Critical success factors in project management identified by Slevin and Pinto (1986) are client acceptance, client consultation, communications, monitoring and feedback, personnel, project mission, project schedule/plan, technical tasks, top management support, and troubleshooting. The moderating variables are organizational size (Hyväri, 2006) and project size (Brown, 2006) which delineate data into subgroups for a finer grained investigation of relationships. The outcome variable is project performance. Project performance was measured by an initial response from each participant about whether or not the project he or she se-

lected was successful or unsuccessful. The dichotomous response was referred to as project success. The 13 constructs pertaining to elements of project outcome identified by Slevin and Pinto (1986) also measured project performance. The scaled scores of the 13 statements were referred to as project performance in the current research study.

Research Question: Does a focus on each critical success factor lead to higher information technology project performance?

The research question addresses the degree of relationship between the critical success factors and information technology project performance. When project management best practices are applied, information technology project success rates increase dramatically (Ildefonso, 2007; Woodward, 2007). Information contained in the Project Management Institute (2004) documentation as project management best practice activities supports the critical success factors. The following critical success factors are addressed relative to project performance: clarity of the project's mission, top management support, well laid out project schedule, client involvement, sufficient personnel, sufficient technology for project development, client acceptance, monitoring and feedback, good communication channels, and contingency plans for the unexpected. The project demographics addressed in the current research study were organization size (Hyväri, 2006) and project size (Brown, 2006). Hyväri empirically established relationships between the critical success factors with project performance, but the relationships were different in larger organizations compared to smaller organizations. Brown established the relationship between project size and project implementation success and project size as a moderating variable.

#### 4. CONTEXT OF THE STUDY

To carry out this study of the relationships between 10 critical success factors and information technology project performance, a validated survey instrument called the Project Implementation Profile (Slevin and Pinto, 1986) was used to collect data related to organizations located in 24 states of the United States. Also the study sought to determine the moderating effect on these as-

sociations after the data were controlled with respect to firm size and project size for the 116 different projects.

The criterion variable was project performance measured in two ways. First, the perception of overall project success was measured with a dichotomous performance score as either successful or unsuccessful. Participants were first instructed to respond to the survey questions by reporting on either a successful or an unsuccessful project. Each participant was subsequently instructed to indicate whether he or she chose to report on an unsuccessful project or a successful project.

The second measurement of project performance was completed with the validated survey Project Implementation Profile (Pinto, 1986). Project performance was scored using an aggregation of 13 scaled project performance scores pertaining to elements of project success (Slevin and Pinto, 1986). Slevin and Pinto measured project success based on whether (1) the project was completed within schedule, (2) the project was completed within budget, (3) the project works, (4) the project is used by the intended clients, (5) the project benefited the intended user, (6) the project implemented the most appropriate solution, (7) the project is used by important clients, (8) the project member is satisfied with the project completion process, (9) the project is accepted by the intended users, (10) the project directly leads to improved decision making or performance for the clients, (11) a positive impact is made on those who use the project, (12) the project is a definite improvement over the process used previous to the project, and (13) the project member's overall perception of project success. This study included all 13 elements as the second method to measure project performance.

The predictor variables in this research study were the ten critical success factors previously discussed: client acceptance, client consultation, communications, monitoring and feedback, adequate personnel, project mission, project schedule or plan, appropriate technology, top management support, and an action plan to handle problems (Slevin & Pinto, 1986). The moderating variables were the firm's size (Hyväri, 2006) and the size of the project Brown, 2006). The res-

pondents were information technology associates employed or contracted by Kenco Management Services to provide management services to 116 various-sized businesses located in 24 states of the United States.

Kenco Management Services includes five companies offering third-party supply-chain services and management services to clients. Their clients vary in organization size and are located in 24 states of the United States. Eligibility was determined based on organizational charts and a self-selection process to ensure a participant was a project team member for an information technology project.

Due to limitations related to accessing a large random sample, the accessible population was selected. The current research study findings are generalizable to similar firms similar to those in this study.

### 5. STUDY MEASUREMENT

The Project Implementation Profile instrument measures contributing factors and project performance (Pinto & Slevin, 1992) and is a validated, reliable instrument (Pinto, 1986). Given a pre-established instrument (Pinto, 1986) and the instrument's wide use (Hyväri, 2006), the Project Implementation Profile instrument was selected to measure both predictor and criterion variables. To strengthen the confidence level in the instrument reliability, the literature review uncovered several positive conclusions regarding relationships between critical success factors and project performance using the Project Implementation Profile instrument (Delisle, 2001; Finch, 2003; Jones, 2007; Pinto; Pinto & Prescott, 1988; Pinto & Slevin, 1989). The criterion variable in the current research study was project performance measured in two ways. The overall perception of project success was measured with a dichotomous project performance score of successful or unsuccessful. Participants were instructed to respond to questions in the survey by reporting on either a successful or an unsuccessful project.

The second measurement of the criterion variable project performance was an aggregation of 13 scaled performance scores from the validated Project Implementation Profile survey instrument (Pinto, 1986). These ele-

ment scores were aggregated as the second measurement of project performance and then used in correlation analysis with the criterion variables.

The Project Implementation Profile measured the predictor variables (Pinto, 1986), which were the critical success factors: client acceptance, client consultation, communications, monitoring and feedback, personnel, project mission, project schedule or plan, appropriate technology, top management support, and adequate contingency plans (Slevin & Pinto, 1986). The moderating variables were organization size (Hyväri, 2006) and project size (Brown, 2006).

### 6. DATA ANALYSIS

The primary criterion variable for the current study was project success measured by the overall perception of success. Project performance also was measured by 13 Likert-type responses to declarative statements. Data were gathered from participants in the role of project manager or technical project member on the project. Background data were collected for the number of employees at the firm and the number of people working on the project.

For the predictor variables of the critical success factors, the survey instrument scored each factor through an aggregation of Likert-type responses to five or six declarative statements pertaining to the characteristics of each factor. The data supported relationships between the critical success factors and information technology project performance. The data were also controlled for project size and firm size.

Data were tabulated into charts using standard summary statistics to derive the means, standard deviations, frequencies, and percentages. Bivariate comparisons were carried out using Pearson product-moment correlations between scaled scores of project performance with predictor variables. To test the hypothesis, multiple regression prediction equations were generated for testing purposes.

Point-biserial correlation was carried out between dichotomous project success scores and predictor variables. Point-biserial correlation is the Pearson product-moment correlation of a dichotomous variable with a con-

tinuous variable (Newsom, 2006). Point-biserial correlation is precisely the same as the between-groups (independent samples) *t* test with an identical level of significance (*p* value) attached (Brown, 2001). Brown stated point-biserial correlation has two important advantages over the between-group *t* tests: (a) supplying a measure of effect size or strength of the relationship and (b) simplifying the presentation of results.

Point-biserial correlation indicates the relationship between two variables as weak ( $r = .10$ ), moderate ( $r = .30$ ), or strong ( $r = .50$ ) (Brown, 2001). Point-biserial correlation measures the strength of the relationship between two variables but the *t* test does not provide the strength of association of the measures. Measuring the strength of association is more important with a large sample ( $N > 100$ ) because of the possibility to have a statistically significant correlation even though the relationship between the variables is weak.

Point-biserial correlation results are less cumbersome to tabularize supporting several analyses on a single table side by side with correlations for continuous variables. If between-groups *t* tests were used instead, an additional table would be created for each of the dichotomous variables compared with continuous variables.

## 7. DATA ANALYSIS

Data analysis included descriptive statistics, Pearson's correlation coefficient for the entire sample, and partial correlations for the subgroup of the sample. Descriptive statistics analyzed raw data and described data using methods such as frequency distribution shown in Table 3 that displays the frequency counts for selected variables. Most respondents (71.6%) reported they had a successful project. The most frequent project activities were either implementing package software (37.9%) or replacing existing software (24.1%). The most frequent individual roles for the respondents were project team member-technical (47.4%) or project manager (20.7%). The sizes of the organization ranged from 99 employees to 5,000 employees or more with a median number of employees being 3,000. The size of the project ranged from 1 to 5 members to 31 or more members with a median project size of 10.5 members.

Table 1: Variable Frequencies ( $N=116$ )

Variable and categories	<i>n</i> ; %
<b>Project Outcome</b>	
Unsuccessful	33, 28.4%
Successful	83, 71.5%
<b>Project activity or product</b>	
A new software development	13, 11.2%
Enhancement software development	14, 12.1%
Replacing existing software	28, 24.1%
Replacing or adding hardware	4, 3.4%
Implementing package software	44, 37.9%
An information technology project	13, 11.2%

<sup>a</sup> *Mdn* = 3,000 employees. <sup>b</sup> *Mdn* = 10.5 members.

Table 2: Correlations for Project Outcomes

CSF	Performance	Success <sup>a</sup>
Project Performance	1.00	.58****
Clear Goals	.43****	.37****
Top Management Support	.49****	.30****
Project Schedule or Plan	.41****	.32****
Client Involvement	.45****	.42****
Sufficient Personnel	.47****	.22*
Adequate Technology	.78****	.44****
Client Acceptance	.68****	.50****

Monitoring and Feedback	.36****	.32****
Communications	.50****	.31****
Contingency Plans	.65****	.44****

\*  $p < .05$

\*\*  $p < .01$

\*\*\*  $p < .005$

\*\*\*\*  $p < .001$ ,  $N=116$

<sup>a</sup> Success: 0 = *unsuccessful*, 1 = *successful*.

Table 3: *Correlations for Selected Variables*

Variable	Firm Size	Project Size
Project Performance	-.06	-.40****
Clear Goals	-.08	-.24***
Top Management Support	-.15	-.22*
Project Schedule or Plan	.04	.06
Client Involvement	.07	.01
Sufficient Personnel	-.22*	-.26***
Adequate Technology	-.15	-.29****
Client Acceptance	.11	-.09
Monitoring and Feedback	.05	.06
Communications	.01	-.13
Contingency Plans	-.08	-.24**

\*  $p < .05$ .

\*\*  $p < .01$

\*\*\*  $p < .005$

\*\*\*\*  $p < .001$ ,  $N=116$

<sup>a</sup> Success: 0 = *unsuccessful*, 1 = *successful*.

Tables 2 and 3 show the correlations for the critical success factors with organizational size and project size. Only 1 of the correlations for the relationships between organizational size and the 11 scale scores was statistically significant. Specifically, organizational size was negatively related to the Sufficient Personnel factor ( $r = -.22$ ,  $p < .05$ ). Project size was negatively related to 6 of the critical success factors, with the largest correlation being between project size and project performance ( $r = -.40$ ,  $p < .001$ ).

Table 4 presents the results of the backward elimination regression model predicting the project performance scale score based on 12 candidate variables that consisted of the 10 predictor variables and the 2 moderating variables. The candidate variables relates to the analysis by examining the most significant relationships with predicting information technology project performance. The final four-variable model was statistically significant ( $p = .001$ ) and accounted for 78.9% of the variance in the dependent variable. Inspection of the beta weights found the project performance score was higher for smaller sized projects ( $\beta = -.19$ ,  $p = .001$ ), for higher scores on the clear goals scale ( $\beta = .26$ ,  $p = .001$ ), sufficient technology scale ( $\beta = .40$ ,  $p = .001$ ), and the client acceptance scale ( $\beta = .32$ ,  $p = .001$ ).

Table 4: *Project Performance Regression*

Source	Beta	p-value
Intercept	-0.67	.15
Size of Project	-0.23	.001
Clear Project Goals	0.40	.001
Availability of Technology	0.43	.001
Client Acceptance	0.34	.001

Final Model:  $F(4, 111) = 103.86$ ,  $p = .001$

$R^2 = .789$ ,  $N = 116$ .

Table 5 displays the results of the prediction of the dichotomous success variable (0 = No Success versus 1 = Successful Project) based on critical success factors. The results of the backward elimination logistic regression model left three variables in the equation. The success of the project was more likely with: (a) higher client acceptance scores (OR = 3.09, 95% CI = 1.67 - 5.71,  $p = .001$ ); (b) lower communication scores

(OR = 0.57, 95% CI = 0.29 - 1.12,  $p = .10$ ); and (c) availability of contingency plan scores (OR = 2.50, 95% CI = 1.28 - 4.88,  $p = .001$ ). Based on Table 5, 71.6% of the projects were deemed to be successful and this became the base classification rate. This final three-variable model resulted in a final classification rate of 81.9%. Specifically, 19 of 33 unsuccessful projects (57.6%) were correctly classified while 76 of 83 of the successful projects (91.6%) were correctly classified. The negative relationship of communication with the dichotomous measure of project success may indicate that this construct meant that as project problems occurred more communications occurred but the project ultimately was a failure.

Table 5 *Logistic Regression on Project Success*

Source	Beta	p-value
Intercept	-6.88	.001
Client Acceptance	1.13	.001
Communications	-0.56	.10
Trouble Shooting	0.92	.007

Final Model:  $X^2(3, N = 116) = 39.37$ ,

$p = .001$ .

Candidate Variables = 12,  $N = 116$

Base Classification Rate = 71.6%.

Final Classification Rate = 81.9%.

## 8. RESEARCH LIMITATIONS

This non-experimental research design is limited by the ability to determine causal relationships and the difficulty of interpreting results due to the complex ways characteristics and behaviors are interrelated (Polit & Beck, 2007). A future experimental study involving training on the critical success factors before the start of information technology projects compared to groups not trained on the critical success factors might establish causation. The causes that affect the critical success factors and information technology project success are of interest to organizational leaders using projects to accomplish information technology objectives.

The self-reported data collection nature of the current research study was a limitation due to the possibility of participants being influenced by measurement procedures or

biases that might have skewed the results (Neuman, 2003). Without direct observation data to confirm, the current research study could not address the self-reported data collection limitation. A future study including direct observation data might address the limitation.

The Likert-type scale might have introduced artificial strong agreement because authors tend to write non-offensive statements representing the absence of an opinion (DeVellis, 2003). A future research study using a different data collection instrument might address the limitation.

The current research study was a correlational study that might be falsely interpreted due to an over reliance on preexisting groups leading to selection bias (Polit & Beck, 2007). A future research study might address the limitation by a method devised to select a truly random sample of the information technology project manager population. The current research was limited by time to conduct the study and the lack of resources needed to address challenges associated with obtaining responses from truly random eligible participants.

Participants were predominantly (47%) technical project team members. The results indicated the highest association with information technology project performance was availability of the needed technology. The over reliance on technical team members may have affected the current study results. A future study excluding technical project team members might support or fail to support the possible bias introduced by sample characteristics in the current research study.

## 9. CONCLUSIONS

The research question was addressed with the critical success factors and information technology project performance. The correlations for both project performance and project success were significant. Factors significant in predicting project success using a scaled measure were size of project and the critical success factors of project mission, availability of technology, and client acceptance. Factors predicting the dichotomous measure of project success were the critical success factors of client acceptance, communications, and troubleshooting. Also the

performance score was higher for smaller sized projects.

Information technology project performance is of interest to organizational leaders because organizational leaders use these types of projects to accomplish operational objections (Hyväri, 2006) and executive-level leaders of organizations authorize investments in these types of projects based on an anticipated project budget, project schedule, and project benefits (Shenhar & Dvir, 2007). Organizational leaders might be interested in the current research pertaining to predicting information technology project performance because the leaders are responsible when an information technology project fails to deliver the anticipated return (Shenhar & Dvir). Ildefonso (2007) and Woodward (2007) concluded that following project management best practices significantly increases information technology project performance. This study contributes to the importance of focusing on these critical success factors in project management best practices to increase the likelihood of project performance.

The current research data supported associations between the critical success factors and information technology project performance even when there were controls for project and organizational size. Project demographics have an effect on associations between the critical success factors and project performance. Project performance is higher when the project is a smaller sized project, when the goals of the project are clear, when needed technology is available, and when there is higher client acceptance scores. When project success is measured with a simple response of successful or unsuccessful, a successful project was related to higher scores for client acceptance and higher scores for trouble shooting. Communication was supported as being associated with information technology project performance. The literature review showed conflicting study results pertaining to the relationships between project communications and project performance. Several researchers (Pinto, 1986; Pinto & Prescott, 1988; Pinto & Slevin, 1989) excluded communications from additional analysis based on weak significance, whereas other researchers (Delisle, 2001; Finch, 2003; Latonio, 2007) concluded communication had a strong association with project performance. In this study communications was negatively related to

project success a dichotomous measure. This may be attributed to the intense communication that occurs to save a project that is failing.

## 10. FUTURE RESEARCH

A future research study of actual measures of project overrun compared to perceived overrun may provide IT leaders more information on the differences between perception and actual performance. Such a study could address the actual budget and the number of deliverables compared to perceptions of IT project leaders and may provide information about the differences between perception and actual performance. The perceptions of subjects may be studied using scaled project performance scores compared to dichotomous project performance scores to possibly reveal misconceptions about categorizing a project as a success or unsuccessful. Organizational leaders might use the empirical data as a basis to implement training programs defining the characteristics of successful and unsuccessful projects.

## 11. SUMMARY

The current research study results supported Ildefonso's (2007) and Woodward's (2007) statements indicating that following project management best practices results in increased information technology project success rates. Pinto's (1986) conclusions pertaining to relationships between critical success factors and project performance are supported by the current research study results even though the population was different. The results failed to support Hyväri's (2006) statements pertaining to the effect of organization size but did support Brown's (2006) statements about the effect of project size on project success.

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