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CONTINGENCY MODEL(S) OF IS PROJECT MANAGEMENT?

Abstract

Researchers in Organization Theory have suggested that the way an organization, business unit or department is managed should vary according to the uncertainty inherent in its environment. Similarly, several IS researchers have suggested that the way an IS development project is managed should depend on the risk or uncertainty of the project. However, the contingency relationships hypothesized in the IS literature remain largely unverified. This paper develops and tests a contingency model where it is hypothesized that the outcome of an IS development project (Project Performance) is influenced by the fit (Project Risk Fit) between the project’s risk (Project Risk Exposure) and how the project is managed (Project Management Practices). The latter was assessed with three constructs drawn from the Organization Theory literature: internal and external integration, formalization, and formal planning. Using a profile deviation perspective of fit, and data obtained from 75 IS projects, significant contingency effects were observed for three of the four success measures used: estimated vs. actual budget, estimated vs. actual time to complete project, and system quality according to project leader. Interestingly, a different contingency relationship was observed for the fourth measure of project success, user information satisfaction. These results suggest that two different contingency models may be at work in IS project contexts, and that both models need to be considered for a thorough understanding of project management.

Résumé

La théorie de la contingence propre au domaine de la théorie des organisations stipule que le mode de gestion d’une entreprise, d’une unité d’affaires ou d’un département devrait varier en fonction de l’incertitude environnementale. Dans le même ordre d’idées, les chercheurs en systèmes d’information ont suggéré que le mode de gestion d’un projet de système d’information devrait varier selon le degré de risque du projet. Cependant, la présence de telles relations reste encore à être confirmée, peu d’études empiriques ayant été menées à ce sujet. L’étude décrite ici propose et teste un modèle de contingence pour la gestion de projet de système d’information. Adoptant une perspective dite de déviation d’un profil idéal, le modèle stipule que la performance d’un projet est influencée par la congruence entre le degré de risque du projet et les pratiques de gestion du projet. Le modèle a été testé à partir de données de 75 projets. Les résultats obtenus supportent l’hypothèse de recherche pour trois des quatre variables de performance utilisées. Ainsi, dans le cas de projets à risque élevé la planification et l’intégration de l’équipe de projet sont particulièrement importantes afin d’assurer le respect du budget et le respect des échéances, de même que la qualité du système, telle que perçue par le chef de projet. Par ailleurs, lorsque la performance est mesurée en termes de satisfaction de l’utilisateur, plus un projet est risqué, plus le degré de participation des utilisateurs devrait être élevé. Les résultats obtenus suggèrent que nous sommes en présence non pas d’un, mais de deux modèles de contingence, selon le type de mesure de performance utilisé.

Keywords: IS Project Management; IS Project Risk; Contingency Models.
Introduction

The idea that the way a business unit, or organization, is managed should vary according to the characteristics of its environment has had many proponents in organization theory and in strategic management. Following Burns and Stalker (1961), contingency theorists have proposed that successful organizations establish a fit between their environments and their structural and process characteristics (Bourgeois, 1985; Duncan, 1972; Lawrence and Lorsch, 1967; Miller, 1981; 1992; Tung, 1979). In this work, environmental uncertainty - reflected by such factors as environmental complexity, the environmental rate of change, and the availability and clarity of information - is said to require more organic structures, more expert-based power, less centralization of authority (Burns and Stalker, 1961; Miller, 1992; Thompson, 1967), less formal planning (Miller, 1992), and more liaison devices (Miller and Friesen, 1984).

Espousing a similar line of contingency thinking, several IS researchers have suggested that successful IS project management requires a fit between the characteristics of a development project and how the project is managed (Alter, 1979; Alter and Ginzberg, 1978; Beath, 1983; 1987; Boehm, 1989; 1991; Davis, 1982; Kydd, 1989; Lyttinen, Mathiassen, and Ropponen, 1998; McFarlan, 1981; McKeen, Guimaraes, and Wetherbe, 1994; Nidumolu, 1995; Zmud, 1980). Despite focusing on different project management activities and on what appears to be different IS project characteristics, the works of these authors share two key features: 1) the conceptualization of project characteristics in terms of project uncertainty or risk, and 2) the contingency hypothesis that how an IS project should be managed depends on the uncertainty or risk of the project. Yet, to date, the central contingency hypothesis shared by these frameworks remains largely untested.

The present paper proposes and tests a contingency model of software project management. Adopting a profile deviation perspective of fit, the model hypothesizes that the performance of a software project is influenced by the degree to which the management practices adopted to conduct the project match the risk level of the project. This central hypothesis was tested with data gathered in a longitudinal study of 75 software projects. The next section reviews the work of IS authors who adopted a contingency view of software project management, and on which the research model is based. It is followed by a presentation of the model, a description of the research method, and a discussion of the results of the study.

The Contingency Perspective of IS Project Management in IS Research

Alter and Ginzberg (1978) were among the first to adopt a contingency perspective of IS project management by proposing project management activities that addressed the risk of implementing information systems. From IS projects they had studied, they identified eight implementation risk factors that, when present, decreased the likelihood of a successful implementation: designer lack of experience, nonexistent or unwilling users, multiple users or designers involved in a project, high personnel turnover rates, lack of support, unspecified project purpose or usage patterns, unpredictable system impact, and technical and cost-effectiveness problems. Establishing contingency relationships between project characteristics and its management, Alter and Ginzberg (1978) then proposed selecting from sixteen project management...
activities to compensate or inhibit the potential undesirable impact of different risk factors.

Drawing from Galbraith (1974) and Van de Ven, Delbecq, and Koenig (1976) in Organization Theory, Zmud (1980) recommended different project management modes depending on project uncertainty. Specifically, he suggested that high uncertainty situations be managed with a group mode of coordination defined as one in which high levels of interaction between the involved parties are maintained. On the other hand, for low uncertainty situations, he suggested an impersonal project management mode that placed greater reliance on rules, plans, and procedures. As for moderate uncertainty levels, Zmud advocated a personal coordination mode, one that utilized a liaison or boundary spanning agent.

McFarlan (1981) proposed a similar contingency approach to software development project management. He identified three key project characteristics contributing to project risk (project size, structure, and technology) and four categories of project management tools (external integration, internal integration, formal planning, and formal control). Depending on the levels (low, medium, high) of the three risk characteristics present in a project, he recommended the use of different project management tools to ensure project success.

Focusing on the process of information requirements determination (IRD), Davis (1982) also presented a contingency framework for selecting an appropriate IRD strategy. He identified four sources of project uncertainty: the utilizing system, the application, the users, and the analysts. He then suggested selecting from four IRD strategies (asking future users, deriving from an existing system, synthesis from characteristics of utilizing system, and discovering from experimentation) depending on the level of uncertainty inherent in a project.

Based on Williamson (1975) and Ouchi (1980), Beath (1983) proposed a contingency model according to which project uncertainty determined the most appropriate project management strategy to be adopted. In cases of low uncertainty, this model recommended an arm’s length strategy characterized by formal specifications that govern the relationship between the parties concerned. On the other hand, a clan strategy, entailing shared understanding and implicit and informal project control by the users was advocated for highly uncertain projects. For projects of moderate uncertainty she recommended a matrix strategy whereby projects are controlled both formally and informally, and are bureaucratically managed by both users and IS staff. In a subsequent refinement of this model, Beath (1987) split the arms-length strategy into the market and quasi-market governance modes, with the market approach deemed appropriate when software is purchased from vendors, and the quasi-market approach to be used when the life cycle approach to development is called for.

Borrowing from Daft and Lengel (1986) who view different organizational mechanisms as being appropriate for reducing either uncertainty or equivocality, Kydd (1989) proposed a similar contingency model for the use of different project management tools. In this model, tools such as prototyping and structured walkthroughs of design specifications were viewed as providing richer information and were therefore thought to be useful for reducing equivocality. On the other hand, tools such as formal systems documentation and preliminary written specifications were seen as
enabling individuals to quickly communicate large quantities of information and were thus thought to be better suited for reducing uncertainty. Thus, different tools were recommended, depending on the levels of equivocality and uncertainty inherent in a project.

Boehm (1989, 1991) proposed a six-step model for managing software risk. The central concept in Boehm’s model is risk exposure, defined as the product of the probability of an unsatisfactory outcome, and the loss due to the occurrence of the unsatisfactory outcome. The first three steps of the risk management model, risk identification, risk analysis, and risk prioritization, contribute to risk assessment. Risk identification results in a list of project-specific risk items; risk analysis assesses the probability of loss and magnitude of potential loss associated with each risk item; risk prioritization produces a rank order list of the risk items. To help control risk, three project management steps are proposed: risk management planning, risk resolution, and risk monitoring. Planning for risk management consists in preparing to address each risk item; risk resolution aims at eliminating the risk items; finally, risk monitoring consists in tracking the project evolution and taking corrective action when required.

McKeen, Guimaraes, and Wetherbe (1994) investigated the effects of four contingency variables on the relationship between user participation (a project management variable) and user satisfaction. The contingency variables were: task complexity (a risk factor), system complexity (a risk factor), user-developer communication, and user influence. The results they obtained indicate that user-developer communication and user influence do not have a significant impact on the relationship between user participation and user satisfaction; rather, these two variables are directly related to user satisfaction, regardless of the level of user participation. On the other hand, task complexity and system complexity were found to interact with the user participation-satisfaction relationship, with a strong relationship between user participation and user satisfaction in cases of high system complexity and task complexity.

Nidumolu (1995) proposed and tested a model linking project uncertainty and project coordination modes (vertical and horizontal coordination) to project outcomes. He found that project uncertainty reduced project performance. However, vertical coordination was found to decrease project uncertainty, which meant that vertical coordination had an indirect positive effect on performance. Moreover, while horizontal coordination was observed to directly influence performance, it was not related to uncertainty. These results suggest that vertical coordination is especially appropriate in high uncertainty projects (a contingency relationship), while no contingency relationship exists involving horizontal coordination.

Recently, Lyytinen, Mathiassen, and Ropponen (1998) compared four software risk management approaches – Alter and Ginzberg (1978), Boehm (1989,1991), Davis (1982), and McFarlan (1982) – in terms of their respective definitions of risk, risk resolution techniques, and how they each translate risky incidents into managerial action. Lyytinen et al.’s (1998) categorical analysis showed that these four models’ heuristics vary considerably in terms of their scope, content, and format. They concluded that none of the four models is complete enough, and that none of them “… can address the pitfalls of not observing risky incidents during software development in a satisfactory manner.” (Lyytinen et al., 1998, p. 245). They also suggested that a more encompassing
framework be developed, based on a socio-technical model of system development, that would incorporate the most appropriate features of the different risk management models.

As can be seen, the different IS project management frameworks reviewed above share several important characteristics. First, according to these contingency frameworks, how an IS project should be managed depends on the characteristics of the project and/or its environment. Second, the characteristics of the project and its environment are essentially viewed from an uncertainty or risk perspective. Thus, the proposed frameworks suggest that establishing a fit between a project’s risk and its management influences the project’s success. However, with the exception of the case studies conducted by Beath (1987), and the models tested by McKeen et al. (1994) and Nidumolu (1995), the proposed frameworks have not been empirically tested. Moreover, as noted by Lyttinen et al. (1998), the scope and content of the proposed frameworks exhibit considerable variation. In particular, the different ways in which the construct of project management is conceptualized (e.g., Beath’s clan vs. arm’s length strategies, Nidumolu’s vertical vs. horizontal coordination modes, or Zmud’s group vs. personal mode of coordination) makes their reconciliation difficult. In an effort to address these issues, the present paper develops and tests a contingency model of IS project risk management with the central hypothesis that the outcome of an IS development project is influenced by the fit between the project’s risk and how the project is managed.

A Contingency Model of IS Project Management

The research model proposed here hypothesizes that Project Performance is influenced by Project Risk Fit, defined as the extent to which the Project Management Practices match the level of Project Risk Exposure. The constructs of the model and the hypothesized contingency relationships are described below.

Project Performance. This construct refers to the efficiency and effectiveness with which an IS development project has been completed. It takes into account two key dimensions (Kappelman and McLean, 1994; Nidumolu, 1995): process performance (how well the project went) and product performance (how good the developed system is). Each dimension ought to be assessed separately, since these are not necessarily highly correlated: it is quite possible for an over budget or beyond schedule project to deliver a high quality product; conversely, a within budget and on time project may deliver a product of poor quality.

Project Risk Exposure. Many IS researchers who examined project management with a contingency perspective identified the concepts of project uncertainty and/or project risk as key constructs that need to be taken into account when managing an IS development project. In a review of this research, Barki, Rivard, and Talbot (1993) highlighted the strong parallels in the meanings attributed to these terms (i.e., uncertainty and risk) in the IS literature. They concluded that both terms have been used to describe project characteristics that tend to increase the probability of project failure (e.g., project size, lack of user experience and support, task complexity). In the general risk literature, the probability of an unsatisfactory outcome is labeled risk while risk exposure is defined as this probability multiplied with the loss potential of the unsatisfactory
outcome. To be consistent with the general risk literature, the present paper adopted this latter definition. Accordingly, the term Project Risk Exposure is used in this paper to refer to the notion of risk defined in Barki et al., (1993).

**Project Management Practices.** Consistent with its conceptualization in Organization Theory, this construct is viewed here as reflecting aspects of structure and process in the context of IS project management. As such, it refers to various management tools and approaches that can be utilized in managing an IS development project. Research in Organization Theory has extensively studied six management constructs (Miller, 1992). The findings suggest that high levels of environmental uncertainty call for high levels of: task specialization, decentralization of authority, integrative liaison devices, environmental scanning, and low levels of formal planning; as for the appropriate level of formalization needed for a given level of environmental uncertainty, the results from past research are inconclusive. Three of these six constructs, integration, formalization, and formal planning are especially salient in IS development contexts (Beath, 1987; McFarlan, 1981; Miller, 1992; Nidumolu, 1995). Specifically, **Integration** covers various liaison devices and mechanisms that facilitate collaboration and coordination between actors involved in an IS project; **Formalization** refers to precise definitions of responsibilities, tasks, and relationships that are implemented to guide and coordinate project activities; and **Formal planning** includes tools and techniques used in structuring project activities, estimating project costs and schedules, and allocating resources. Given that these three project management constructs provide an already well-established conceptualization of a large number of activities and decisions concerning a project’s management, they were used in the present study to reflect Project Management Practices.

**Project Risk Fit.** This construct reflects the extent to which the Project Management Practices adopted in a project match its level of Risk Exposure. The importance of having high levels of integration in uncertain environments but lower levels in more certain environments has been consistently stressed and empirically supported in the Organization Theory literature (Galbraith, 1974; Lawrence and Lorsch, 1967; Miller, 1992; Van de Ven, 1976). The idea behind this hypothesis is that the more uncertain its environment, the more an organization needs to introduce liaison devices and integrative mechanisms that facilitate information exchange and collaboration among a diverse array of organizational actors. Extending this reasoning to an IS project context, it can be said that an IS project’s integration level should match its risk exposure level. Specifically, high risk exposure projects would be seen as requiring high levels of integration whereas low levels of integration would be appropriate for low risk exposure projects. Indeed, while empirical evidence supporting this hypothesis is scant, such a hypothesis has often been suggested in the IS literature (Beath, 1987; McFarlan, 1981; Zmud, 1980).

The findings in Organization Theory regarding the appropriate levels of formalization for differing uncertainty levels are mixed (Miller, 1992). Specifically, high environmental uncertainty is seen to require high levels of formalization in terms of defining tasks and responsibilities so as to ensure better coordination. On the other hand, too much formalization is also thought to reduce the flexibility needed to deal with an uncertain environment. In an IS project context, formalization in terms of rules and regulations, standards, and formal system documentation is thought to reduce uncertainty (Kydd, 1989). Thus, it can be said that projects having high levels of risk exposure
would need high levels of formalization.

As for formal planning, the Organization Theory literature recommends low levels of formal planning in high uncertainty environments (Miller, 1992). This argument stems from the idea that the rigidities inherent to high levels of formal planning decrease an organization’s ability to adapt to external changes associated with uncertain environments. In an IS project context, formal planning tools are not seen as being appropriate for high risk exposure projects since the information needed for such planning is often unavailable and the key elements of the project not well understood. In contrast, such tools are thought to be useful in low risk exposure projects because they can help structure the sequence of tasks in addition to providing realistic cost and time targets (McFarlan, 1981).

The central hypothesis of the contingency model can be summarized as:

**H1. Project Risk Fit influences Project Performance.**

When adopting a contingency approach to studying a phenomenon, researchers must be very careful in defining their conceptualization of fit. Definitional rigor is critical, since different conceptual definitions of fit imply different meanings of a contingency theory and different expected empirical results (Drazin and Van de Ven, 1985; Venkatraman, 1989). Venkatraman (1989) identifies six different perspectives from which fit can be defined and studied; these are, fit as (a) moderation, (b) mediation, (c) matching, (d) covariation, (e) profile deviation, and (f) gestalts. To each perspective corresponds an appropriate verbalization of hypothesized relationships, and an appropriate analytical scheme for testing the relationships. Each perspective is characterized along three dimensions: the number of variables in the fit-based relationship, the degree of specificity of the relationship (whether a precise functional form of the relationship can be specified), and the presence of a criterion variable.

In the present study, several variables are embedded in the fit relationship, the degree of specificity of the relationship is low, and there exists a criterion variable (project success). These characteristics correspond to the *profile deviation* perspective of fit (Venkatraman, 1989). In this perspective, fit is defined as the degree of proximity to an externally specified profile or pattern, whereby "... patterns of consistency among dimensions of organizational context, structure, and performance" (Drazin and Van de Ven, 1985, p. 520) are simultaneously examined. Adapting Venkatraman’s definition of fit as profile deviation to an ISD project context, this approach would imply that if an ideal profile for Project Management Practices is specified for a particular level of Risk Exposure, a software project’s degree of adherence to such a multidimensional profile will be positively related to Project Performance if it has a high level of risk exposure-project management practices fit. Conversely, deviation from this profile implies a low degree of fit, resulting in a negative effect on Project Performance. According to Venkatraman, “this perspective allows a researcher to specify an ideal profile and to demonstrate that adherence to such a profile has systematic implications for effectiveness” (p.434).

An important issue when this conceptualization of fit is adopted is the development of ideal profiles. According to Venkatraman, there are two obvious alternatives: (a) develop a
theoretical profile or (b) develop an empirical profile. Venkatraman argues that while the first alternative is “intuitively appealing, the operational task of developing such a profile with numerical scores along a set of dimensions is difficult” (p.434). The second alternative is to develop a profile using a calibration sample – generally defined as the data points that are closer to the top of the performance scale. Then, a measure of the closeness between the two patterns (the Euclidean distance between the ideal pattern for a project and the project’s actual pattern) is correlated with indicators of project performance. Significant, but negative correlations provide evidence for the presence of contingent relationships, as defined by the profile deviation perspective of fit (Drazin and Van de Ven, 1985).\(^2\) Consistent with Venkatraman’s recommendation, the present study adopted the second approach as described later in the following section.

**Method**

**Measures.** *Project Risk Exposure* was assessed with the risk measure proposed by Barki, Rivard, and Talbot (1993). Accordingly, project characteristics that increase the probability of project failure were assessed with 23 variables along five dimensions: technological newness, application size, lack of expertise, application complexity, and organizational environment. Further, the magnitude of potential loss in case of project failure was also assessed. The items used to measure each variable and assessments of the reliability and validity of the construct are described in Barki, Rivard, and Talbot (1993). A Project Risk Exposure score for each project was calculated by averaging that project's scores on the 23 variables and by multiplying this average with the project's magnitude of potential loss score.

A project’s *Project Management Practices* pattern was assessed along the dimensions of *Integration*, *Formalization*, and *Formal Planning*, using 1-7 Likert scales. The Integration items assessed the extent to which efforts were made to integrate both the users and the developers into the software project. The items used to assess Formalization measured the extent to which formal development methods and standards were used in the project. The Formal Planning items assessed the extent to which formal planning and control tools were used in managing the project and evaluating performance. The items used to assess each dimension and their reliabilities are provided in the Appendix.

*Project Performance* was assessed both from a product and a process perspective. Product performance was assessed both from the project leader’s and the users’ perspectives. An 18-item *System Quality* measure drawn from Rivard, Poirier, Bergeron, and Raymond (1997) was used to assess product performance from the project leader’s perspective. This measure takes into account various system characteristics including system reliability and performance, system costs and benefits, and the relevance of the information provided by the system. The items used and the reliability of the scale are presented in the Appendix. To assess performance from the users’ perspective the 13-item short form of the *User Information Satisfaction (UIS)* measure was used.

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\(^2\) This correlation should be negative since the smaller the distance between the two patterns (i.e., the closer a project’s management pattern is to the ideal or best practices pattern), the higher the project’s performance will be.
Process performance was assessed with two measures. The first, \textit{Cost Gap}, reflected the estimated versus the actual cost of the project and was calculated as:

\[
\text{Cost Gap} = 1 - \left( \frac{\text{Actual $ cost of project}}{\text{Estimated $ cost of project}} \right).
\]

The second, \textit{Time Gap}, reflected the estimated versus the actual elapsed time of project completion and was calculated as:

\[
\text{Time Gap} = 1 - \left( \frac{\text{Actual time [months]}}{\text{Estimated time [months]}} \right).
\]

For both measures, positive values indicate under budget projects or projects completed earlier than scheduled while negative values indicate over budget or late projects. All scales developed in the study were pre-tested with 15 project leaders and two experts in project management. As a result of this exercise, the phrasing of several questions was modified, and some questions discarded. The Appendix lists the items used in the study questionnaires.

\textbf{Data Collection}. Initially, a letter describing the study was sent to the IS managers of the largest 100 companies in Quebec, and to all the ministries, government agencies, and public corporations of the province. A few weeks following the mailing, the recipients were contacted by phone to solicit their participation and to inquire about the availability of projects currently being developed, with system conversion not yet completed. The purpose of this requirement was twofold. The fact that the projects were still ongoing meant that in answering questions about project characteristics and management activities respondents would report on current events, thereby eliminating retrospective bias. This requirement also meant that the sample would contain projects at varying degrees of advancement, ranging from the requirements determination stage to system conversion, increasing the representativeness of the sample.

The sampling process resulted in an initial sample of 120 ongoing projects in 75 organizations. For each project two respondents were identified. First, the project leader was interviewed and was given a questionnaire containing project characteristics and project management questions. The project leader was also asked to assist in identifying a key user knowledgeable about the user community, project objectives, and organizational goals. For each project, a key user thus identified was also interviewed, and given a questionnaire containing project characteristics questions about which they would typically know more than the project leader (e.g., questions pertaining to user tasks for which the system was being developed and user characteristics). To ensure a high response rate, the questionnaires were left with the respondents, and if possible hand-collected a few weeks later.

Once the initial data for a project were collected, the project was followed while awaiting its completion. After system implementation and following a three month usage period, a second questionnaire was sent to the project leader as well as the key user. For each variable, whether the respondent was the project leader or the key user, and when during the project the variable was
measured, are indicated in the Appendix. Following a two year data collection period, a sample of 75 completed projects was obtained. Of the remaining 45 projects in the initial sample, 15 were still in development, 19 had been abandoned, and complete performance data from 11 projects could not be obtained for various reasons (e.g., because the project leader had left the organization). The characteristics of the 75 projects that form the final study sample are presented in Tables 1 and 2.

*INSERT TABLES 1 & 2 HERE*

**Testing the Contingency Model**

As described earlier, the present paper defined the notion of fit as the closeness between the Project Management Practices pattern of a project and an empirically determined “ideal” or “best practices” pattern. The contingency model hypothesizes that, as the distance between a project’s pattern and the ideal pattern increases, the project’s performance will decrease. To operationalize deviations from an ideal pattern, Drazin and Van de Ven (1985) suggest calculating a Euclidean distance score, which in effect represents the degree of fit. To the extent that the distance scores correlate significantly and negatively with performance measures, evidence for the presence of contingent relationships are obtained.

To conduct this analysis, first, the ideal patterns need to be empirically estimated. In the present study eight such patterns were identified: a pattern for low risk projects and a pattern for high risk projects, for each of the four indicators of Project Performance. To do so, the sample of 75 projects was first split into two subsamples: a high risk subsample (projects with Project Risk Exposure scores above the overall sample mean), and a low risk subsample (projects with Project Risk Exposure scores below the overall sample mean). Next, for each subsample and for a given performance measure, the 10 highest performing projects were selected. For each set of 10 projects the ideal management practices patterns were estimated by calculating the mean Integration, Formalization, and Formal Planning scores for that set. For example, the 10 projects with the highest System Quality scores within the low risk subsample were identified and their mean Integration, Formalization and Formal Planning scores were calculated. This pattern of means was used as the ideal project management pattern for low risk projects when performance is measured by System Quality. This procedure was repeated for the 10 projects with the highest System Quality scores within the high risk subsample, providing the ideal project management pattern for high risk projects (when performance is assessed by System Quality). Finally, the low risk and high risk ideal pattern calculations were repeated for the other three performance measures, Cost Gap, Time Gap, and User Information Satisfaction (in each case, the top ten projects were selected anew). The eight empirically derived ideal Project Management Practices patterns are shown in Figure 1.
The Project Management Practices patterns depicted in Figure 1 show a high degree of similarity, for all four performance measures. In each case, successful-high risk projects exhibit higher levels of Integration and Formal Planning than successful-low risk projects. For three of the four performance measures, there is virtually no difference in terms of Formalization between the high and low risk top ten projects. The only exception is UIS where successful-high risk projects exhibit higher Formalization levels than successful-low risk projects.

To operationalize the notion of fit as deviations from an ideal pattern, Drazin and Van de Ven (1985) suggest the calculation of a Euclidean distance score as follows:

\[ \text{DIST}_j = \sqrt{\sum (X_{is} - X_{js})^2} \]

where \( \text{DIST}_j \) is the distance score, for a given performance measure, between the ideal pattern and project \( j \)’s pattern. \( X_{is} \) is the score of the ideal pattern on the \( s \)th dimension (e.g., Integration) and \( X_{js} \) is the score of the \( j \)th project on the \( s \)th dimension. For example, project \( j \)'s distance score, with System Quality as the performance measure, was calculated as follows:

\[ \text{DIST}_j = \sqrt{(5.17 - \text{Integration score}_j)^2 + (5.44 - \text{Formalization score}_j)^2 + (3.92 - \text{Formal Planning score}_j)^2} \]

if project \( j \) was low risk (i.e., Project Risk Exposure score below the sample mean), and

\[ \text{DIST}_j = \sqrt{(5.49 - \text{Integration score}_j)^2 + (5.47 - \text{Formalization score}_j)^2 + (4.45 - \text{Formal Planning score}_j)^2} \]

if project \( j \) was high risk (i.e., Project Risk Exposure score above the sample mean). The constants in the above equations are the average Integration, Formalization, and Formal Planning scores for the top 10 projects in the low risk subsample and the top 10 projects in the high risk subsample (both when System Quality is used as the performance measure), respectively (see Figure 1). After removing the top 20 projects from the sample, a distance score was calculated for each of the 55 projects remaining in the sample (when performance is measured by System Quality). Finally, the correlation between the projects’ distance scores and their System Quality scores was calculated (for the 55 projects). For each project, new distance scores were calculated for each of the remaining three performance measures (using the ideal profiles of the three performance measures, shown in Figure 1) and the correlation between each set of distance scores and their respective performance measures calculated. The resulting four correlations are presented in the second column of Table 3.

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3 Van de Ven and Drazin (1985) suggest a possible modification to the procedure described above whereby the different project management dimensions could be weighted in calculating the distance scores. For example, Sabherwal and Kirs (1994) use standardized betas (obtained by regressing the different dimensions on the performance variable) as weights. We used equal weights for the three project management dimensions since no a priori reasons existed for assigning different weights to different dimensions.
As can be seen from Table 3, two correlations were significant at p < .01 (Cost Gap, r = -.34, and System Quality, r = -.45), and one was significant at p < .10 (Time Gap, r = -.23). The correlation for UIS (r = -.11), while in the expected direction, was not significant. These results provide support for H1 and indicate that Project Risk Fit influences Project Performance. Stated differently, as the Project Management Practices pattern of a project approaches the ideal patterns empirically estimated in the present study, Project Performance increases.

The presence of differing Project Management Practices profiles (depending on a project’s Project Risk Exposure) indicates that leaders of successful projects vary how they manage a project depending on the project’s Project Risk Exposure. Increasing the levels of Integration and Formal Planning for risky projects appears to be the approach followed by leaders of successful projects, when success is measured as meeting cost and budget estimates, as well as the quality of the system as perceived by the project leader. Moreover, as a project’s Project Management Practices pattern gets closer to this pattern, the project tends to be more successful (again, as measured by these three indicators of Project Performance).

While the results provide overall support for H1 for three of the four Project Performance measures, no support for H1 was obtained in the case of UIS. One possible explanation of this result could be that, project managers are likely to be as concerned about System Quality, as they would be both for Cost Gap and Time Gap since meeting project budgets and schedules are two indicators on which many project leaders’ performance evaluations, as well as reputations, depend. Given project leaders’ concern for all three of these indicators, any contingencies that may be operating in how they manage IS projects are likely to be present for all three measures. In contrast, UIS is an indicator of Project Performance from the users’ perspective, and as such, may be a project outcome measure about which project leaders are perhaps not as concerned as with meeting budgets and schedules. If so, they would not be expected to manage IS projects with UIS as much in their mind as the other three performance indicators, which could explain why the fit between the way a project is managed and project risk may not be related to UIS.

To explore the possibility that a different contingency relationship may be operating in the case of UIS, an additional analysis was conducted with a new construct, User Participation, that may be closer to users’ concerns than the three Project Management Practices constructs examined earlier. For each project in the sample, User Participation was assessed as part of a larger study with a 15-item scale based on Barki and Hartwick (1994), and shown in the Appendix. Again, splitting the sample into high and low risk subsamples, the top ten projects in each subsample were identified (the ten projects having the highest UIS scores). While mean User Participation for the top ten projects in the low risk subsample was 4.3, this mean was 5.4 for the top ten projects in the high risk subsample (difference significant at p < .01). This indicates that, higher levels of Project Risk Exposure are associated with higher levels of User Participation. To examine whether User Participation levels approaching (or deviating from) these empirically determined “ideal” levels are
related to UIS, a User participation distance score was calculated (5.4 minus a project’s User participation score if project is high risk, or 4.3 minus a project’s User Participation score if project is low risk) for the remaining 55 projects. As expected, the correlation between this distance score and UIS was negative and significant ($r = -.45$, $p < .01$). Thus, the closer a project’s User Participation levels to the two means identified, the higher its UIS, providing support for the presence of a contingent relationship between Project Risk Exposure and User Participation.

When the above analysis with User Participation was repeated for Cost Gap, Time Gap, and System Quality, no evidence of a contingent relationship was found. The analysis was conducted as follows: first, the sample was split into high and low risk subsamples, and the top ten projects (in terms of their Cost Gap scores) in each subsample were identified; next, the User Participation means for the two top ten groups were compared; then, the previous two steps were repeated for Time Gap and System Quality. While mean User Participation scores for the top ten projects in the low risk subsamples were 4.3, 4.4, and 4.8 these means were 4.0 and 4.2, 5.4 for the top ten projects in the high risk subsamples (for Cost Gap, Time Gap, and System Quality respectively). The differences between the means were not significant. User Participation distance scores calculated similarly to UIS above were calculated for Cost Gap, Time Gap, and System Quality. Not surprisingly, the correlations between these distance scores and the three performance measures, were not significant ($r$’s .17, .15, and .18 for Cost Gap, Time Gap, and System Quality, respectively, all $p$’s not significant).

The above results are summarized in the third column of Table 3. As can be seen in the Table, the correlation patterns obtained with Project Management Practices versus Participation exhibit a marked contrast. While the correlations obtained with Project Management Practices were significant for Cost Gap, Time Gap, and System Quality (from the project leader’s perspective), this correlation was not significant for UIS. Conversely, while the correlations between the first three performance measures and the respective distance scores with Participation were not significant, the correlation with UIS was in the expected direction and significant. This pattern of correlations suggests that the ideal profile of project management - in terms of Integration, Formalization, and Formal planning – indeed influences project performance when performance is assessed with indicators that are especially important from a project leader’s perspective (i.e., Cost Gap, Time Gap, and System Quality). However, this profile does not appear to influence project performance when this was assessed from the users’ perspective (i.e., UIS). In contrast, Participation as a contingent variable was found to have an influence when performance was assessed from the users’ perspective (i.e., UIS), but it did not appear to influence performance when this was assessed with other three measures. These results strongly suggest that in terms of project management, there exist not one, but two, complementary, contingency models, one from the project leader’s perspective and one from the users’ perspective.

**Conclusion**

The objective of the present study was to test the general hypothesis that Project Performance is influenced by Project Risk Fit, defined as the extent to which the Project Management Practices match the level of Project Risk Exposure. Three constructs reflecting
project management practices were operationalized: formal planning, formalization, and integration. Project performance was assessed along four dimensions: budget compliance, time compliance, system quality as perceived by the project leader, and user information satisfaction. Adopting a profile deviation perspective of fit, the research hypothesis was supported for the first three dimensions of project performance. That is, it was found that the farther from an ideal profile of formalization, formal planning and integration a project’s management was, the lower its performance (in terms of time and budget compliance, and system quality). According to the empirically derived ideal profiles, high risk exposure projects appear to require high levels of integration, formal planning, and formalization. For low risk exposure projects, an ideal profile consists of lower levels of integration and formal planning. In both cases, the ideal profiles depict relatively high levels of formalization.

Interestingly, the fit hypothesis based on the three project management constructs studied was not supported when performance was measured in terms of user information satisfaction. Rather, when user information satisfaction was the performance measure, high risk exposure projects appeared to call for high levels of user participation; on the other hand, when risk exposure was low, lower levels of user participation were warranted. This result is consistent with the findings of McKeen et al. (1994), and suggests that when user satisfaction is the outcome of concern, a different contingency model, where the critical project management practice is user participation, may be at work.

Many studies of ISD project management focus on a single perspective of project performance. Studies examining project performance in terms of user information satisfaction or utilization can be said to have a user focus. On the other hand, studies examining project outcomes in terms of the project’s compliance with its schedule and budget, or with the satisfaction of the project leader can be said to have a project leader perspective. The results obtained here suggest that both perspectives need to be taken into account for a more comprehensive understanding of software project management.
REFERENCES


Rivard, S., G. Poirier, L., Raymond, F. Bergeron, "Development of a Measure to Assess the Quality of User-Developed Applications," Data Base, 28, 3, (Summer 1997), 44-58.


APPENDIX

PROJECT MANAGEMENT PRACTICES.  7-point Likert scale. Respondent: project leader, while the project was still ongoing. For each item the respondent indicated the extent to which the contents of the statement corresponds/does not correspond to what transpired in the project.

INTEGRATION (Cronbach alpha = .72)

1. There exists a frequently meeting project team.
2. Users actively participate in the definition of system requirements.
3. The project team meets frequently.
4. Users are active members of the project team.
5. Project team members are kept informed about major decisions concerning the project.
6. Every effort is made to keep project team turnover at a minimum.
7. Project team members actively participate in the definition of project goals and schedules.

FORMALIZATION (Cronbach alpha = .79)

1. A system development methodology is rigorously followed.
2. Complete documentation of the project exists.
3. Mechanisms to keep the project documentation up to date exist.

FORMAL PLANNING (Cronbach alpha = .76)

1. Tools such as PERT or CPM are used to closely follow the project's status.
2. Being on schedule is the major criterion used in evaluating team member performance.
3. Special attention is being paid to project planning.
4. Significant resources were allocated to estimate project times and budgets.

SYSTEM QUALITY. 7-point Likert scale. Respondent: project leader, following project completion. For each item the respondents indicated the extent to which the contents of the statement completely/not at all describes the system that was developed (Cronbach alpha = .88).

1. Reliable (the system runs without errors, does what it is supposed to do, and the information it produces is error-free and accurate).
2. Ease of use (the system is easy to use).
3. Secure (the system enables recovery from errors, accidents, and intrusions while maintaining data security and integrity).
4. Easy to maintain (programming errors can be easily corrected).
5. Flexible (the system can easily be modified to meet changing requirements).
6. Technically simple (the programs, the data base structure, and the technical documentation are easy to understand).
7. Portable (the system can easily be adapted to a new technical or organizational environment).
8. Efficient in its usage of resources (The system performs its different functions without wasting technical resources).
9. Testable (it is easy to test whether the system is functioning correctly).
10. Meets initial objectives (the system conforms to the specifications established at the start of the
11. Advantageous from a cost/benefit point of view (the benefits that will be derived from the system exceed its cost).

12. Understandable (the system is easy to understand).

13. Documented (documentation exists describing how the system functions and its structure).

14. Quick (the system performs its functions within acceptable delays).

15. Precise (the information produced by the system is precise).

16. Complete (the range of functions offered by the system is adequate).

17. Relevant (the information produced by the system is useful for the users).

18. Recent (the information produced by the system is up to date).

**USER PARTICIPATION.** 15-item, 7-point Likert scale. Respondent: *key user*, following project completion. For each item the respondents indicated the extent to which the contents of the statement completely/not at all describes what transpired in the project (Cronbach alpha = .88).

1. Users took on the leadership role in the development of the system.
2. Estimating development costs was users' responsibility.
3. Evaluating system benefits was users' responsibility.
4. Covering unforeseen budget increases in the project was users' responsibility.
5. Selecting the hardware/software was users' responsibility.
6. Users played a major role in the system analysis phase of the project.
7. Users played a major role in the system design phase of the project.
8. Users played a major role in the implementation phase of the project.
9. One or more users acted as liaison between the users and the project team.
10. Ensuring project success was users' responsibility.
11. The project team drew up a formalized agreement of the work to be done.
12. Users were able to make changes to the formal agreements of the work to be done.
13. The project team kept users informed concerning project progress and/or problems.
14. Users formally evaluated the work done by the project team.
15. Users formally approved the work done by the project team.

**PROJECT RISK EXPOSURE.** Measurement of 23 uncertainty variables and magnitude of potential loss as per Barki et al., (1993). Respondent: *project leader and key user* (depending on variable, see Barki et al., 1993), during project. Project Risk Exposure score calculated as Overall Uncertainty (an average of 23 variables, after conversion to same scale) multiplied by Magnitude of Potential Loss (see Barki et al, 1993, p. 215-216)
<table>
<thead>
<tr>
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<th>Mean</th>
<th>Standard Deviation</th>
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Table 1. Project and Organization Characteristics (N=120)

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<td>Number of employees (IS department)</td>
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Table 2. Project and Organization Characteristics (N=75)

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<th>Correlation with Respective Participation Distance Score</th>
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<td>Cost Gap</td>
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<td>-.17 (ns) (N=46)</td>
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<td>Time Gap</td>
<td>-.23 (p &lt; .10) (N = 53)</td>
<td>.15 (ns) (N=59)</td>
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<td>System Quality (project leader)</td>
<td>-.45 (p &lt; .01) (N = 53)</td>
<td>-.18 (ns) (N=39)</td>
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<tr>
<td>UIS (user representative)</td>
<td>-.11 ( ns) (N = 47)</td>
<td>-.45 (p&lt;.01) (N=46)</td>
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Table 3. Correlations between Performance Measures and Pattern Distance Scores
Figure 1 – Empirically derived ideal profiles