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Relationship Between Information System Project Characteristics and Project Management Activities: An Empirical Investigation

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ABSTRACT

The activities of a project manager in overseeing the development of a software system are many and varied. Not all such activities are performed in managing every project. If so, a natural ensuing question is whether project managers adapt their managerial functions to the projects being managed. Prior research suggests that they do adapt, and that project characteristics may be the factors determining this adaptation. This assertion is investigated by considering three characteristics of a project (size, type, and environment) and investigating their association with four traditionally recognized management functions (planning, organizing, controlling, and motivating). Results indicate that project managers do modify some managerial functions based on size and type of the project but not based on the environmental characteristics of the project.

INTRODUCTION

There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old system and merely lukewarm defenders in those who would gain by the new one.
... Machiavelli (1513 A.D.)

The very nature of Information Systems (IS) projects requires a special emphasis on their management. The effectiveness of the final system "product" ultimately depends to a large extent on the degree of the "project management" effort during various stages of its development [25]. Similar to managing any other organizational activity, management of IS projects involves administrative functions such as planning, organizing, controlling, and motivating. In consequence, the responsibilities of project managers overseeing the development of new systems or enhancement of existing systems, are many and varied.

Phases of software development such as systems analysis and design, and issues of software development such as the use of prototypes, ease of maintenance and stability of the system developed, have recently been of considerable interest to both researchers and practitioners [19, 23, 24, 30, 33]. And yet, the activities of the project manager in managing a systems development project have received little attention. Table 1 summarizes some of the major activities that project managers administer during the systems development effort [13, 25]. Project managers do not necessarily perform each of these activities in every project. If these activities are *not* uniformly performed in all projects, what determines the difference in the nature or extent of performance of these activities in different projects? It appears that each of these project management activities is critical to the systems development effort in a varying degree and extent depending on the characteristics of the project [26, 28]. This paper investigates the relationship between project characteristics of systems and the management functions performed during their development.

MANAGING SYSTEMS DEVELOPMENT PROJECTS

There are two major perspectives of the activities per-

Table 1
Typical Activities of a Project Manager

Planning
Producing a schedule for the project
Evaluate project costs
Evaluate new technologies
Organizing
Specify product specifications
Select language for the project
Set documentation standards
Define standards for coding
Define modeling activities
Arrange and conduct user meetings
Controlling
Collect and maintain cost data
Ensure adherence to the standards set
Check backup and recovery procedures
Revise cost estimates during progress
Obtain additional funding if necessary
Measure product performance
Motivating
Conduct user training
Hire and train development personnel
Provide liaison with other units
Communicate enhancements/changes to project members

formed by a project manager during the system development process: a *managerial perspective* that examines the activities from the viewpoint of traditionally recognized management functions of planning, organizing, controlling and motivating; and a *technical perspective* focussing on the activities of a project manager during different stages of the System Development Life Cycle (SDLC). Notwithstanding alternative dichotomies proposed elsewhere [e.g., 39], this study espouses a managerial perspective (in contrast to a technical perspective). It appears that Kydd [24] labels the management perspective as "structural mechanisms" and the technical perspective as "MIS management tools." She addresses how these could be used to reduce the uncertainty and equivocality in various stages of the SDLC. The purpose of this study, however, is to examine the relationship between characteristics of a project and the extent to which various project management functions are performed during its development. It views the tasks listed in Table 1, not merely as a set of activities, but as a set of items describing the traditionally recognized management functions: planning, organizing, controlling, and motivating.

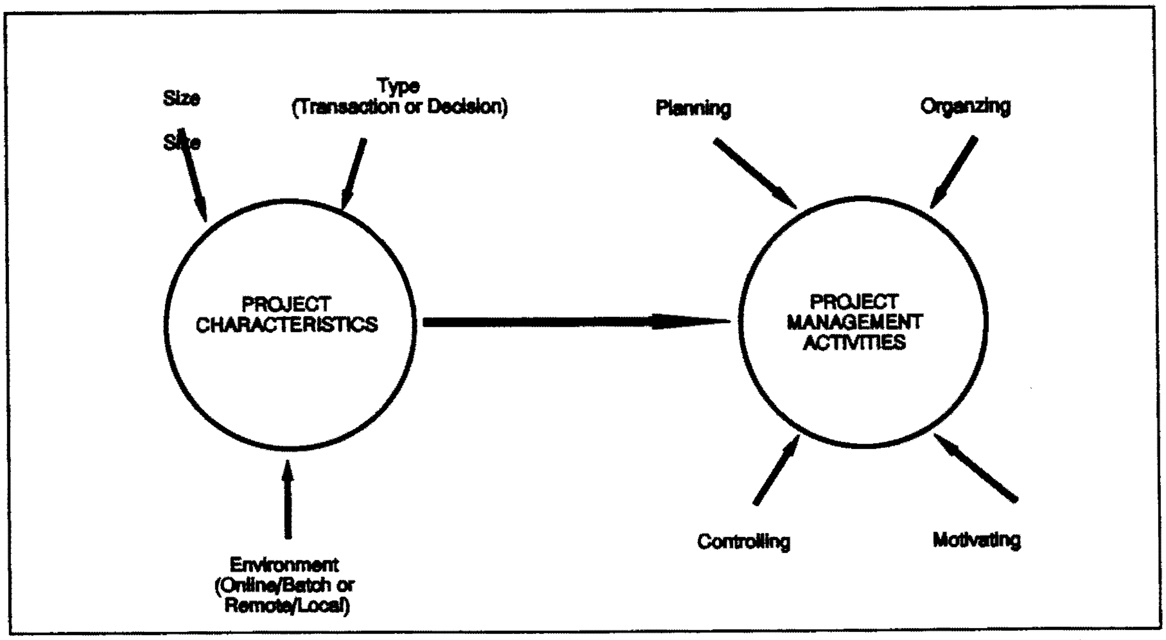
Saarinen [28] while investigating the influence of system development methods on system success asserts that the "... size of the system development project has not been taken into account while deciding on the level of formal planning and management control." He further concludes that one of the reasons for system success is the relatively small size of the projects and a large degree of formal planning. This need for formal planning is also emphasized by Bussert [8]. McFarlane and McKinney [26] are of the view that project size is critical and plays an important role in determining the effort allocated within the different project management activities. They suggest that larger projects are riskier than smaller ones. A good and accurate requirements definition, formal planning, user involvement, effective communication, and past experience of the project staff have all been defined as the key elements to project success [22, 26].

RESEARCH MODEL

A managerial approach, referred to as contingency theory, emphasizes adjusting managerial actions and styles to specific circumstances of the situation confronting the organization. In the context of managing system development projects, appropriateness of adjusting managerial style to the situation has been advocated by various researchers [e.g., 28]. As a preliminary step to examining whether such adjustments can improve the system effectiveness and efficiency, it is necessary to explore whether project management functions are adapted to suit the characteristics of the project. McFarlane and McKinney [26] suggested that smaller projects with greater formal planning are more likely to succeed. This was also empirically supported by Saarinen [28].

The association of project management functions and project characteristics is illustrated in the research model shown in Figure 1. This study specifically examines three project characteristics: the *size, type,* and *operating environment* of the system being developed. Prior research suggests that the size of the project is associated with some project management activities [8, 26, 29]. The "type" of the project was categorized as a transaction processing or decision system. That the "type" of a system plays a critical role in its development is supported by several researchers who suggest alternative design strategies for developing decision support systems [e.g., 1, 20]. In contrast to other classifications of project types used elsewhere [5], transaction and decision system dichotomy is commonly used and understood. For the purposes of this study, *decision systems* are deemed to incorporate some features that facilitate decision making in contrast to purely transaction processing systems which are used mainly for routine reporting needs. The operating environments of systems are characterized in terms of two dichotomies: online/batch and remote/local systems. Schach [29] identifies many distinguishing characteristics of online systems. An online system is characterized by the fact that its inputs come from the real world and in consequence such systems have no control over the timing of their inputs. Furthermore, each input must be processed before the next

Figure 1
Research Model



input arrives. Another characteristic of online systems is that they are often implemented in distributed hardware. These distinguishing features make such systems fundamentally more complex than batch systems.

The right hand side of the research model (see Figure 1) incorporates the traditionally recognized project management functions. Better management of the system development is considered to be of vital importance to the system development process. Project managers implement four management functions (planning, organizing, controlling, and motivating) in the process of utilizing resources to support the system development goals.

Planning is a process where managers set objectives, assess the future, and develop courses of action to accomplish these objectives. Planning includes determining appropriate objectives and an optimum time table for achieving them [6, pp.4-9]. Effective planning often means the difference between success, mediocrity, and failure. In the system development context, Saarinen [28] concludes that formal planning was low in less successful systems. Bussert [8] also favors the need for formal planning in systems development. Schach [29, p.71], recognizing the significance of planning in managing projects, identifies three main phases of planning system development. First, the problem that the system is attempting to solve must be clearly stated. Second, alternative solution strategies must be evaluated until an optimal strategy is determined. Third, a project management plan for the product as a whole must be developed.

If planning can be viewed as the determination of "ends or objectives," then organizing is the process of selecting and structuring the "means" by which those ends are accomplished. The organizing process seeks answers to the how questions: How should work be divided? How should it be coordinated? How should resources, both human and physical, be allocated [6, p.249]? In the system development context, the design phase attempts to answer the *how* questions [29, p.23]. Activities typically performed in this design phase are widely discussed in literature [e.g., 15, 38].

Controlling is the process by which managers determine whether the original objectives of the project are achieved and whether the actual implementation is consistent with original plans [6, p.9]. In systems development, the review and testing phase assures that a product is consistent with its original objectives.

Leadership is the act of motivating group members to perform certain tasks to achieve specified objectives. Motivation refers to the forces leading to behavior directed toward the satisfaction of some need [6, p.419). In the project management context, motivating development personnel would involve recognizing that a project team is composed of individuals who have underlying needs while working in a task-oriented environment. Bartol and Martin [4] have highlighted the problems of not recognizing motivational factors in managing IS personnel. According to them, the design of a job is a particular area of concern for IS contexts.

Based on the above research model and analysis of prior research, this study examines the following propositions regarding the relationship between the characteristics of system development projects and managerial functions performed during their development. These propositions are isomorphic with experiences of system development in the industry. For example, in his recent book entitled *Principles of Software Engineering Management,* Gilb [16] provides many concrete examples of typical managerial functions being *over or underperformed* in various projects. Thus, the notion of "greater managing" is a matter of degree. That is to say managers may plan, organize, control and motivate to differing extents with different project characteristics.

Proposition 1: Larger projects need greater managing than smaller projects.

Proposition 2: Online projects need greater managing than batch projects.

Proposition 3: Remote projects need greater managing than local projects.

Proposition 4: Decision systems need greater managing than transaction-processing systems.

RESEARCH METHOD

In order to examine these propositions, this study used a survey design. Thirty-one project managers representing sixteen different firms participated in the study. A univariate analysis of the research variables was used to analyze one project characteristic at a time.

Operationalization of Study Variables

Size: The most common measure of the size of a software product is the number of lines of source code [5, p.82] — often used as a measure of its complexity. Objections against using size as a measure of project complexity have mainly come from the software metrics literature [e.g., 35]. An objective of software metrics studies is to predict the cost and time needed for development efforts and hence precise estimates are often required. The present study, however, uses size not for such predictive purposes, but only to identify the association of the size of projects and managerial functions employed during their development. In addition, this survey requires an approximate size of the project only after it has been developed, and does not require an *a priori* estimation of size that software metric models demand. Operands and operators in the software product are often mentioned as alternatives to lines of code as a measure of size [29]. In addition, categorizing software based on some functional categories, known as function points, is also used as a measure of project size [34]. Since these measures are often too difficult to recall they are not particularly useful in a survey instrument.

Thus, for the purposes of this study, the number of lines of source code in the project is an appropriate measure of its size. Project managers responding to the survey were asked to classify whether the size of the project, measured in terms of the lines of executable code in the project, was (1) less than 12000, (2) between 12000-100000, or (3) greater than 100000. Personal interviews conducted prior to developing the instrument supported this division of projects by lines of code.

Type of Projects: To achieve the purpose of the present study it was useful to label a system as a transaction processing or decision system. Use of system features to claim a system category (for example, DSS) has long been a promotional weapon for commercial software packages. Since such a list of system features was too long to be usable in a survey instrument, it was condensed to four basic properties of decision systems. During the instrument development process, what-if capabilities, use of external data, statistical analysis capabilities, and use of "4 GL" interfaces were identified as the four properties of decision systems. Presence of at least two of these four properties was operationally defined as distinguishing a decision system from a purely transaction processing system. Use of such system features to characterize a system has been a common technique [e.g., 32]. Hence, a simple presence-absence indicator for each of the attributes was used to categorize systems as either "decision" or "transaction processing."

Operating Environment: The operating environments were directly measured as a percentage of application that was online/batch (EN1]) and remote/local (EN2). In both cases, the reference is to the environment of the final system product itself and not to the environment in which the project was being developed. The present survey asked project managers to rate the percentage of application that belonged to each category. If these percentages were exactly equal, then the environment was classified as "mixed." Such mixed systems have been excluded from the current study to avoid borderline cases clouding the conclusions reached.

Planning: The planning activities of a systems development manager begins with the feasibility study. A feasibility study enables a project manager to see whether the objectives of the proposed system are appropriate and whether the organizational resources will permit an attempt to achieve those objectives. Other tools/techniques used during system development, such as creation of data-flow diagrams, structure charts, user requirements specifications, and program specifications, also reflect the extent of planning done for the project. The techniques and tools referred to above help

Table 2

Items Used to Measure Various Constructs

PLANNING (PLA1)	**Objective Measures** (1) Feasibility document (2) Data-Flow diagrams (3) Structured charts (4) User-requirement specifications (5) Program specifications (6) Use of project management tools
(PLA2)	**Qualitative Measures** (1) Extent of executive involvement in keeping up with hardware and software technology. (2) Extent to which hardware and software requirements were determined. (3) How well defined was the initial scope of the project?
ORGANIZING (ORG)	(1) Modularity of the project (2) DP department's participation in setting standards (3) User participation in setting standards (4) Top-level management involvement in setting standards (5) PM's involvement in (a) output specifications (b) conducting user interviews (c) general design (6) Use of prototypes for (a) screen design (b) report design
CONTROLLING (CONT)	(1) DP staff's involvement in code-reviews (2) DP staff's involvement in (a) testing (b) conducting structured walk-throughs (c) final review of the system delivered (3) PM's involvement in (a) unit testing (b) system testing (c) integration testing (d) user-acceptance testing (4) Program specifications kept up-to-date with requirement changes
MOTIVATING (MOTI)	(1) PM's involvement in measuring employee performance (2) Degree of communication with the project members (3) PM's involvement in providing training necessary

define the extent of formal planning employed during systems development. Yet, these are inherently different from other measures of the planning construct such as how well defined was the initial scope of the project. Hence, the planning construct was operationalized in two separate dimensions: a set of six techniques used during project management that enhances the planning content (PLA1); and three qualitative measures of the planning process (PLA2). Table 2 summarizes the operationalization of the planning (PLA1 and PLA2) construct. The planning tools describing the PLA1 dimension were evaluated as either "used" or "not used" by the project managers. The survey instrument itself used "don't know" as a third alternative in order to avoid measurement errors due to forced answers. The three qualitative measures were assessed from a set of seven questions, each on a seven point scale ranging from "a great extent" to "not at all."

Organizing: The architectural design, a description in terms of modules of the design as a whole, determines how the work is divided among members of project teams. Thus the modularity of the project achieved is a measure of how the project was organized. In addition to modularity, this study used the project manager's involvement in designing the overall architecture of the system. Also eight items, all reflecting the design activities of the system development process, were used to operationalize the organizing construct (ORG). All these items were measured on a seven point scale ranging from "a great extent" to "not at all." Table 2 summarizes the operationalization of the organizing (ORG) construct.

Controlling: The controlling construct was measured from items that elicit information on the extent of review and testing done for a given project. Three items measuring the DP staff's involvement in code reviews, general testing, and final review of the system delivered were used. In addition, four items measuring the project manager's involvement in various aspects of testing and one item measuring the extent to which the program specifications were kept up-to-date with requirement changes comprised a total of nine items to measure the "controlling" exercised during systems development. The use of these attributes as a measure of control exercised during systems development is discussed extensively in the literature [e.g., 12, 18, 27, 36]. All these items were scored on a seven-point scale ranging from "great extent" to "not at all." Table 2 summarizes the operationalization of the controlling (CONT) construct.

Motivating: The degree of communication between the project manager and project staff during system development is used as a surrogate measure for providing feedback on employee performance and the status of system development. Ashford and Cummings [3] noted that feedback is important to employees not only because it facilitates the attainment of organizationally defined performance goals, but also because it helps them to attain personal goals. Providing such feedback is viewed as a positive managerial behavior in many prior studies [e.g., 14, 21]. Ashford [2] provides empirical evidence to suggest that employees seek out feedback from their supervisors. White and Leifer [37] have also identified "communication" as a critical factor determining project success. Other properties of job design measured in the study are project managers' involvement in measuring employee performance, their involvement in providing the training necessary, and whether or not overtime compensation was provided. All these items were scored on a seven-point scale ranging from "great extent" to "not at all." Table 2 summarizes the operationalization of the motivation (MOTI) construct.

Hypotheses

The following major hypotheses, derived from the propositions stated earlier, were tested using the operationalization of research constructs described in the previous section:

1) Project managers perform greater managing for larger projects than smaller ones.

2) Project managers perform greater managing for projects of online environment than batch environment.

3) Project managers perform greater managing for projects of remote environment than local environment.

4) Project managers perform greater managing for decision systems than transaction processing systems.

The above hypotheses are stated in compound form instead of detailing separate hypotheses for each of the project management functions. In addition, the planning construct is operationalized in two dimensions (PLA1 and PLA2). As a result, five separate hypotheses were tested in each case, leading to a total of twenty different hypotheses.

Data Collection

The survey instrument was developed from items discussed in literature cited throughout the preceding section and on the basis of the conceptual model shown in Figure 1. In addition, we also interviewed three senior project managers to ensure the comprehensiveness of the survey items.

The instrument was distributed to sixty-five project managers representing sixteen different firms in the northeast and midwest regions of the United States. All the prospective respondents were carefully selected to ensure that they were experienced in managing systems development projects. This selection was facilitated by a contact person in each responding firm. Job titles alone are often poor indicators of the actual activities performed by managers during systems development. The advantage of using contact persons was that they were able to identify the appropriate respondents. The project managers were requested to respond to the survey instrument with reference to the latest completed and implemented project they independently managed. Thirty-one project managers representing sixteen different firms responded to the survey. At least one response was received from each of the firms contacted.

The firms surveyed represented a wide range of DP department sizes. DP department size, measured by the number of managers in the department developing the project, ranged from 4 to 300 with a mean of 31.4 and a standard deviation of 56.5. The time taken to develop the project also represented a wide range with a minimum of 4 months to a maximum of 96 months, a mean of 27.8 months and a standard deviation of 21.9 months. A graphical representation of the distribution of the application areas of the projects surveyed and the job titles of the respondents are presented in Figures 2a and 2b.

Issues of Reliability and Validity

There are many types of reliability estimates commonly measured and reported. In the context of system development, this study operationalizes the constructs of planning, organizing, controlling, and motivating for the first time.

Figure 2a

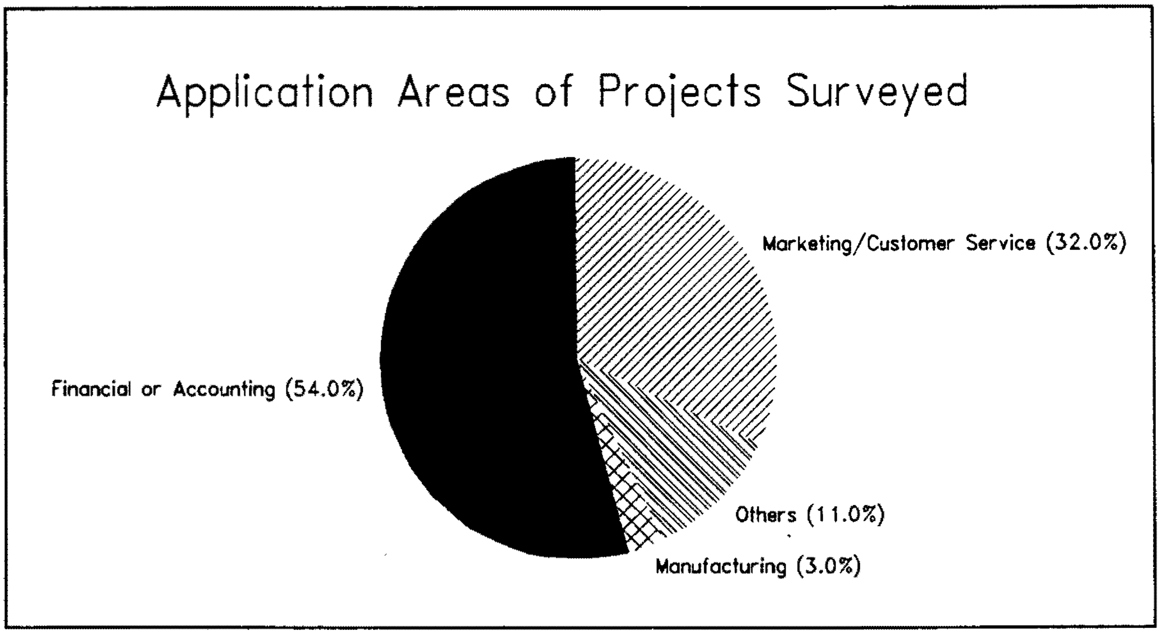
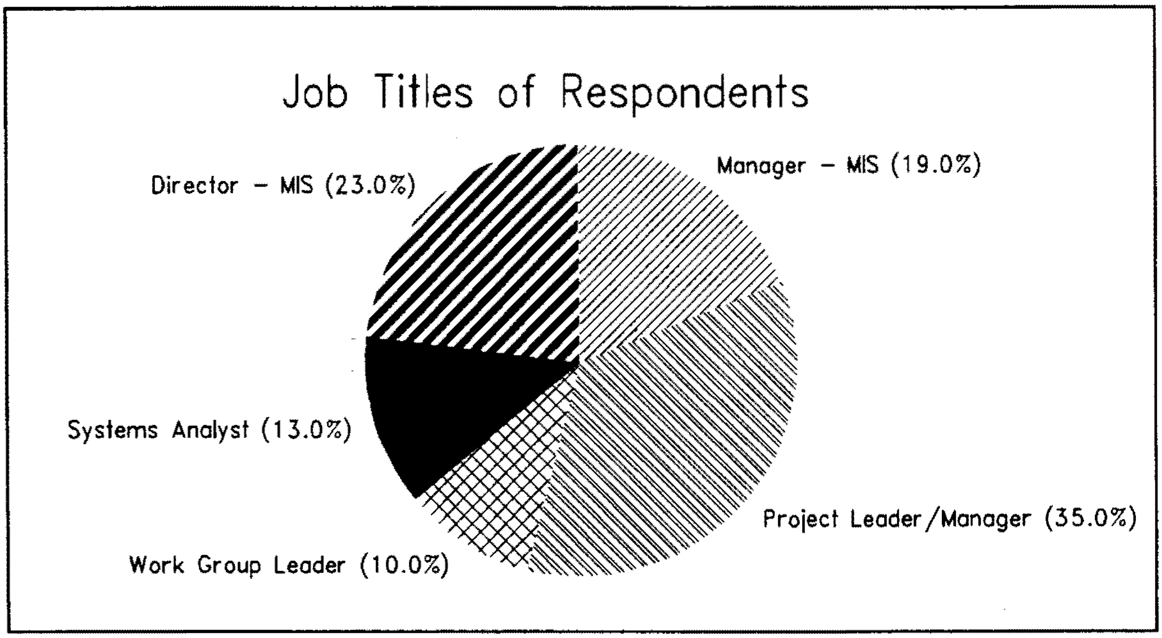


Figure 2b



There are no available instruments to measure these constructs. Hence, improvement over existing instruments was not possible. Cronbach's alpha, a measure of internal consistency, of the four constructs studied are reported in Table 3. It is possible to improve reliability estimates such as Cronbach's alpha by increasing the number of items on the scale or by selecting items that are more cohesive so as to raise the average correlation among items. We believe adopting such strategies solely to improve Cronbach's alpha is superfluous. In using scales to measure broad and polymorphous constructs such as the ones used in this study, it is desirable for a test to sample a large number of different variables which may not be highly correlated to get a wider sampling of the construct being measured. As an example, consider the "controlling" construct used to measure the extent of testing done on the software product. The survey instrument had many items relating to different types of testing such as unit testing, system testing, and integration testing. It is possible for a software development team to have employed more of certain types of testing and not of the others, but an appropriate response to this survey would decrease the Cronbach's alpha. And yet, including such items is consistent with the survey objectives. In addition to the Cronbach's alpha (a measure of internal consistency), it is desirable for an instrument to have an optimal level of homogeneity, as reflected by the *mean interitem correlations* — there must be an acceptable balance between the *homogeneity* and *fidelity* [7]. A statistical documentation of homogeneity is the mean interitem correlation and that of fidelity is Cronbach's alpha. Briggs and Cheek [7] note that if the mean interitem correlation is lower than .1, it means that the items are too complex to represent a single construct; and if it is greater than .5, it means that the items are overly redundant. The estimates of mean interitem correlations for the study constructs, as reported in Table 3, are within this acceptable range. This table also shows the Cronbach's alpha for each of the constructs.

The issue of validity is epitomized by the question: Are we measuring what we think we are measuring? Content validation is a matter of judgement. Alone or with others, one judges the representativeness of the test items to decide on the content validity. Here, whether the items used are representative of the constructs studied had to be judged. Pilot studies followed by personal interviews during the process of instrument development helped the selection of representative items to enhance the content validity. We also received positive feedback from four experienced project managers about the representativeness of the survey items. They verified that the survey items are accurately reflective of the domain represented by the construct and not other constructs outside of their domain.

Judgment sampling was used to select the survey participants. Our main concern was that the responding project managers should have the requisite experience to possess an overall knowledge of the project. This is usually not discernible from job titles since the level of IS personnel possessing an overall knowledge of a project is different in different organizations and may also vary from one project to another. Hence, in an attempt to improve the internal validity of the study, extra care was taken to select appropriate survey participants. This use of judgment sampling, as with any other nonrandom sampling method, raises concerns about the external validity of the study [9]. However, such trade-offs between external and internal validity are often present in many research designs [e.g., 17].

Table 3
Reliabilities of Scales Used

Construct	Reliability (Cronbach's Alpha)	Mean Interitem Correlation
Planning (PLA2) (7 Items)	0.68	0.24
Organizing (ORG) (8 Items)	0.80	0.32
Controlling (CONT) (9 Items)	0.65	0.15
Motivating (MOTI) (9 Items)	0.60	0.16

DATA ANALYSIS AND DISCUSSION

The RELIABILITY procedure of the SPSSx (release 4.0) statistical analysis package was used to prepare the reliability estimates reported earlier. All other analyses were run on SAS (release 6.06). Descriptive statistics of the study variables are provided in Table 4. Means and standard deviations reported for planning, organizing, controlling, and motivating grouped by various project characteristics present an introductory illustration of the collected data.

Data Analysis

Two sample t-tests, used in this study, require that study variables be normally distributed. The assumption of normal distribution cannot be valid for our PLA1 construct since it is a derived measure from an ordinal scale measurement. The nonparametric Wilcoxon rank sum test, also referred to as the Mann-Whitney U test, was employed to compare these group means. The assumptions required for the Mann-Whitney test are that the observations are independent and they are measured at least on an ordinal scale [10, p.215; 31,

Table 4
Means and Standard Deviations (in parentheses) of Study Variables by Project Characteristic

Organizational Characteristics	Number of Firms	Planning (PLA1)	Planning (PLA2)	Organizing (ORG)	Controlling (CONT)
Size					
(less than 100,000)	15	3.13 (1.85)	4.28 (0.81)	4.21 (1.39)	5.08 (1.19)
(greater than 100,000)	16	4.75 (1.24)	4.48 (1.06)	5.02 (1.00)	5.24 (0.88)
Environment					
Batch	8	3.75 (1.83)	4.52 (0.88)	4.53 (0.76)	5.33 (0.79)
Online	17	4.47 (1.59)	4.58 (0.91)	4.79 (1.40)	5.00 (1.09)
Environment					
Local	25	3.88 (1.64)	4.38 (0.89)	4.76 (1.24)	5.19 (0.98)
Remote	6	4.33 (2.25)	4.41 (1.21)	4.08 (1.27)	5.07 (1.30)
Type					
Transaction Processing	12	3.58 (1.50)	4.01 (0.65)	4.48 (1.43)	5.17 (1.09)
Decision Systems	19	4.21 (1.87)	4.62 (1.03)	4.73 (1.15)	5.16 (1.01)

p.196]. These assumptions were met for the PLA1 data. Two-sample t-tests were used to compare the group means to test all other hypotheses. In all cases, the assumption of equal variances for t-tests was met. Significance levels of all the supported hypotheses are tabulated in Table 5. The power of unsupported hypotheses predominantly ranged from 0.80 to 0.99. Consequently, the probability of making Type II errors is low.

Careful study of Table 5 reveals underlying patterns in the supported and unsupported hypotheses. Results indicate that project managers vary the extent of some managerial activities based on project size and project type. Project environment did not cause statistically significant difference in project management functions. Specifically, larger projects had greater PLA1, ORG, and MOTI dimensions of the management functions. This verifies that "size" as a project characteristic influences managerial adaptations during systems development. Projects that are decision-oriented (contrasted with pure transaction-processing systems) had greater PLA2 and MOTI dimensions of the project management functions. Thus, the association of "type" and some managerial functions is also verified. Another discernible pattern is that controlling (CONT) during the system development process did not vary with any of the project characteristics. This leads us to conclude that of the four dimensions of managing studied, controlling (CONT) was not associated with any of the project characteristics.

DISCUSSION

The supported hypotheses (see Table 5) indicate that managers perceive the "size" and "type of project" as characteristics necessitating modification of some managerial activities. The statistically significant results reported here provide partial support to our *a priori* delineation of the project characteristics and managerial functions in the research model.

Failure to observe statistically significant difference for "controlling (CONT)" is probably because "testing" was used as a predominant measure of this construct. In his book *Principles of Software Engineering Management*, Gilb [16, p.245) cites examples of how measures such as reported bug rates commonly used in testing are often established for the whole organization, and he also asserts that project teams do not conceive any modifications based on the characteristics of the software or the module being tested. This study lends further credence to this observation.

Failure to observe a statistically significant difference based on the project environment is an important finding, possibly characterizing the perceptible lack of awareness of project managers to this dimension. There are two plausible explanations to this finding. Presumably the environment of the project, in either online-batch or remote-local dichotomy, does not alter the complexity of the project to warrant any observable change in managerial functions employed. Alternatively, it is possible that the environmental factors do alter the complexity of the project, but many managers are simply so insensitive to this influence that they do not modify their managerial functions. Since the present study simply explored the project characteristics affecting managerial functions during the system-development process, it is not possible to conclude which one of the two explanations is

Table 5
Results of Analyses Showing Support for Hypotheses and Significance Levels

Project Characteristics	Planning (PLA1)	Planning (PLA2)	Organizing (ORG)	Controlling (CONT)	Motivating (MOTI)
Size (<100,000 or >100,000)	Supported (0.0070)	Not Supported	Supported (0.0356)	Not Supported	Supported (0.0005)
Environment (Online — Batch)	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported
Environment (Remote — Local)	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported
Type (Transaction processing or Decision systems	Supported (0.1100)	Supported (0.0378)	Not Supported	Not Supported	Supported (0.0116)

Note: Significance levels reported for PLA1 are based on the Mann-Whitney tests. Significance levels for other variables are based on two-sample t-tests.

legitimate. A study investigating the relationship among project characteristics, managerial functions of project managers and system success is needed to further understand the contingencies present.

In using the results of the study in future research, it is important to bear in mind the particular operationalizations of the constructs of planning, organizing, controlling, and motivating. All these are broad and polymorphous constructs, and as Briggs and Cheek [7] point out, one must be mindful of the components of which they are built. The measures used in this study have been presented in Table 2, and particular care should be exercised in comparing or transporting these constructs to studies using other measures of the same constructs. Although, to the best of our knowledge, operationalizations of these constructs in the systems development context are not available, one should guard against temptations to directly compare the results of this study with studies in other areas using these constructs.

SUMMARY AND CONCLUDING REMARKS

Although isolated managerial functions have been studied in the past [e.g., 24, 28], there has been no attempt to classify several project management activities into traditionally recognized managerial functions. Such a failing is exceedingly surprising especially in light of the many studies [e.g., 4, 11, 14] concluding that information processing professionals are similar in many ways to other professionals, and hence the traditionally recognized managerial functions are relevant in the IS context as well. A preliminary step to designing a successful system is to understand the contingency relationships present in system development.

This study approached the functions of a project manager from the traditional managerial perspective of planning, organizing, controlling, and motivating. New techniques and tools for system development are being continually proposed and organizational resources are being expended to evaluate and adopt them. Studying the functions of a project manager from a purely managerial standpoint will enable us to find suitable adaptations to projects of varying characteristics. While the techniques and tools used in systems development change, the managerial functions employed during systems development process seem relatively stable. If this stability is empirically verified through longitudinal studies, we can develop guidelines for successful systems development that will remain relatively unaffected by the continual changes in the tools and techniques of system development.

Significant implications of this study are in the areas of controlling system development and in understanding the complexities of developing online and remote systems. It is likely, as suggested in practitioner literature [e.g., 16], that intensity of testing would have to be modified based on the complexities of the system or the modules being tested. Our study indicates that managers do not make such adaptations at present. It also appears that managers may be insensitive to the complexities of developing online and remote systems. Future studies on the influence of alternative managerial approaches in such environments can shed further light on whether such adaptations can be productive and will serve to extend the findings of this study.

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