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The Materiality of Information System Planning Maturity to Project Performance

James J. Jiang
College of Business Administration
University of Central Florida
james.jiang@bus.ucf.edu

Gary Klein
College of Business and Administration
University of Colorado at Colorado Springs
gklein@computer.org

Morgan Shepherd
College of Business and Administration
University of Colorado at Colorado Springs
mshepher@uccs.edu

Abstract

Research for this paper suggests that there is still an alarming lack of success of IS projects in industry today. Two critical success factors that have been examined to date are project manager performance and IS planning maturity. However, the previous studies have bypassed the relative impact of the two factors in combination. This study proposes and empirically tests a model that examines the relationships between project manager performance and IS planning maturity

and their relationship to project success. The results indicate that IS planning maturity is empirically linked positively to project success and to project manager performance. Additionally, the performance of the project manager is also positively related to project outcome. The implication for practitioners is that project management is not an activity limited only to the duration of the development of the IS product but project management must have broader implications for organization management.

Keywords: IS maturity, IS project management, project manager performance, project performance, organizational planning

I. INTRODUCTION

Projects are the way in which information systems are developed. The project structure provides measurable units that allow for comparisons of actual performance to expectations of cost, delivery time, and IS quality [Schwalbe 2000]. Management practices and tools to assist with project completion to achieve success, in terms of these expectations, appear with great regularity [Thamhain 1996; Zimmerer and Yasin 1998]. Still, a seeming lack of success in IS projects is evident in the newspapers, journal articles, and popular books with reports indicating that up to 85% of all IS projects end in failure due to excessive cost overruns, schedule delays, or outright cancellation [Gibbs 1994; Glass 1997; Linberg 1999; Yourdon 1997]. The concern for factors of project success is understandable given the performances reported.

One well-recognized critical factor of success is the performance of the project manager. Researchers in software engineering, project management, and management information systems identify the performance of the project manager as one of the more critical indicators of success [Pinto and Kharbanda 1995; Pressman 2000]. The performance of the project manager is dependent on the activities s/he conducts as well as on the success achieved in these tasks [Kanter 1997; Thamhaim and Wilemon 1987]. The tasks tend to be quite varied and include

planning the project, leading the team, controlling the resources, and communicating with users and management.

Another long-established theme across disciplines is the importance of planning and goal setting in achieving business success [King 1978; Pyburn 1983]. Goals developed through a formal planning process provide a focus and commitment to the work at hand [Locke and Latham 1990]. In turn, effective planning is considered more likely as knowledge is shared across disciplines at high levels of the organization [Lederer and Mendelow 1988]. This requires the participation of top managers across their fields of expertise, such that IS managers are deeply involved in the business planning and other top managers are involved in deriving the IS plan [Lederer and Mendelow 1986, 1987]. Such formality has long been considered characteristic of planning maturity in an organization [Pyburn 1983; Segars 1999; Teo and King 1997].

The factors of project manager performance and planning maturity are timed to different schedules. Planning activities are conducted as part of the organizational process and are done as part of a regular process, independent of any project schedule. The activities of the project manager start at the inception of the project, continue throughout development, and are necessarily directed to a much more narrow view. To date, studies have bypassed the relative impact of the two factors in combination. We propose and test a model to examine the relationships between project manager performance and IS planning maturity and their relationship to project success.

II. BACKGROUND

IS planning maturity is a prime component of IS departmental maturity [Nolan 1973]. When the IS is first introduced into an organization, the IS function is guided by technical and cost issues. As the department matures, involvement in the total organizational environment becomes more formal and extensive [Franz and Robey 1986]. Thus, the IS components of an organization are introduced into ever higher

levels of organizational strategic planning. These mature planning activities lead to clear goals for guiding and directing the behavior of an organization [Locke and Latham 1990]. The goals provoke the intention to conduct necessary steps to complete a plan [Tubbs 1993]. This creation of a working environment through a formal planning process should enable project managers to operate more effectively and allow for greater success of the projects. Such relationships between strategic IS planning and IS success are recommended, but little empirical evidence exists to support the link [Floyd and Wooldridge 1990; Premkumar and King 1992, 1994; Weill and Olson 1989].

Project managers are often linked to the success of a project through the tasks they perform during the course of system development [Pinto and Kharbanda 1995]. Project managers can impact different aspects of success, which still do not have precise measures due to difficulties inherent in multidimensional metrics [Kwak and Ibbs 2000; Linberg 1999]. Attributes common to much work on project success are budgeted performance and quality of deliverables [Turner 1993]. Traditional financial measures are used in project selection, so it seems natural that deviations from hard measures such as cost and time be included. Likewise, satisfaction of the user requirements with a quality system is essential to the deployment. Regardless of specific metrics, project success should be seen from the viewpoint of stakeholder groups, including users and owners.

To achieve success, the project manager must adopt a large number of roles and tasks. Since at least the early 1970s, the project manager's role has been viewed as that of an integrator: integrating everything and everybody to accomplish the project and organizational plans [Schwalbe 2000]. Roberts and Fusfeld [1997] added the role of idea generator to the integrating functions of team builder, sponsor, and coach. Here, tasks included identifying interfaces among stakeholders, controlling the plan and schedule, and communicating with all players [Nambisan and Wilemon 2000; Posner 1987; Roman 1986]. This history of the role

shows that to conduct their jobs, project managers must have managerial, technical, and communication skills [Jiang et al. 1998].

Both planning maturity and the performance of the project manager are vital to success, but an exact relationship of both to eventual success is not clear in the literature. We propose a model as shown in Figure 1. IS planning maturity is a component of the environmental conditions in an organization. The activities are conducted prior to the start of a project and thus represent conditions that enable the project manager to perform his or her tasks as well as to present a plan needed for a focus on success. The managerial functions performed by the project manager are also critical to eventual success as they directly control the development process. Each link is discussed in turn and developed into a hypothesis.

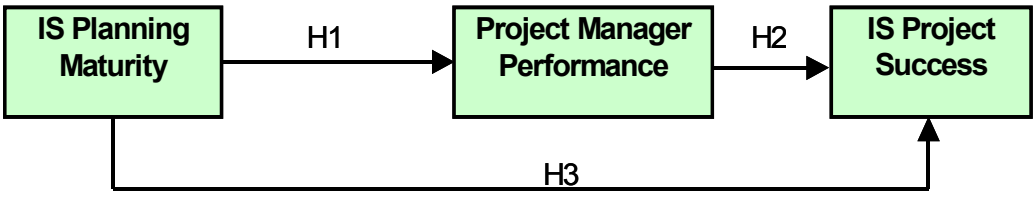

Figure 1. Research Model

IS project managers often reside outside the normal structure of an organization by being formally located in departments other than those conducting the project development operations to complete the project [Frame 1999]. Many firms have separate project offices that provide organizational control over disparate projects across multiple departments [Frame and Christopher 1998]. As such, their authority is derived from their reputation, expertise, and commitment to the objectives of the project [Nicholas 1989]. Necessary environmental factors include managerial support, resource commitment, and a link to the strategic direction [Lientz and Rea 1999]. The resources and managerial support are essential to the authority of the project manager and the strategic direction permits a formal plan with goals, which allows a project manager to conduct his or her integrating tasks

outside the normal departmental structure [Katz and Allen 1985]. Those project managers who can perform their tasks in this fashion succeed, while the others tend to fail [Pinto and Kharbanda 1995]. The extent of planning thus becomes a critical manipulative device for project managers and leads to the first hypothesis:

H1: IS planning maturity is positively related to project manager performance

IS planning has long been recognized as critical in achieving success of projects [Lederer and Mendelow 1987; Pyburn 1983; Segars 1999]. Such planning involves top management and the development of a clear plan commensurate with the business plan [Premkumar and King 1992]. The extent of IS planning and maturity accommodates the strategic direction and support of users [Johnston and Carrico 1988; Venkatraman 1991]. Established practices support the importance of planning goals in conducting activities and shaping intent [Lientz and Rea 1999]. In all, the alignment of the IS plan to the strategic plan of the organization is crucial and requires the involvement of top management in setting the direction of IS [Chan et al. 1997; Dewan et al. 1998]. Therefore, we expect to find a link between IS planning maturity and eventual project success, or:

H2: IS planning maturity is positively related to project success.

Numerous researchers have argued the importance of project managers in projects [Schwalbe 2000; Frame 1999]. It is the project manager's responsibility to meet specific scope, time, cost, and quality goals of projects. One of the more important success factors in the achievement of project goals is the selection of a good project manager, someone who possesses adequate skills and creates a collaborative environment [Pinto and Kharbanda 1995]. Regardless of individual differences and the nature of tool utilization in a project, the project manager's performance will significantly influence the final project outcomes. We, therefore, suggest the following hypothesis:

H3: Project manager performance is positively associated with IS project performance.

III. METHODOLOGY

SAMPLE

Questionnaires were mailed to 500 randomly selected Project Management Institute (PMI) members in the U.S. with postage paid envelopes enclosed for each questionnaire. PMI is the professional association for practitioners of project management with over 50,000 members worldwide. The sample was chosen from this population because members of PMI represent a cross-section of managerial positions and a population that is widely used in project management research. Respondents were asked to reply to the questions if they had been recently involved in an IS development project. All of the respondents were assured that their responses would be kept confidential. This mailing generated 105 responses. A reminder was sent to those in the original sample not returning the instrument.

After the follow-up, responses totaled 186, for an overall response rate of 37%. A summary of the demographic characteristics of the sample is presented in Table 1. The subjects have broad experience in different kinds and sizes of IS applications, different positions, and overall experience. The sample appears well qualified to judge the issues related to organizational maturity and IS development.

External validity refers to the extent to which findings can be generalized across times, people, and settings. Because of the limited number of respondents in the first mailing, non-response bias was a potential threat to the study's external validity. For example, projects could have differed systematically from the participants to the non-respondents on the examined variables. To examine this possible threat, a total of three independent t-tests compared the means of the model's variables (defined fully below) to determine if there was a systematic difference among the first-round and second-round respondents. The existence of a significant difference would imply a non-response bias. No significant difference was found. Non-responding bias, therefore, appeared unlikely.

Table 1. Job Demographics

1.	Managerial Position	
	Administrative	64
	IS Project Leader	73
	IS Professional	45
	No response	4
2.	Work Experience:	
	1 – 10 years	23
	11 – 20 years	72
	21 or above	91
3.	Team Size in Most Recently Completed IS Project:	
	10 people or less	82
	11 – 20	60
	21 – 50	26
	51 or above	14
	No response	4

Table 2. Descriptive Statistics of the Research Model's Variables

Statistics	IS Planning Maturity	Project Managers	IS Project Success
Mean	3.50	3.39	3.47
SD	.86	.90	.76
Median	3.60	3.58	3.48
Skewness	-.48	-.47	-.09
Kurtosis	-.43	-.43	-.42

The external validity of the findings is likewise threatened if the sample is systematically biased—for example, if the responses are generally from more successful projects. Table 2 shows the descriptive statistics for the various constructs. The responses had good distribution of project outcome since the means and medians were similar, skewness was less than two, and kurtosis was less than five

[Ghiselli et al. 1981]. IS planning maturity and project manager performance were also well distributed.

Additional threats to external validity could occur if the samples showed other systematic biases in terms of demographics, such as age, gender, and position. An ANOVA was conducted by using project performance (as the dependent variable) against each demographic category (independent variables). Results did not indicate any significant relationships to managerial position, gender, work experience, or team size. Likewise, no significant relations held for IS maturity and project manager performance as the dependent variables. This indicates that bias is not likely to have been introduced by the demographics of the sample.

IS PLANNING MATURITY CONSTRUCT

The IS planning maturity construct, shown in Table 3, is from Grover and Goslar [1993]. The items reflect the importance attributed by managers to goal-setting and communication in the planning process [King 1978; King 1988; Pyburn 1983]. The questionnaire asks respondents to identify the extent to which each of the items was true during the time of their latest project. Each measure was scored using a five-point scale ranging from not at all (1) to a great extent (5). All items are presented such that the greater the score, the greater the extent of IS planning maturity. To examine the validity of the measure, we employ confirmatory factor analysis (CFA). When conducting a CFA, if the model provides a good approximation to reality, it should provide a good fit to the data. The CFA for the IS maturity measure results in an Adjusted Goodness of Fit Index (AGFI) of .83 (greater than .80 is recommended), a Comparative Fit Index (CFI) of .94 (greater than or equal to .90 is recommended), a Non-normed Fit Index (NNFI) of .88 (greater than or equal to .90 is recommended), and a Normed Fit Index (NFI) of .92 (greater than or equal to .90 is recommended) [Anderson and Gerbing 1988]. Thus, the items represent a good fit for the measurement model.

Convergent validity is demonstrated when different instruments are used to measure the same construct, and scores from these different instruments are strongly correlated. Convergent validity can be assessed by t-tests for the factor loadings being greater than twice their standard error [Anderson and Gerbing 1988]. The t-tests for each indicator loading are exhibited in Table 3 and the results show that the construct demonstrates a high convergent validity since all t-values are significant at the .01 level. In addition, the internal consistency reliability of the construct is examined with the Cronbach alpha value. Alpha value is high if the various items that constitute the construct are strongly correlated with one another. The Cronbach alpha value for this construct was .85, which exceeds the recommend level of .70.

Table 3. IS Planning Maturity Construct

Items (Cronbach alpha = .85)	Standardized Loading	t-statistic
A1: How informed are your information systems managers about your company's business plans?	.62	**6.50**
A2: How informed is your firm's top management about IS technology?	.67	**7.19**
A3: How formalized is IS planning in your organization?	.78	**8.80**
A4: How involved is top management in IS planning?	.84	**9.81**
A5: To what extent does IS planning take your company's business into consideration?	.79	**8.98**
Red indicates significant at .01		

PROJECT MANAGER PERFORMANCE CONSTRUCT

The project manager performance items in Table 4 are from Thamhain and Wilemon [1987]. Respondents were asked to identify the extent to which each of their project manager's activities was conducted in their most recently completed IS project. Each measure was scored using a five-point scale ranging from disagree (1) to agree (5). All items are such that the higher the score, the greater

the extent to which the activities were conducted by their project manager. To examine the validity of the project manager's activities measure, we again conduct a CFA. The results indicate a good fit of the measurement model with AGFI = .90, CFI = .98, NNFI = .98, and NFI = .94. Similarly, the convergent validity is assessed by reviewing the t-tests for the factor loadings. The results show that the construct has high convergent validity since all t-values are significant at the .01 level. The Cronbach alpha of .94 indicates strong internal consistency reliability.

PROJECT SUCCESS CONSTRUCT

The project success measure is from Thamhain and Wileman [1987] as applied in the IS literature [Jones and Harrison 1996]. The respondents were asked about their satisfaction in their most recently completed IS project. Each item is scored using a five-point satisfaction scale ranging from disagreement (1) to agreement with the items of satisfaction (5). All items, listed in Table 5, are presented such that the higher the score, the greater the satisfaction of the particular item. To examine the validity of the project success measure, we again conducted a confirmatory factor analysis. The CFA on the measurement model indicates a good fit with AGFI = .82, CFI = .93, NNFI = .86 and NFI = .91. Convergent validity was assessed by reviewing the t-tests for the factor loading. The results show high convergent validity since all t-values are significant at the .01 level. Similarly, the Cronbach alpha value of .90 indicates strong internal reliability of the construct.

Table 4. Project Manager Performance Construct

Items (Cronbach alpha = .94)	Standardized Loading	t-statistic
M1: Project manager understood the various barriers to team development and built a work environment conductive to the team's motivational needs.	.76	**11.70**
M2: Project manager continuously updated and involved management and users to refuel their interest and commitment to the project.	.71	**10.74**
M3: Project manager built a favorable image for the project, in terms of high priority, interesting work, importance to the organization, high visibility.	removed due to CFA results	
M4: Project leadership positions were carefully defined and staffed at the beginning of a new project.	.74	**11.20**
M5: Project manager conducted effective planning early in the project life cycle.	.85	**13.91**
M6: Project manager successfully involved key personnel at all organizational levels.	.80	**12.58**
M7: Project manager communicated individually with each prospective team member about specific tasks, the outcomes, timing, responsibilities, report relations, potential rewards, and importance of the project to company.	.76	**11.70**
M8: Project manager defined the basic team structure and operating concepts early during the project formation phase. The project plan, task matrix, project charter, and policy are principal tools.	.79	**12.45**
M9: The team building sessions were conducted by the project manager throughout the project lifecycle.	.67	**9.90**
M10: Project manager determined lack of team member commitment early in the life of the project and attempted to change possible negative views toward the project.	.73	**11.08**
M11: Project manager sought senior management support to provide a proper environment for the project team to function effectively.	.72	**10.93**
M12: Project manager watched for changes in performance on an ongoing basis.	.76	**11.78**
M13: Project manager focused his efforts on problem (conflicts) avoidance.	.64	**9.31**
Red indicates significant at .01		

Table 5. Project Success Construct

Items (Cronbach alpha = .90)	Standardized Loading	t-statistic
P1: Able to meet project goals	.72	**13.56**
P2: Innovative and creative	.70	**13.84**
P3: High quality of work produced	.90	**21.63**
P4: Willingness to change project plan	removed due to CFA results	
P5: Significant amount of work produced	.63	**11.05**
P6: Adherence to budget	.64	**11.21**
P7: Adherence to schedule	.76	**16.47**
P8: Efficient operations	.78	**15.60**
Red indicates significant at .01		

Discriminant validity is demonstrated when different instruments are used to measure different constructs, and the correlations between the measures of the different constructs are weak. Discriminant validity can be examined through a variance extracted test [Fornell and Larcker 1981]. This test compares the average variance extracted estimates (the amount of variance captured by an underlying factor in relation to the amount of variance due to measurement error) for every factor pair of interest and compares the estimates with the squared correlation between the two factors. Discriminant validity is demonstrated if both variance extracted estimates are greater than the squared correlation. In the present study, the square of the correlation between any two factors is smaller than their corresponding average variance extracted estimates (Table 6). This supports the discriminant validity of the variables of this study.

Table 6. Discriminant Validity Among Model Variables

	IS Planning Maturity	Project Manager Performance	Project Success
IS Planning Maturity	**.54**	.28	.23
Project Manager Performance		**.56**	.37
Project Success			**.55**

Note: Diagonals represent the average variance extracted estimates, while off-diagonals represent the squared variance.

IV. DATA ANALYSIS AND RESULTS

The research model and hypotheses were tested by path analysis, specifically structural equation modeling (SEM) techniques in SAS. There are three important assumptions associated with path analysis: (1) normal distribution of variables; (2) absence of multicollinearity among variables; and (3) the number of variables in the model. The maximum likelihood estimation procedures (used in the SAS CALIS procedures) are fairly robust against moderate violations of normal distribution assumption [Joreskog and Sorbon 1989]. Still, Mardia's multivariate kurtosis (2.05) and normalized multivariate kurtosis (1.89) tests were conducted to assess normality, with no indication of a violation in the data set. Multicollinearity is a condition in which one or more variables exhibit very strong correlations (greater than .80) with one another [Anderson and Gerbing 1988]. The correlations between variables are all less than .80 and, thus, no significant violation of multicollinearity was found (see Table 7). Although there is no limit on the total number of variables in structural equation modeling, the total number of variables in this model was three, whereas the recommendation is less than six [Bentler and Chou 1987].

Table 7. Correlation Among the Model's Variables

	IS Planning Maturity	Project Manager Performance	Project Success
IS Planning Maturity	1.00	**.53**	**.48**
Project Manager Performance		1.00	**.61**
Project Success			1.00
Red indicates significant at p = .01 level.			

The theorized model in Figure 1 fit the data well, with all three fit indices above .90 (NFI = .95, NNFI = .94, CFI = .95), and AGFI = .84. Table 8 shows the results of the SEM model. The direct effect of IS planning maturity on project manager performance was supported in this study ($p < .01$). Therefore, hypothesis H1 is supported: the extent of IS planning maturity is significantly and positively associated with project manager performance. The path coefficient for this effect was .58. Likewise, hypothesis H2, that IS planning maturity is significantly and positively associated with project performance, was supported. The standardized score for this effect was .21. Finally, the direct effect of project manager performance on project success was positive and significant ($p < .01$), which suggested support for hypothesis H3: the better the project manager performance, the greater the project success. The standardized effect was .53.

Table 8. Path Analysis Results

Independent Variable	Corresponding Dependent Variable	Hypothesis	Path Coefficient	Standard Error	t-statistics
IS Planning Maturity	Project Manager Performance	H1	.58	.08	**7.23**
IS Planning Maturity	Project Success	H2	.21	.07	**2.27**
Project Manager Performance	Project Success	H3	.53	.07	**5.87**

Red indicates p < .01.

The internal validity of a model tests whether alternative explanations of the results can be provided, such as the effects of missing variables [Mitchell 1985]. In this study, project size as a missing variable is important enough to be controlled explicitly. For example, the relationship between project manager performance and project performance may be more an artifact of their correlation with project size than the presence of IS planning maturity effects. When project size (measured by the number of team members) was explicitly included in the model, the t-test and Wald test suggest that its effects on project performance and project manager performance were not significant and should be dropped. Project size did not appear to provide an alternative explanation of the IS planning maturity effects, although project size is considered to be a factor in controllability [Putnam and Fitzsimmons 1979].

V. CONCLUSIONS

This research links together the importance of both IS project planning maturity and project manager performance to the eventual success of project delivery. The sample of project team members indicated that both elements are critical. Empirical links from planning to success have been limited, but IS planning maturity is empirically linked positively to project success and project manager performance in this study. Additionally, the performance of the project manager is

also positively related to project outcome, showing that a continuation of good management practice through the development stages is an essential component of success. The unique aspects of this study are the tandem consideration of two factors studied previously in isolation, the first empirical support of IS planning maturity as an indicator of IS project success, and the added link between an organizational factor to the operational level of practice.

Past research did find certain links that complement the results of this study. Premkumar and King [1992] proposed that organizational performance is improved under strong planning scenarios. Lack of planning is found to lead to a waste of resources [Sullivan 1985]. A few limited studies focused on linking organizational planning to organizational performance measures, such as ROI, sales growth, and market ratio [Floyd and Wooldridge 1990; Premkumar and King 1992, 1994; Weill and Olson 1989]. More general studies have reported on the importance of top management and user involvement in the planning process for effective planning, but effectiveness has proven an elusive measure [Adriaans and Hoogakker 1989; Brancheau et al. 1989]. In short, the literature examines the IS planning process itself and its impacts on organizational performance. However, the relationship between IS planning maturity and IS project development has not previously been a focus of study.

The implications for management are quite direct. Project management is not an activity limited only to the duration of the development of the IS product. Certainly, project management during these phases is critical to success, but IS planning maturity impacts the performance of the project manager. Whether the planning provides groundwork or a more favorable organizational culture, the extent of planning and the involvement of various management stakeholders directly and indirectly lead to the success of the project. Project success and the environment in which project managers operate to achieve success are both advanced by the adoption of formal, mature planning processes. The practices to improve planning include those mentioned by previous researchers, including steering committees,

goal setting, and resource commitment to facilitate the integration of the plans and the operations [King 1988; Lederer and Mendelow 1986; Schwalbe 2000; Segars 1999]. Whatever techniques are employed, the incorporation of IS planning into the organization's strategic planning process is crucial to achieving the desired maturity.

The results of this study must be considered in conjunction with the limitations of the sample and model. The sample is from one professional organization. Although the respondents represent a wide variety of interests within their organizations, they do have a common interest in project management and may suffer professionally related biases. The model does not consider any planning outputs to determine the depth of the links that exist. Such outputs may be IS policies, strategies, or development practices. Likewise, effectiveness of the planning process is not considered and may serve to dampen the effects found if effectively measured and considered. The project outcomes considered several stakeholders, but not the direct perceptions of those stakeholders. Users and owners should have an interest in schedules and requirements, but other factors are relevant to the perceptions of overall satisfaction with the product and can only be gathered with a matched sample of the different stakeholders over the same projects.

Further studies are required with other populations to solidify the relationship found in this study. These future studies should continue to consider both management elements rather than ignoring the links between early aspects of a project and the continuing control aspects. Other consideration should be given to dimensions not considered in this model, such as the effectiveness of planning and resource availability [King 1988; Weill and Olson 1989]. Each of these items is expected to be of importance. Likewise, as current research on project success clarifies the measures utilized by industry, they should be brought into a model for analysis [Kwak and Ibbs 2000]. The model should also be expanded to consider intermediate factors that serve to negotiate the relationship between planning and performance, especially the risks involved with IS projects and which implementation strategies prove effective in implementing IS plans. Furthermore, the nature

of planning that leads to success should be investigated to determine the more discernable factors leading to the success, such as groundwork or environmental considerations. Matched data from various stakeholders should also be the direction sought in future work in order to investigate the various possible perceptions of the different stakeholders. This includes populations other than those in professional project management organizations.

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VII. ABOUT THE AUTHORS

James J. Jiang is a professor of Management Information Systems at the University of Central Florida. He obtained his Ph.D. in Information Systems at the University of Cincinnati. His research interests include IS project management and IS personnel management. He has published over 70 referred articles in journals such as *IEEE Transactions on System, Man, & Cybernetics*, *Decision Support Systems*, *IEEE Transactions on Engineering Management*, *Decision Sciences, Journal of Management Information Systems (JMIS), Communications of the ACM*, *Information & Management*, *Journal of Systems & Software*, *Data Base*, and *Project Management Journal*. He is a member of IEEE, ACM, AIS, and DSI.

Gary Klein is the Couger Professor of Information Systems at the University of Colorado in Colorado Springs. He obtained his Ph.D. in Management Science from Purdue University. Before that time, he served with Arthur Andersen & Company in Kansas City and was director of the Information Systems Department for a regional financial institution. His research interests include project management, system development and mathematical modeling with over 70 academic publications in these areas. He teaches programming and knowledge management courses. In addition to being an active participant in international conferences, he has made professional presentations on Decision Support Systems in the U.S. and Japan, where he once served as a guest professor to Kwansei

Gakuin University. He is a member of IEEE, ACM, the Society of Competitive Intelligence Professionals, the Decision Science Institute, and the Project Management Institute.

Morgan Shepherd is an assistant professor of Information Systems at the University of Colorado at Colorado Springs. His teaching interests are in telecommunications, decision support for virtual teams, and e-commerce. He received his B.S. in Mechanical Engineering from the University of Virginia and his Ph.D. in MIS from the University of Arizona. He worked for 10 years in industry prior to returning for his Ph.D., spending most of that time with IBM as a staff level network engineer. His work has been published in the *Journal of Management Information Systems*, *Informatica*, and several national and international conference proceedings.

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