
An Integrated Performance Model of Information Systems Projects

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ABSTRACT: This study makes an initial attempt to validate an integrated, theoretically driven performance model of information systems (IS) projects. IS project performance is defined in terms of task, psychological, and organizational outcomes. We draw upon different theoretical perspectives including IS, organizational teams, and project management to link six categories of variables to IS project performance: technology characteristics, project characteristics, task characteristics, people characteristics, organizational characteristics, and work processes. Data collected via a field survey of IS project leaders in 84 manufacturing organizations were used to test the proposed model. Support is found for three conclusions: (1) IS project performance is a multidimensional construct, (2) certain preconditions falling into the above categories have to exist to achieve a high performing IS project, and (3) there is a possible cross-relationship among the variables studied by IS research, organizational teams research, and project management research. We discuss the implications of this study for future research and managerial practice.

KEY WORDS AND PHRASES: information systems development, information systems projects, integrated performance models, project performance.

ALTHOUGH ORGANIZATIONS ARE INCREASINGLY USING information systems (IS) projects in myriad tasks and giving them assorted responsibilities [32], they have limited understanding of how to manage these organizational collectives effectively. Organizations know very little as to what influences the performance of IS projects [4]. This concern is exacerbated by the fact that the IS research community has only recently begun to pay close attention to the IS projects performance construct. Robey et al. [58, p. 126] note that IS project performance is an area that is "often neglected in research on information systems."

The few empirical studies, for example [4, 52, 57], that attempted to answer to the IS project performance concern, have been limited and do not back the increased interest by the business community. The literature in this area is broadly divided into two mutually uncoordinated streams of research:

1. The social view of IS project performance, for example [25, 58], which refers to research focusing on issues relevant to the behaviors and attributes of project members, to within project social context in which human behaviors of members occur, and to the organizational environment within which IS projects operate. This view usually submerges technology as a major determinant of IS project outcomes; and
2. The technical view of IS project performance, for example [14, 60], which refers to research focusing on issues relevant to the attributes of the IS project itself and the task it should accomplish. This type of research usually ignores people behaviors and social exchange processes as important contextual variables.

This dichotomy limits the contribution of existing research in providing the more desired integrated analysis to the problem. Furthermore, there is an opportunity to draw upon the rich literatures on organizational teams and project management and gain new insights into the management of IS projects. Given the state of research on the performance of IS projects, proposing an integrated model that considers the major contingencies of IS projects performance and provides an organized view of this phenomenon represents an important challenge. A unified model of IS project performance determinants can contribute to cumulating research efforts [36] and lead to the development of a better theory with greater explanatory power [35]. This research is an initial attempt in that direction.

The paper is expected to contribute to both theory and practice. The current investigation is expected to add to IS project performance research by:

1. providing theory-grounded conceptualization of IS project performance,
2. organizing and synthesizing the literatures on IS, organizational teams, and project management to understand the IS project performance phenomenon better and to set the stage for further research in this area,
3. proposing an integrated model of factors affecting the performance of IS projects,
4. validating this model in an empirical field survey research, and
5. providing a set of guidelines that might be helpful for the effective management of IS projects.

Review of Prior Research Leading to Integration

IS RESEARCHERS HAVE MADE NUMEROUS ATTEMPTS to investigate many issues at either the system or organizational levels. Nonetheless, attempts to empirically investigate issues related specifically to IS project performance as a dependent variable are limited indeed. IS project performance is an area of research that is often neglected

by IS researchers [58]. Inasmuch as research on IS effectiveness is significant in that it tries to examine the impact of IS on its environment, it is important to understand that IS project performance is a different construct from IS effectiveness. The two constructs differ in four major ways. First, IS project performance and IS effectiveness differ in terms of focus. Usage, user satisfaction, system quality, and information quality impact are examples of surrogates used in many IS effectiveness studies [15]. Such studies are basically concerned with success at the system level, the usual manifestation of an IS project work but not the sole testimony to an IS project performance. Second, traditional IS effectiveness research lacks attention to the social context within which systems development is undertaken. Any attempt to study IS projects without considering this social context will confer a misrepresented picture of what affects IS project performance. Third, the unit of analysis is different in the two constructs. The unit of analysis in IS effectiveness research is overwhelmingly the individual [15], and the purpose is to assess the impact of the technology at that level. The unit of analysis in IS project performance research, on the other hand, is the project team. Finally, the measurement issues are different in the two constructs. IS effectiveness is measured predominantly using unidimensional surrogates of success, such as usage [15]. To the contrary, IS project performance is usually viewed as a construct that incorporates multiple dimensions of success, such as project efficiency and effectiveness [25].

Given these major differences between the two constructs, one expects the factors that influence the two constructs will also be different.

A quick review of past IS project performance studies (Table 1) reveals that existing literature on the subject can be divided into two streams of research: the social interactionist view and the technical view. Aladwani et al. [4], Henderson and Lee [25], and Robey et al. [58], for instance, assumed the social interactionist view of IS project performance and implicitly discounted technology and task characteristics as major determinants of IS project outcomes. Aladwani et al. [4] examined the relationship between group heterogeneity, group-based rewards, participation, and IS project performance. Robey et al. [58] studied the relationship between participation, influence, conflict and conflict resolution, and IS project performance. Henderson and Lee [25] investigated the role of managerial- and self-control mechanisms in IS projects.

Other researchers, such as Rai and Al-Hindi [52], Deephouse et al. [14], and Saarinen [60], on the other hand, adopted the technical view and discounted people and process characteristics as important contextual variables. Rai and Al-Hindi [52] studied the effect of the interaction between technical process modeling and task uncertainty on project outcomes. Deephouse et al. [14] examined the relationship between software processes and project performance without attending to the role of people characteristics and teamwork processes. Saarinen [60] examined the variables that contribute most to the success of IS projects such as development time, level of telecommunications, adequacy of tools, and so on. The study clearly focused on examining the variables relevant to the technical context and ignored social issues.

Moreover, past research seems to be rather narrow in its definition of IS project performance. IS scholars [25, 44, 52, 56, 58] normally operationalized IS project

Table 1. Issue Coverage in Empirical IS Project Performance Research

Source	Technical view			Social interactionist view		
	Technology issues	Task issues	Project issues	Org. issues	Process issues	People issues
[60]	11	—	—	2	—	1
[25]	—	—	—	2	2	—
[1]	1	—	—	1	—	—
[58]	—	—	—	—	4	—
[2]	1	—	—	1	—	—
[40]	1	1	—	—	2	—
[34]	1	1	3	1	3	—
[44]	1	1	—	—	1	—
[14]	4	—	1	1	—	1
[61]	—	—	—	—	1	1
[56]	—	1	—	2	—	—
[4]	—	—	—	1	1	1
[57]	2	1	—	6	1	—
[52]	1	1	—	—	—	—
Total	23	6	4	17	15	4

performance in terms of process efficiency (as measured, for example, by cost and schedule overruns) and process effectiveness (as measured, for example, by outcome quality). This view has a particular flaw in that it ignores project members' feelings/judgments (such as job satisfaction) as an important performance criterion. Hackman and Oldham [22] suggest that the overall effectiveness of a group depends on the degree to which: (1) the team's output meets the standards of the people who benefit from that output, (2) the process of carrying out the work improves the capabilities of members to work together in the future, and (3) the team's experience contributes to the advancement and well-being of work group members. In this definition, the authors [22] highlight the importance of the quality of working life of members and the satisfaction of the customers of the working unit.

The above discussion reveals that there are weaknesses in the IS projects literature. Past empirical research does not consider some of the major contextual factors that determine the performance of IS projects, is narrow in its definition of project performance, and lacks synthesis. We argue that this situation may be attributed in part to a lack of a unifying framework for exploring the phenomenon of IS project performance. Kuhn [35] suggests that a mature area of research should have, among other things, an integrative framework. Developing an integrative framework can have many constructive implications. Having a unifying framework can contribute to cumulating the efforts within the research area of interest [36]. A rich base of concepts can be available for researchers with which they can design studies that compare to each other. In this way extensions can be readily possible. This leads to the development

of better theories that exhibit greater explanatory power [35]. A good theory is expected to lead to a set of generalizations that can be easily migrated to operational settings [21].

Given the state of research on IS project performance, proposing an integrated model that considers the major contingencies of IS projects performance and provides an organized view of this phenomenon represents an important challenge. It is by no means claimed here that such a model will be exhaustive. Rather, we expect that the proposed model will be further elaborated on in future work. Furthermore, there is an opportunity to draw upon the rich literatures on organizational teams research and project management research to gain new insights into the management of IS projects.

The consolidated picture of the different perspectives can be expected on two different levels. The review suggests that the integrated model is conceivable on the dependent as well as the independent variables levels. First of all, as has been discussed, the outcome of a teamwork effort is multidimensional and requires the measurement of not only the quality of the produced work, but also the quality of working life of project members. The three relevant literatures can contribute to this consolidated view. Organizational teams research provides invaluable insights regarding the importance and measurement of psychological aspects of performance, such as satisfaction, whereas project management research and IS project performance research provide equally penetrating ideas on the significance of product-level performance measures of the project, such as efficiency and effectiveness.

Further, an integrated view is readily apparent between the three literatures in terms of the independent variables. In fact, there is a need to benefit from the different literatures in providing the indispensable knowledge that may contribute to better understanding IS project performance. Unlike existing IS project performance research, organizational teams research [12, 66] devotes particular attention to how people interact during work. This literature pays attention to people characteristics such as staff expertise, and work processes such as problem solving, and their role in shaping the behavior of organizational work groups. However, information technology, such as development support tools, the usual playground of information systems, is an overlooked variable in organizational teams' research. Goodman et al. [20, p. 135] state that "Current models of work-group effectiveness overstate the role of human variables . . . and understate the importance of technology and organizational context variables." This omission is a serious flaw that may not be conducive of the better understanding of the effectiveness of organizational teams. Project management research is concerned with identifying a set of factors critical for the success of organizational projects. This type of research, however, is predominantly conceptual in nature [46]. Only a few investigations adopted a broad perspective on project management and success and subjected their work to an elaborate empirical testing [10, 18, 31, 43, 46, 47]. A major strength of this area of inquiry is the attention paid to task/project characteristics, such as goal clarity. The project management research in general, however, pays little attention to social processes.

From the foregoing discussion, it is evident that the three literatures emphasize some contextual characteristics more than others. It is not suggested by any means

Table 2. Relative Coverage in IS, Organizational Teams, and Project Management Literatures

	Technology issues	Task issues	Project issues	Org. issues	Process issues	People issues
Information systems	H [60]	L [4]	L [58]	M-H [57]	L-M [34]	L [52]
Organizational teams	L [19]	L-M [39]	H [69]	M-H [21]	H [65]	H [71]
Project management	L [31]	H [10]	H [43]	M-H [18]	L-M [47]	L-M [64]

L = low; M = moderate; H = high emphasis.

that the three literatures do not intersect on these issues. Sometimes, a particular issue is considered in one or more of the three literatures. However, it is claimed that whenever an issue is associated with a particular literature, that is because it provides the most consistent argument for the issue and its related concepts (see Table 2). These dimensions will represent the key components of our research model. The following section will discuss this model in detail.

A Performance Model of IS Projects

AN EXTENSIVE REVIEW OF THE LITERATURES on IS, organizational teams, and project management identified numerous factors that potentially influence the performance of IS projects. The inclusion of all of these variables in a single model can be problematic. Despite the conventional wisdom that considering all the antecedents of a construct would increase the possibility of accounting for an increased amount of its variation, it must be noted that from an analytical point of view a large number of variables can show significant relationships where there may be none. Fortunately, the three literatures have clues for us as to what variables may be included in the model. IS research provides the necessary theory for incorporating technology (such as use of support technology) into our model. Organizational teams research supports the view for considering teamwork processes (such as problem solving competency) and people attributes (such as expertise of staff). The literature on project management strongly argues for the inclusion of task characteristics (such as clear goals) in any integrative framework. Together, the three literatures offer a number of generalizations that span many aspects of IS project management (such as, management advocacy and project team size) and IS project performance (such as, task, psychological, and organizational outcomes). These observations can be grouped according to the following six major dimensions: technology characteristics, project characteristics, task characteristics, people characteristics, organizational characteristics, and process characteristics.

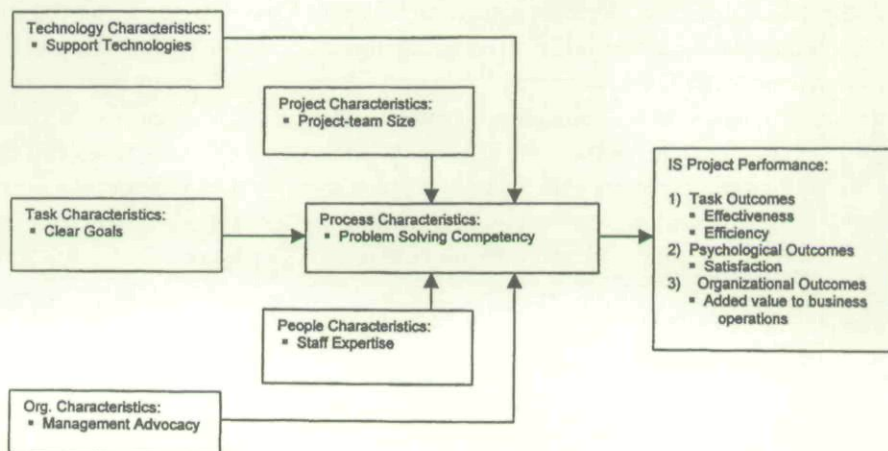


Figure 1. Research Model

Figure 1 summarizes our research model. It argues that certain project design attributes (such as, use of support technology, project team size, clear goals, expertise of staff, and management advocacy) are necessary inputs for accomplishing favorable process outcomes (such as problem solving), which in turn represent necessary conditions to secure the ultimate desired task, psychological, and organizational outcomes. There are two main reasons for selecting these variables for inclusion in our model. First, the findings of our research should have implications for practicing managers by adding to our understanding of how these variables can be better managed. Second, despite the valuable literature in organizational teams and project management, the impact of these variables on problem solving and IS project performance has not been taken into account by the IS literature. This provides us an opportunity to contribute to the IS project performance literature. The following is a review of key variables in our model.

Use of Support Technologies

Henderson and Cooperider [24] define support technologies in terms of production, coordination, and organizational dimensions. According to the authors, there are three components of production technology: activities that relate to representing information requirements, activities that relate to analyzing information flows and data relationships, and activities that relate to transforming these views into program codes. Coordination technologies are those that enable control and cooperative functionalities. Organizational technologies reflect support and infrastructure functionalities. Several reports have noted that such support technologies indeed have a noticeable impact on process, task, psychological, and organizational outcomes of systems development. For example, Johar [30] describes how an intelligent-based support technology can improve problem solving capabilities of system developers. Moreover, Post et al. [49]

assert that adequate development equipment and tools have an indisputable voice in determining the success or failure of many IS projects. Swanson et al. [70] report the experience of a multinational company who had a dramatic productivity improvement as a result of the use of automated support products. Banker and Slaughter [8], Saarinen [60], and Rai and Patnayakuni [54] also report similar results. It is believed that not only programmers/analysts abilities were supplemented by the existence of support technologies [24], but also delivery cycle is shortened. Thus, it is expected that the use of support technologies will determine the outcomes of IS projects.

H1a: Use of support technologies will influence problem solving competency of IS projects.

H1b: Use of support technologies will influence task, psychological, and organizational outcomes of IS projects.

Project Team Size

Aladwani et al. [5] maintain that understanding project team size is crucial for understanding the outcomes of IS projects. Intuitively, larger project team size can, given a particular task, be thought of as a non-limiting factor adding abilities or resources to the work group [23]. However, continuing research suggests a new and different conclusion. Several studies have shown that project team size can have serious implications for problem solving competency of work groups. Shaw [65], for example, asserts that project team size influences the amount and distribution of efforts within the working unit in a counterproductive manner. Latane et al. [37] convincingly explain that this is so because as the number of individuals involved in a project team increases, pressure on any individual to perform well is diffused. Consequently, it becomes easier for any individual in the project team to become a "free-rider." Furthermore, Aladwani et al. [5] found that the increase in project team size exerts a negative influence on IS project performance. Koushik and Mookerjee [33] show that marginal productive outcome of the IS project is a diminishing function of project team size. Having a larger project team size cause project productivity to decrease [69] and project members' dissatisfaction to increase [3]. Therefore, we anticipate that project team size will also determine the outcomes of the IS project.

H2a: Project team size will influence problem solving competency of IS projects.

H2b: Project team size will influence task, psychological, and organizational outcomes of IS projects.

Clear Goals

A clear mission that establishes initial goals and general directions is essential for the success of organizational projects [46]. Clear goals can influence group problem solving by motivating strategy development [38]. According to Morgan and Bowers [41], goal clarity can improve the ability of project members to understand the problem

solving situation and develop a common understanding of the problem, to effectively communicate this understanding to other project members, and to develop a unified approach or strategy for solving the problem. Furthermore, goal setting can influence task outcomes of working units by directing attention to the task, mobilizing employees effort, increasing persistence, and increasing commitment [26, 38]. Empirical findings reported by some scholars point to the fact that clear goals lead to project success [46]. In addition, goal clarity is found to have an impact on job satisfaction of workers [63]. McKeen et al. [40], however, found a positive, albeit not significant, relationship between task ambiguity and IS effectiveness as measured by user satisfaction. Hence, it is predicted that clear goals will impact the outcomes of the IS project.

H3a: Clear goals will influence problem solving competency of IS projects.

H3b: Clear goals will influence task, psychological, and organizational outcomes of IS projects.

Expertise of Staff

Past research suggests that experience and knowledge and the resultant familiarity with the problem faced can be an important determinant of IS project outcomes. A capable project with appropriate staff expertise means that it enjoys a diversity of abilities and experiences. Intuitively, an IS project that possesses a significant inventory of experience and skills is more likely to solve problems better than one that does not enjoy the same privilege. Since a significant proportion of the work of systems developers involves repeat problems [70], members with appropriate experience are more likely to have faced the same problem before [51]. Due to this familiarity, the experienced member is expected to show higher performance than their less experienced peers do. Moreover, Hollenbeck and Klein [26] theorize that people characteristics, including ability, are important antecedents of goal commitment and consequently better performance. Tziner and Eden [71] provide empirical evidence in a tank crew setting showing that individual ability is a significant determinant of the performance of a working unit. Moreover, they reported that for tasks that were highly interdependent (such as in the case of software projects), work group performance was likely to relate positively to the summed capabilities of all members. Therefore, it is expected that expertise of project members will affect the outcomes of the IS project.

H4a: Expertise of staff will influence problem solving competency of IS projects.

H4b: Expertise of staff will influence task, psychological, and organizational outcomes of IS projects.

Management Advocacy

In this paper, management advocacy refers to the willingness of management to provide the required resources and authority for project success [46]. There is agreement

among researchers regarding the importance of management advocacy for favorable IS projects outcomes. Management approval of the work of the IS project and the resultant commitment and advocacy for this work can make human, monetary, and other important resources avail for the IS project leading to a conducive and superior problem solving environment. Moreover, Schultz and Slevin [64] reported a significant relationship between managerial advocacy and the five variables tapping project success. Ravichandran and Rai [57] concluded that top management leadership can increase the likelihood of IS product quality and efficiency. In the context of IS implementation, management advocacy was found to positively relate to user satisfaction with end user computing (EUC) [29], diffusion of CASE tools [53], satisfaction with design support systems (DSS) [62], and strategic IS planning [6]. Thus, it is expected that management advocacy will determine IS project outcomes.

H5a: Management advocacy will influence problem solving competency of IS projects.

H5b: Management advocacy will influence task, psychological, and organizational outcomes of IS projects.

Problem Solving Competency

Problem solving activities have several manifestations for the work of IS projects. An IS project that employs high problem solving skills can concert available resources in ways that facilitate the favorable outcome of the effort. As mentioned previously, the task of system development projects is a collaborative effort. Such projects usually construct task strategies to be followed to improve their solution process [13]. Solution norms may be developed and followed during the development episodes. These may or may not be compatible with available solution structures. For example, a project may go on with the process by meeting to catalog general users needs, technical staff may then meet privately to have a feeling of the problem, and finally, the whole project may schedule its first joint meeting. Moreover, efficacy in problem solving may help direct efforts to other important issues. The sooner the project conceptualizes a preliminary feasible solution for the problem, the more likely that the project mobilizes all the effort to perfecting the solution. The solution improves not only the process, but also the outcome of the effort. The favorable outcome of a capable project may enhance members' self-confidence. Hackman [21] in his normative model puts a considerable weight on how the problem solving strategy can influence the performance of groups including the propensity of members to be part of the project in the future. Furthermore, by solving a problem more effectively and efficiently the clients of the project may be served better. Consequently, problem solving is another antecedent of IS project performance.

H6: Problem solving competency will influence task, psychological, and organizational outcomes of IS projects.

Data Analysis and Research Findings

Sample

FIVE HUNDRED MANUFACTURING ORGANIZATIONS were randomly selected from the *Directory of Top Computer Executives* list and contacted to solicit their participation in our study. A letter was sent to the senior IS executive requesting that they forward the questionnaire to the leader of the most recently completed IS project. A reminder letter along with a follow-up questionnaire was sent three weeks after the initial mailing. Of the 500 contacted organizations, 14 organizations either declined to participate or indicated that the contacted person was no longer with the organization. The effective sample size is, therefore, 486 organizations. Of these, we received usable questionnaires from 84 IS project leaders, or approximately a 17.3 percent response rate, which is comparable to most other IS surveys [57].

Most of the IS project leaders in our sample, or close to 86 percent of the respondents, were between 30 and 55 years of age. Close to 14 percent of the respondents were either less than 30 years old or more than 55 years old. The majority, or 70 percent, of the project leaders had a bachelor degree; those holding a master's degree rank next, representing approximately 25 percent of the respondents. Only a few (close to 5 percent) of the leaders had just a high school education. None, however, had a doctoral degree. Approximately 73 percent of the projects were led by males and 27 percent of the projects were led by females.

Approximately 14 percent of the projects were completed within three months, 20 percent were completed within four to six months, 30 percent were completed within 7 to 12 months, 25 percent were completed within 13 to 24 months, 8 percent were completed within 25 to 36 months, and 2 percent were completed after more than 36 months. These findings show that our sample is well distributed along the different durations. Moreover, approximately 10 percent of the sample belonged to organizations that have less than 300 employees and 2 percent of the projects in our sample belonged to organizations that employ more than 20,000 employees. The majority of the IS projects in our sample (or close to 88 percent) belonged to organizations that were in between in terms of organizational size. The data reveals that the projects in our sample came from organizations that varied widely in terms of size.

Since nonresponse bias is a serious threat to the validity of empirical results in survey research, we tested for this problem by comparing early versus late respondents [7]. The results indicate that there are no significant differences between early and late respondents along key sample characteristics, that is, demographics of the respondents, project duration, and organizational size ($\alpha = 0.05$).

Operational Measures

Whenever possible, we used previously developed and adequately validated scales. Where necessary, we modified some of the words in the questions to suit the context of this study. We asked an IS researcher and an IS project leader to review the scales

and share their concerns with us. After incorporating their observations, the questionnaire was pilot-tested by three IS project leaders. The comments provided by the three project leaders improved the readability and face validity of the scales. The items in the psychological outcome, organizational outcome, problem solving, clear goals, and management advocacy instruments were measured using a seven-point scale that ranges from 1 (strongly disagree) to 7 (strongly agree). The items in the task outcome instruments were measured using a scale that ranges from 1 (extremely low) to 7 (extremely high). The items in the staff expertise scale were anchored around 1 (the very worst) to 7 (the very best). The items in the support technologies instrument were measured using a scale that ranges from 1 (no extent) to 5 (very great extent).

We operationalized task outcomes using the two measures described by Henderson and Lee [25]. The first scale measures efficiency and has four items (reported Cronbach's alpha is 0.75), one each to measure the amount of work produced, adherence to schedules, adherence to budgets, and overall efficiency of operations. The second scale measures projects' effectiveness. The three items in this instrument (reported Cronbach's alpha is 0.72) tap the quality of work and the ability of the project to meet its goals. The seven items tapping efficiency and effectiveness loaded on a single factor when submitted to a principal component analysis procedure. Item loadings ranged from 0.74 to 0.92 (variance explained = 73.9 percent; eigenvalue = 5.2). The seven-item scale showed adequate reliability, Cronbach's alpha is 0.94.

The psychological outcome, or members' satisfaction, scale was borrowed from Hackman and Oldham [22]. Among the IS researchers who had used this measure were Igarria et al. [28] and Igarria and Guimaraes [27]; they reported high-scale reliability levels (0.86 and 0.84, respectively). The scale has three items. The first two items ask the respondents about their level of satisfaction within the project, and the last item taps intentions to quitting the project. The three items loaded on the same factor when submitted to a factor analysis procedure. Item loadings ranged from 0.88 to 0.96 (variance explained = 86.2 percent; eigenvalue = 2.6). Cronbach's alpha for the scale is 0.91.

In this paper, process outcomes, or problem solving competency, are viewed as a set of activities an IS project carries out in pursuing IS solutions that meet customers needs. The suggested problem solving scale consists of five items that cover Simon's [67] three-stage problem solving process. The first stage may be divided into problem identification and problem definition [59]. The former relates to recognizing the problem without any effort to reformulate it. The second stage may be thought of as consisting of three categories: generation, review, and evaluation of alternatives. The last stage, choice, reflects the solution choice and the fact that solution implementation is governed by existing social and technological structures within the project. Therefore, we have included five items in our instrument: identifying problems, defining problems, generating alternative solutions, reviewing and evaluating alternatives, and selecting the best option. The five items loaded on the same factor when submitted to a factor analysis procedure. Item loadings ranged from 0.92 to 0.95

(variance explained = 88.4 percent; eigenvalue = 4.2). The five-item scale showed adequate reliability, Cronbach's alpha is 0.97.

The support technologies scale taps Henderson's and Coopridge's [24] three-component functional model of planning and design aids. Production technology incorporates representation, analysis, and transformation capabilities. Coordination technology covers control and cooperative functionalities. Organizational support technology refers to functionalities that deal with infrastructure and support issues. The seven variables loaded highly on two factors when submitted to a factor analysis procedure. Items 4 (rules and policies), 5 (exchanging information), 6 (helping members), and 7 (portability) constituted factor one, whereas items 1 (representation), 2 (analysis), and 3 (execution) formed factor two. Item loadings for the first factor (back-end technology support) range from 0.75 to 0.86 (eigenvalue = 2.8 and variance explained is 39.3 percent) and for the second factor (front-end technology support) range from 0.72 to 0.89 (eigenvalue = 2.4 and variance explained is 33.6 percent). Nevertheless, a second-order factor analysis produced one factor that explained 77.5 percent of the common variance. Thus, we decided to average the seven items to come up with a general measure of support technologies. Cronbach's alpha for the seven-item scale is 0.87.

The goals clarity scale was adopted from [68]. The five-item scale (reported Cronbach's alpha is 0.74) reflects the clarity of the project's goals and project-organizational goal(s) compatibility, an important indicator of project members' deep understanding of not only the written code, but also the "spirit" of the general goals. The five items load on the same factor when submitted to a factor analysis procedure. Item loadings range from 0.87 to 0.89. The factor explains approximately 78.1 percent of the variance in the variables (eigenvalue = 3.9). Cronbach's alpha for the five-item scale is 0.93.

A two-item measure [55] is used to tap staff expertise. The two items reflect IS project members' intellectual capabilities and the quality of the education/training they received. Although an objective measure like years of experience may seem to be more an accurate measure of ability, the adopted approach was in fact more reflective since number of years alone do not reflect one's intellectual capabilities, nor does it reflect the quality of the education/training one receives. The two items constituting the expertise scale loaded on the same factor with eigenvalue = 1.7 and percentage of variance explained = 84.7. Cronbach's alpha for the scale is 0.82.

Slevin and Pinto [68] provided the items for management advocacy scale (reported reliability level of 0.86). Unlike existing operationalizations of management advocacy one could locate in the IS literature [62], this operational measure was found to reflect top management advocacy as defined in the context of projects. The five items forming this measure deal with such issues as management responsiveness to the requests of the project, sharing of responsibility, support of the project in cases of crises, and authority delegation to the project. The five items loaded on a single-factor solution with item loadings ranging from 0.77 to 0.87 (eigenvalue = 3.5 and percent of variance explained = 69.8). Cronbach's alpha for the five-item scale is 0.89.

Organizational outcomes and project team size constructs were measured using a single item for each. The item measuring organizational outcomes asked the project leader about the value of the produced information system to business operations, whereas the item measuring project team size asked the IS project leader to indicate the number of people working within the project.

Model Testing

We used path analysis to test our model. Path analysis is a regression-based technique widely used for studying the direct and indirect effects in models encompassing mediating variables [17, 45]. Standardized betas are generally used to detect the strength and direction of relationships in the model. To assure the validity of path analysis, it is imperative to establish that there is no multicollinearity among the exogenous variables and no nonlinear relationships between exogenous and endogenous variables. Indeed, in our case, correlations among exogenous variable (see Table 3) are less than 0.8, indicating no problems with multicollinearity [11]. Examination of residual plots revealed no nonlinear relationships.

We followed a four-step procedure to test the model. In step one we regressed problem solving on support technologies, project team size, clear goals, staff expertise, and management advocacy. In steps 2, 3, and 4, we regressed task outcomes, psychological outcomes, and organizational outcomes, respectively, on problem solving, support technologies, project team size, clear goals, staff expertise, and management advocacy. As shown in Table 4, clear goals ($\beta = 0.37, p < 0.01$), staff expertise ($\beta = 0.33, p < 0.01$), and project team size ($\beta = -0.29, p < 0.01$) are significant predictors of problem solving. The input variables in our model explain approximately 39 percent of the variance in problem solving ($p < 0.01$).

The results reported in Table 4 further show that problem solving ($\beta = 0.53, p < 0.01$), use of support technologies ($\beta = 0.29, p < 0.01$), and management advocacy ($\beta = 0.20, p < 0.05$) have significant direct effects on task outcomes of IS projects. The variables explain approximately 46 percent of the variance in task outcomes. Table 5 reveals that only problem solving ($\beta = 0.52, p < 0.01$) and clear goals ($\beta = 0.29, p < 0.01$) have significant direct effects on psychological outcomes of IS projects. Furthermore, the Table 5 indicates that problem solving ($\beta = 0.36, p < 0.01$) and management advocacy ($\beta = 0.25, p < 0.05$) have significant direct effects on organizational outcomes of IS projects. The variables in the psychological outcomes model explain 47 percent of the variance ($p < 0.01$), whereas the input variables in the organizational outcomes model explain 22 percent of the variance ($p < 0.01$).

To confirm the intervening role of problem solving in our research model, it is imperative that [9]: (1) the input variables relate to the mediating variable, (2) the input variables relate to outcome variables, and (3) the relationship between the input and outcome variables becomes lower when the mediating variable is entered in the model. Table 3 shows that support technologies, project team size, clear goals, staff expertise, and management advocacy are related to problem solving and to IS project

Table 3. Descriptive Statistics and Correlations Matrix

	Mean	SD	R ^a	2	3	4	5	6	7	8	9
Task outcomes	4.96	1.26	0.94	0.76**	0.31**	0.59**	0.33**	-0.25*	0.40**	0.40**	0.35**
Psychological outcomes	5.28	1.49	0.91	—	0.19*	0.65**	0.18*	-0.33**	0.52**	0.35**	0.24*
Organizational outcomes	5.46	1.38	—	0.19*	—	0.28*	0.01	-0.21*	0.07	0.32**	0.34**
Problem solving	4.79	1.51	0.97	0.65**	0.28**	—	0.05	-0.41**	0.45**	0.41**	0.23*
Support technologies	2.70	0.89	0.87	0.18*	0.01	0.05	—	0.05	0.09	0.12	0.08
Project team size	9.78	6.23	—	-0.33**	-0.21*	-0.41**	0.05	—	-0.16	-0.14	-0.10
Clear goals	5.24	1.69	0.93	0.52**	0.07	0.45**	0.09	-0.16	—	0.10	0.10
Staff expertise	4.87	1.13	0.82	0.35**	0.32**	0.41**	0.12	-0.14	0.10	—	0.07
Management advocacy	4.45	1.53	0.89	0.24*	0.34**	0.23*	0.08	-0.10	0.10	0.07	—

^a Cronbach's alpha; * significant at 0.05; ** significant at 0.01.

Table 4. Effects of Input Variables on Problem Solving and Task Outcomes

	Problem solving			Task outcomes				
	D	S	r	D	I	T	S	r
Support technologies	-0.01	0.06	0.05	0.29**	-0.01	0.28**	0.05	0.33**
Project team size	-0.29**	-0.12	-0.41**	-0.03	-0.15	-0.18	-0.07	-0.25*
Clear goals	0.37**	0.08	0.45**	0.14	0.20	0.34**	0.06	0.40**
Staff expertise	0.33**	0.08	0.41**	0.17	0.18	0.35**	0.05	0.40**
Management advocacy	0.15	0.08	0.23**	0.20*	0.08	0.28**	0.07	0.35**
Problem solving				0.53**	—	0.53**	0.06	0.59**
Adjusted R ² = 0.39**				Adjusted R ² = 0.46**				

* = $p < 0.05$; ** = $p < 0.01$; D = direct; I = indirect; S = spurious; T = total.

performance and that problem solving is related to performance. Tables 3, 4, and 5 show that when we introduced problem solving into the three performance models, the effects of support technologies, project team size, clear goals, staff expertise, and management advocacy on IS project performance were lower. These results confirm the hypothesized mediating role of problem solving in our model. Figure 2 summarizes model-testing results.

Discussion and Conclusions

THREE MAJOR CONCLUSIONS EMERGE FROM THIS STUDY. First, the study supports the multidimensional view of IS project performance. Although IS researchers have understood the nature and importance of IS project performance, past conceptualizations of the construct have been somewhat limited. Following the leads of researchers interested in management science and project management (for example [64]), IS researchers have usually adopted a task outcome view of study the performance of IS projects (for example [57]). In this paper, we argued that this task-oriented view is not sufficient to adequately conceptualize IS project performance. Hence, we proposed that the research on organizational teams, which provides a flip viewpoint to that of project management research in that it gives more weight for psychological outcomes of organizational work groups (for example [21]), can be very helpful in reconceptualizing the IS project performance construct. Concentrating on the material outcome of the IS project without considering the social context ignores the fact that an IS project is accomplished its work within a highly interactive context. IS project performance must consider the social context within which IS projects operate. This study adopts a reconciling and more logical view of IS projects performance, which incorporates both technological as well as psychological views of IS projects performance. Moreover,

Table 5. Effects of Input Variables on Psychological and Organizational Outcomes

	Psychological outcomes					Organizational outcomes				
	D	I	T	S	r	D	I	T	S	r
Support technologies	0.14	-0.01	0.13	0.05	0.18*	-0.03	0.00	-0.03	0.04	0.01
Project team size	-0.10	-0.15	-0.25	-0.08	-0.33**	-0.04	0.10	-0.06	-0.15	-0.21*
Clear goals	0.29**	0.19	0.48**	0.04	0.52**	-0.15	0.13	-0.02	0.09	0.07
Staff expertise	0.14	0.17	0.31**	0.04	0.35**	0.19	0.12	0.31**	0.01	0.32**
Management advocacy	0.10	0.08	0.18	0.06	0.24*	0.25*	0.05	0.30**	0.04	0.34**
Problem solving	0.52**	—	0.52**	0.13	0.65**	0.36**	—	0.36**	-0.07	0.28**
Adjusted R ² = 0.47**	Adjusted R ² = 0.22**									

* = $p < 0.05$; ** = $p < 0.01$; D = direct; I = indirect; S = spurious; T = total.

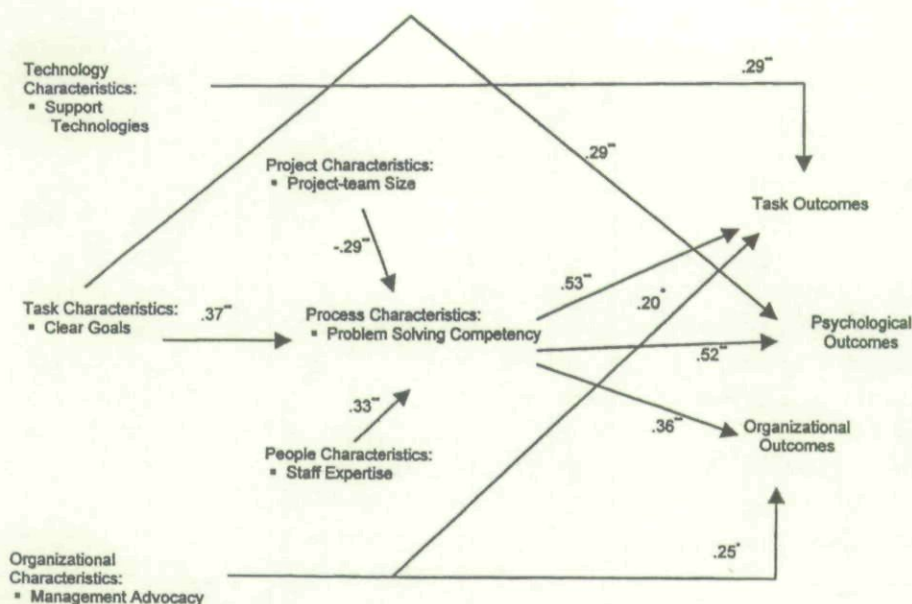


Figure 2. Path Analysis Results

consistent with the more recent view of IS projects, our study considers the organizational benefits of IS projects by considering the value of their outcomes to business operations. Based on this understanding we suggested three dimensions of IS projects' performance: task, psychological, and organizational outcomes. The findings of our analyses support our contention of the multidimensionality of the IS projects performance construct.

Second, our data confirm that an IS project has to have a number of important characteristics to function effectively. The analysis reveals that problem solving competency is an important design attribute for IS projects. The finding is in line with past IS research, which affirms that the work of IS projects is essentially a problem solving endeavor [13]. In addition, the influence of management advocacy on task and organizational outcomes of IS projects stresses once more the importance of top management support for technology initiatives within organizations. These findings parallel those found in previous IS research. The strong backing of management furnishes the appropriate guidance for the work of the project [16], results in sufficient organizational resources be devoted to the work of an IS project, and provides the necessary power to deal with the change [48] initiated by the work of such projects. Also, staff expertise is found to have an effect on process and organizational outcomes of IS projects. An IS project possessing a significant inventory of experience and skills is more likely to perform better than one that does not enjoy the same privilege. It is believed that a significant proportion of the work of systems developers involves repeat problems [70]. Members with appropriate experience and knowledge are more likely to have had faced the same problem before [51]. This suggests that selecting and developing IS human resources are indispensable strategies within organizations.

Management has to devise the appropriate human resources techniques to ensure a certain level of intellectual abilities and quality of educational background among the members of the IS projects. Moreover, the analysis indicates that use of support technologies has a positive impact on task outcomes of IS projects. Support technologies can supplement the abilities and productivity of the involved programmers/analysts [24], while significantly improving the system's development time [50]. Furthermore, support technologies provide back-end support in the form of mechanisms to exchange information and platforms to make portability of skills, knowledge, and procedures across planning and design processes easier [24]. The above suggests that the use of design aids, especially with the increased pressures to shorten the time-to-market cycle of new information systems [24, 70], is in fact a critical element for modern systems development practices within organizations. Further, the results show that clarity of project goals is an important factor in promoting the process and psychological outcomes of IS projects. Setting task goals clearly has an influence on performance by directing attention to the task, mobilizing employees effort, increasing persistence, motivating strategy development, and generating higher satisfaction among project members. The findings of this study stress that IS projects should have a clear understanding of what they must achieve and how they will do it. Finally, project team size is found to negatively influence problem solving. Some researchers have indicated that beyond a certain point, project team size may cause productivity to decrease [65, 69] and members' dissatisfaction [42]. To examine whether the relationship between project team size and task, psychological, and organizational outcomes in this sample is curvilinear, we conducted a hierarchical regression analysis in which size and its quadratic term were regressed on all dependent variables. The contribution of the quadratic term of size was not significant in any of the three models, indicating that the relationship between project team size and performance is indeed linear. The negative relationship between size and problem solving may suggest that the studied IS projects may in fact be crowded. We recommend that IS managers carefully size their IS projects to avoid a number of problems including decreased problem solving competency.

Third, the overall pattern of relationships between exogenous and endogenous variables suggests a possible cross-relationship between the literatures on information systems, organizational teams, and project management. The overall findings provide support for our integrated performance model. We found that input variables explained a significant proportion of the variance in the tested models. The findings emphasize the importance of the literature on organizational teams in providing the insights into the dynamics of the social system—IS projects in our case. The results lead us to believe that there is an opportunity for cross-fertilization among the three streams of research. As suggested in a previous section, the three literatures cross-relate from the dependent variables side. The IS project performance construct has been conceptualized to consist of three dimensions—task outcomes, psychological outcomes, and organizational outcomes. Task and organizational outcomes represent the contribution of the project management and IS views to IS project performance. Psychological outcomes represent the contribution of organizational teams research

to the consolidated view of IS project performance. The theory and our data show that the three constructs are important dimensions of IS project performance. Moreover, the literatures on IS, organizational teams, and project management are believed to cross-relate from the independent variables side. The contemplated cross-relationship between the three streams of research resulted in an integrated model. The descriptive model is viewed as to consist of six dimensions (technology characteristics, project characteristics, task characteristics, people characteristics, organizational characteristics, and work processes), which can be viewed as domains that correspond to the three literatures and their intersection. Technology is the domain of information systems, teamwork processes are the domain of organizational teams, task characteristics is the domain of project management, and organizational and people characteristics can be thought of as the areas where the three literatures converge. Together these findings highlight the significance of and correspondence among the literatures on organizational teams, project management, and IS.

The findings of our study have implications for IS theory and future research. Our study contributes to IS theory by synthesizing concepts from organizational teams research and project management research with those in IS research. We proposed and tested an integrated performance model of IS projects and the findings of our investigation provided some preliminary answers to some of the questions raised. However, there is still a need for subsequent effort to refine the proposed theory until it results in a set of guidelines that can be transferred to operational settings. Theoretically, researchers are encouraged to improve upon our theory by incorporating other constructs, such as, participation, coordination techniques, the newness of the technology, and the familiarity of the staff with the technology implemented, to name a few. In addition, since the IS project performance construct has been shown to be multidimensional, future research may want to adopt a more encompassing view of performance than it has employed in past research. This step will help, to a large extent, facilitate the comparison of results cross studies and lead to building a better theory with greater explanatory power. Methodologically, we admit that a good theory must be tested with data from different sources. Since our study was conducted using data gathered from manufacturing organizations, the results may not be generalizable to organizations with different work environments. Hence, the need to replicate the study in other organizational contexts in order to be able to generalize the findings. Moreover, the research variables were measured through the perception of a single respondent. This gives rise to the possibility that common source variance may account for some of the results obtained. Although we tried to alleviate this problem by selecting the most knowledgeable person about project activities—that is, the IS project leader—to respond to our questionnaire, we still recommend that future research measure study variables through the perceptions of multiple members of the IS project. Further, the organizational outcomes instrument may need to be elaborated upon. As is, the single-item instrument may not capture all of the dimensions of organizational outcomes.

The results of the current investigation have implications for practicing managers. The study identified a set of factors that are believed to affect the performance of IS

projects. Management has an obligation to maintain a work environment that is conducive of optimal performance levels of its IS projects. This fact suggests that a well-thought-of IS project management strategy must be established and followed. This strategy should cover the different work dimensions of such projects and operationalized into programs for action. Since staff expertise was found to influence the performance of IS projects, such a strategy should entail the careful recruiting of well qualified IS specialists with adequate capabilities and quality and relevant education. For example, management should look for individuals with: (1) technical skills including knowledge of state of the art technical standards, software development, and configuration management; (2) administrative skills including the timely preparation and maintenance of project related documentation such as reports, deliverable reviews, and project evaluation reviews; and (3) business skills including knowledge of general business processes, practices, and procedures. These individuals should then be carefully joined in an IS project taking into account the diversity of their experiences and backgrounds. Further, training should occupy an important part in the guiding strategy. The design and implementation of training programs that consider improving problem solving skills as well as teamwork skills should become a priority issue for management. Part of this overall strategy should be the establishment of project management guidelines for the IS projects. Such guidelines, for instance, should promote the sound practices of planning and controlling of project activities including setting specific, realistic, definite (time-wise), and measurable project goals. Not only does management have to carefully direct the operations of IS projects, but it must also get committed and involved in the whole process. Probably the most desired and influential action of all is management support of the IS projects. The bottom line is that the overall guiding strategy, resource availability, and other forms of sponsorship are only possible if management believes in the IS project and supports it.

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Appendix A: Questionnaire Items

Task Outcomes

RELATIVE TO OTHER COMPARABLE IS PROJECTS, how did your IS project rate on each of the following:

1. efficiency of operations,
2. adherence to schedules,
3. adherence to budgets,
4. amount of produced work,
5. quality of produced work,
6. effectiveness of interactions with consultants, and
7. ability to meet its goals.

Psychological Outcomes

1. Generally speaking, members of our project were very satisfied with their work.
2. The members were generally satisfied with the kind of work they did in this project.
3. Members frequently thought of quitting the project.

Organizational Outcomes

1. The outcome of the project added value to business operations.

Problem Solving Competency

Compared to most other IS projects in our organization, our project was better than most in:

1. identifying problems,
2. defining problems,
3. generating alternative solutions,
4. reviewing alternatives, and
5. evaluating options.

Support Technologies

To what extent has the project used planning and design aids for:

1. representing objects, relationships, and processes;
2. analyzing objects, relationships, and processes;

3. executing planning or design tasks thereby substituting for a human designer or planner;
4. planning for and enforcement of rules and policies that govern the activities of the project;
5. exchanging information related to planning or design tasks among project members;
6. helping members with the understanding and use of planning and design aids;
7. providing portability of skills, knowledge, procedures, or methods across planning or design processes.

Clear Goals

1. The basic goals of this project were clear for all of us.
2. The goals of the project were in line with the general goals of the organization.
3. I was enthusiastic about the chances for success of this project.
4. The results of the project benefited the organization.
5. I could identify the benefits to the organization of the success of this project.

Staff Expertise

Compared to others in the firm at the same level in the same speciality area, please rate members of the project in terms of:

1. native intellectual ability, and
2. quality of academic education.

Management Advocacy

1. Top management supported the project in crises.
2. Top management was responsive to our requests for additional resources.
3. Top management granted us the necessary authority and supported our decisions concerning the project.
4. Top management shared responsibility with the project for ensuring the project's success.
5. I agreed with top management on the degree of my authority and responsibility for the project.

Project Team Size

1. How many individuals were there in your project?

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