
The Comprehensiveness of IT Planning Processes: A Contingency Approach

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ABSTRACT

This paper focusses on process comprehensiveness as a key behavioral characteristic of information technology (IT) planning processes. A contingency model is used to suggest that the level of environmental complexity and turbulence and the level of existing consensus in the planning group influence the relationship between process comprehensiveness and planning performance. Data were gathered in the context of IT planning at 29 state government agencies to investigate the hypotheses. The ideas presented in this paper are expected to stimulate practice and further research toward understanding effective IT planning actions and behaviors.

INTRODUCTION

The value of information technology (IT) in enabling firms to develop innovative products and services, enter new markets, create new distribution channels, nurture novel strategic alliances, experiment with alternative organizational forms, and "wire" together individuals, groups, and organizations to enhance the coordination of work activity within and across organizational boundaries has been well acknowledged [25]. There is a growing recognition that success in leveraging IT capabilities to achieve such benefits is significantly determined by a firm's competence in IT management ([7]; [8]; [13]; [21]). IT planning is one key IT management process that has received significant attention from MIS researchers and practitioners ([4]; [6]; [7]; [15]; [20]; [23]). IT planning is defined as the stream of organizational activities directed toward recognizing opportunities for IT use, determining resource requirements for exploiting these opportunities, and developing strategies and action plans for realizing these opportunities and meeting resource needs [3, p. 59]. Though a considerable volume of research has examined the nature of IT planning as well as strategic planning in general, three major motivations drive the current research.

First, the majority of the literature has focussed its attention upon the *content* of IT plans, while relatively ignoring appropriate *actions and behaviors* for conducting the IT

planning process (see [3]; [6] for good reviews). Second, though research on strategic planning has facilitated our understanding about the effects of specific planning process attributes on organizational performance ([9]; [10]; [16]; [17]), questions remain regarding the transferability of this knowledge to management of IT planning processes. Recent writings suggest that IT planning involves three major activities: ([7]; [11]; [22]; [26]; [27]): (i) *strategic planning*, which is concerned with the competitive advantages of IT-based products and services, (ii) *applications planning*, which is concerned with the sequencing and implementation of IT applications as well as the examination of the inventory of existing and proposed IT applications, and (iii) *infrastructure planning*, which involves the building of an IT infrastructure necessary to support a firm's IT-related initiatives. On one hand, functional and line managers are viewed to be better positioned to conduct strategic and business applications planning; on the other, MIS managers are advocated as appropriate authorities for conducting infrastructure planning ([14]; [18]; [27]). The challenge in managing IT planning is provision of autonomy to these managers for conducting planning activities in their sphere of authority and influence, while simultaneously maintaining adequate coordination across the individual activities [3]. This description of IT planning underscores the significant complexity of its scope

and the necessity for examining IT planning process issues as a separate line of inquiry.

A third motivation for this research stems from questions about the choice of appropriate dependent variables for examining the impacts of IT planning process attributes. While strategic planning research has utilized organizational level performance variables, the links between IT planning actions and behaviors and these organizational outcome variables are not quite strong. One of the goals of this research is to initiate thinking about the choice of appropriate variables for examining the impacts of IT planning process attributes.

This manuscript adopts a decision-making perspective to examine the impacts of one key attribute of the IT planning process: **process comprehensiveness**. Process comprehensiveness is the "extent to which an organization attempts to be exhaustive or inclusive in making and integrating strategic decisions" [10, p. 402]. We develop a contingency model to examine the effects of process comprehensiveness on the performance of IT planning groups. The following section presents a conceptual model; next, we report upon a research project that attempted to test hypotheses derived from this model.

A CONTINGENCY MODEL FOR EXAMINING THE EFFECTS OF PROCESS COMPREHENSIVENESS

The decision-making perspective views a planning process as a group decision-making activity involving decisions about strategic, applications, and infrastructure plans ([20]; [22]). This perspective is instrumental in identifying three major impediments to the effective decision-making performance of IT planning groups: environmental **complexity**

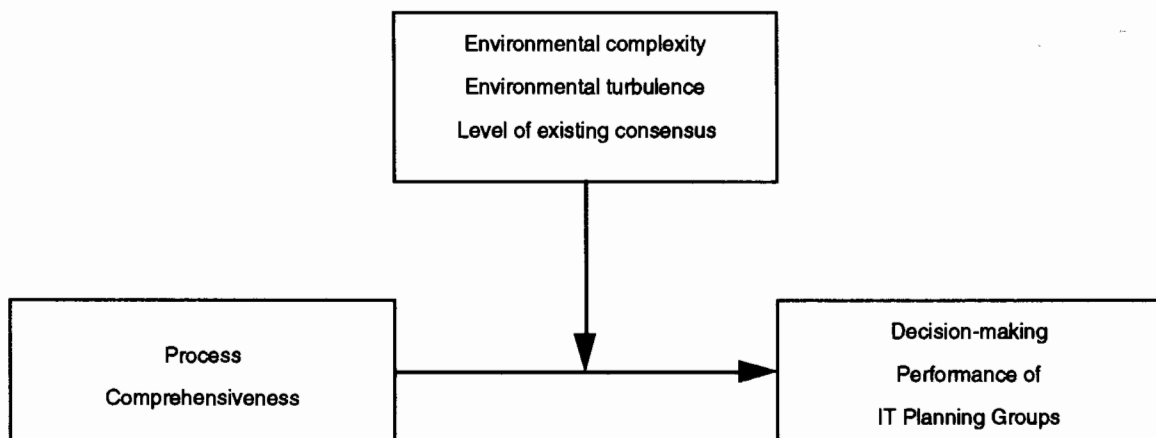
and **turbulence** and **existing consensus** on IT issues. Process comprehensiveness enables planning groups to respond to these impediments. Figure 1 illustrates the conceptual model for this research.

Frederickson (see [9]; [10]) suggested the idea of process comprehensiveness as a major characteristic of planning processes; it reflects a planning group's position on a continuum represented by the synoptic planning approach at one end ([2]; [12]) and the incremental planning approach at the other end ([16]; [17]).

High comprehensiveness is synonymous with the synoptic model and involves a comprehensive acquisition and exhaustive evaluation of information about strategic alternatives and integration of the individual plans into an overarching organizational plan. Planning groups, characterized by high comprehensiveness, utilize extensive analyses, draw upon people with diverse backgrounds as well as persons from outside the organization to ensure a comprehensive generation of alternatives, emphasize the use of documented criteria for evaluating alternatives, use formally scheduled meetings, and prepare contingency plans for a wide range of scenarios ([2]; [10]; [12]). Central to high comprehensiveness is the emphasis upon the use of carefully documented rules and procedures for planning.

Low comprehensiveness implies an incremental approach where plans evolve through trial-and-error procedures ([16]; [17]). This approach is based on the recognition that the bounded rationality of individuals limits the range of alternatives they can examine before formulating strategies. Few attempts are made to integrate individual plans into an overarching organizational plan. With low process comprehensiveness, planning groups pursue behaviors such as reliance upon the ideas, expertise, and experiences of a few

Figure 1
Conceptual Model for this Research



members, identification of satisfactory rather than comprehensive solutions, less emphasis on detail and overall integration of plans, and iterative development of plans. Such an emphasis reduces demands for information and recognizes the costliness of analysis. The incremental approach also favors an emphasis upon ideas and interpretations, rather than upon existing rules and procedures, for diagnosis of the planning issues. Planning groups focus their attention upon the interpretations proposed by various members, test out each interpretation, and develop their understanding in a trial-and-error, iterative manner.

Contingency Factors

Figure 1 illustrates three key contingency factors: (a) environmental **complexity and turbulence** and (b) level of **existing consensus** on IT issues. Complexity and turbulence affect the nature of decision-making processes in organizations. Complexity is reflected in the number of stakeholders to whom groups must attend, whereas turbulence is related to the frequency and unpredictability of changes in stakeholder expectations. Complexity and turbulence pose problems of uncertainty and equivocality and hamper planning groups' attempts to develop an accurate understanding of the critical planning issues [5].

High levels of complexity and turbulence present high uncertainty and equivocality. Uncertainty manifests itself in the lack of adequate information about IT planning issues, whereas equivocality manifests itself in the form of an inadequate understanding about planning issues. Planning groups attempt to cope with the effects of high complexity and turbulence through sense-making and interpretation behaviors [5]. Here, existing knowledge bases, analytical procedures, and existing formal planning practices are often inappropriate, forcing the planning group to adopt an iterative, trial-and-error approach to IT planning. Members formulate initial interpretations and then share them with other members in an attempt to develop a shared group understanding of the planning situation. Prior research in strategic planning suggests that low process comprehensiveness is appropriate for guiding the decision-making activities of planning groups under conditions of high environmental complexity and turbulence [10]. Low process comprehensiveness places few heroic demands on the cognitive capabilities of planning groups and enhances groups' ability to accurately interpret the planning issues.

On the contrary, with low complexity and turbulence, planning groups experience lower levels of uncertainty and equivocality. As a consequence, existing knowledge bases, analytical routines, and formal planning approaches are likely to be suitable for guiding the decision-making activities of IT planning groups. Research evidence exists that high process comprehensiveness permits planning groups to develop the

appropriate understanding about IT planning issues [9]. Thus, we state the following hypotheses:

Hypothesis 1a Higher performance will be observed when IT planning groups adopt high (low) process comprehensiveness under conditions of low (high) environmental complexity.

Hypothesis 1b Higher performance will be observed when IT planning groups adopt high (low) process comprehensiveness under conditions of low (high) environmental turbulence.

Sambamurthy et al. [22] suggest that the level of **existing consensus** over key IT planning issues is another factor moderating the relationship between process comprehensiveness and the decision-making performance of IT planning groups. The level of existing consensus refers to the extent to which members share the same goals, priorities, and preferences relative to the organizational use of IT. For example, disagreements may arise about how much organizational resources to allocate toward acquiring, evaluating, and integrating new technologies. While IS managers may push for increased allocation of resources toward new technologies in order to avoid obsolescence of the current technology infrastructure, concerns among line managers over the quality, capacity, and availability of current technologies or applications may cause them to favor more allocation of resources towards the maintenance of current technologies. In such a context, the planning group may experience low levels of existing agreement over IT planning issues. The level of existing agreement influences the likelihood that IT planning group members will share common views about the content of IT plans. Higher decision-making performance results when the IT planning group is able to surface differences in viewpoints and understanding about important planning issues, thoroughly examine the merits of alternative viewpoints, and develop consensus regarding these issues. IT planning groups characterized by low levels of initial consensus face increased pressures to reach agreement and require planning processes that support bargaining, negotiation, and integrative problem solving.

Prior research has both argued and demonstrated that a low process comprehensiveness or an incremental planning approach permits the accommodation of conflicting viewpoints through a process of bargaining and negotiation and partisan mutual adjustment ([17]; [24]). In particular, Van de Ven [24] notes, "... it is unlikely that bargaining and negotiation can occur among partisan decision makers unless small tentative steps are taken" (p. 763). On the contrary, high comprehensiveness may be most suitable when high levels of existing consensus exist regarding IT planning issues as planning groups are more able to utilize rule-bound planning approaches for integrating the views of various

group members into a comprehensive IT plan. As fewer occasions for disputes over the form and content of IT plans are likely to arise, less need exists for the facilitation of bargaining and negotiation. This leads to the following hypothesis:

Hypothesis 2 Higher performance is likely to result when IT planning groups use high (low) process comprehensiveness under conditions of high (low) levels of existing consensus on IT planning issues.

RESULTS

The above hypotheses were evaluated through data gathered on IT planning processes at state agencies in a large southeastern state. The details of the research method, including the selection of site for conduct of the research, measurement strategies, and analysis strategies are outlined in the technical appendix at the end of the article. Table 1 presents a summary of the results. The results of the study provided strong support for Hypothesis 1a regarding the moderating effects of environmental complexity. Subsequent analysis revealed that the direction of the significant interaction effects was consistent with the hypothesis. No significant support was observed for the corresponding relationship regarding environmental turbulence (Hypothesis 1b) or the level of existing consensus (Hypothesis 2).

The nature of our research context and the items used to operationalize measures of turbulence provide one possible

explanation for the lack of significant results about its moderating effects. We measured turbulence as the extent of changes in demands imposed by clients, suppliers, vendors, whereas we measured complexity as the extent of demands placed by legislature, governor's office, and federal agencies.¹

Our knowledge of the research context suggests that the problems of uncertainty and equivocality posed by complexity are pervasive throughout the agency. For example, demands imposed by the governor's office affects the entire agency; hence, the IRM planning group has to rely upon process comprehensiveness as a means for handling the effects of complexity. On the other hand, even high levels of turbulence can be managed in a segmented fashion, depending upon whether the changes in demands originate from clients, suppliers, or vendors. Thus, it is quite possible that an IRM planning group can cope with the effects of turbulence through delegation of responsibilities for information acquisition and trial development of understanding without necessarily having to rely upon process comprehensiveness entirely as a coping strategy. Thus, in our research context, it appears that process comprehensiveness is a more appropriate strategy for handling complexity rather than turbulence. Future research in other contexts could further examine the moderating effects of turbulence.

Regarding the lack of effects due to level of existing consensus, our instrument for assessing the level of existing consensus emphasized the extent to which planning group members enacted similar views of the organization's IRM

Table 1
Summary of the Study's Result

Hypothesis	Description	Effect on quality of business planning	Effect on quality of infrastructure planning
H1a	interaction between environmental complexity and process comprehensiveness	supported (t-statistic = 2.80, df=1, 23 p<.01)	supported (t-statistic = 3.27, df=1, 23 p<.01)
H1b	interaction between environmental turbulence and process comprehensiveness	not supported	not supported
H2	interaction between the level of existing agreement and the process comprehensiveness.	not supported	not supported

¹Our original instrument was designed to include the same set of stakeholders for measuring both complexity and turbulence. Factor analysis revealed that the factor comprised of the legislature, the governor's office, and the federal agencies was most dominant regarding complexity (largest eigen value and contribution to variance explained). On the contrary, the dominant factor that emerged relative to turbulence was comprised of clients, suppliers, and vendors. These differences in structures are likely to be a function of this research context.

activities, technology-based goals, objectives, needs, problems, opportunities and priorities. While these issues are important, they are more indicative of the level of ongoing harmony in the group; what we did not measure was the level of consensus regarding *specific IRM planning issues* that need to be addressed by each planning group. A focus on the specific issues facing each group may demonstrate stronger evidence of the moderating effects of the level of existing agreement. This is an agenda for future research inquiry. Further, we also strongly encourage future researchers examining this phenomena to operationalize the "existing agreement" construct along two dimensions, technological issues and business issues.

CONCLUSION

The significant implication of this paper is the empirical support for process comprehensiveness as a crucial element of the conduct of IT planning processes. The results suggest that the level of process comprehensiveness should be tailored to the level of complexity of the planning issues facing IT planning groups. This suggests that when organizations face complex demands from a variety of stakeholders, their IT planning processes should emphasize less reliance on formal rules and procedures and exhaustive gathering of information and analyses. A preferred strategy would be to utilize a small planning group with its members carefully chosen for their knowledge and expertise about the specific IT planning issues, rely upon the ideas and expertise of these few members, focus on satisfactory rather than comprehensive solutions, and emphasize a lower amount of detail in the plans.

The paper applied a decision-making perspective of the IT planning process to develop a contingency understanding of the effects of process comprehensiveness on planning groups' performance. The decision-making perspective has shown quite promise in research on the process of strategy formulation ([9]; [10]). While Sabherwal and King [20] have applied this perspective to the process of IT planning, they did not include a direct measure of planning performance. Our research extends their research by including a direct measure of IT planning quality. We recognize that our operationalization of plan quality as a measure of planning performance has certain important limitations. For instance, such a measure is more closely tied to the nature of the document produced in the planning process rather than the information products and services, that are ultimately installed, and their ultimate impacts on organizational performance. Planning has often been criticized for its preoccupation with documents and rituals and for not being closely allied with innovative activities in organizations [17].

Despite the above limitations, for reasons discussed in

an earlier section, we view plan quality to be an appropriate dependent variable for research on IT planning. However, an exciting challenge for researchers is to develop conceptual argumentation and empirical support for alternative measures of planning performance that reflect both the content and process of IT planning. We are currently engaged in such an effort.

Another significant limitation of our research is related to the context, viz. the use of state government agencies as the targets of our inquiry. We recognize that public agencies may not completely share all the characteristics of private sector firms, which are most often the target of research studies on IT planning. A related limitation is the fact that our study is based on a sample size of 29 agencies. *Prima facie*, the sample size could be a major limitation. However, as discussed before, a significant strength of this study is the tight control over variations in planning methodologies and organizational contexts.

Overall, we believe that the paper contributes to the small, but growing, volume of research aimed at examining the conduct of IT planning processes. Despite many concerns, the IT planning literature has neglected its attention toward actions, behaviors, and practices that lead to successful IT planning performance [3]. Further, the limited writings that do address IT planning processes are often constrained by their underlying assumptions: (a) that the environments are relatively stable and that IT planners in organizations will not face severe problems in learning; (b) that a centralized planning process with some involvement by business unit managers should always be appropriate; and, (c) that individuals are responsible for performing IT planning at routine intervals of time, using well-documented methods and analysis routines. However, with information technologies becoming more deeply embedded within organizations' value chain activities, individual business units are gaining control and seeking more autonomy in their management of IT resources, and IT planning is being performed by a wide variety of groups constituted of representatives from the corporate IS staff and individual business units. Newer and more appropriate models of designing IT planning systems are needed. In this context, the variety of IT planning activities (strategic, applications, and infrastructure planning) and the need for involvement of multiple actors (corporate IS, divisional IS, and line managers) presents a demand and fertile opportunities for research on conduct of the IT planning processes. We hope that our research has stimulated interest and offered some guidance in this regard.

TECHNICAL APPENDIX

The Research Method

Two key concerns guided the design of our research

strategy for testing the hypotheses. First, since a variety of planning methodologies are utilized for the conduct of IT planning in organizations [11], we were concerned that the nature of the specific methodology employed could affect the outcomes of the planning process. Thus, our research design strives to control for the effects due to variations in the planning methodologies. Second, in order to test the hypotheses, we were interested in a research site and a design that would enable us to obtain meaningful, comparable measures of the performance of IT planning groups.

Research Context

The specific setting chosen for the conduct of our empirical investigation was the Information Resources Management (IRM) planning activities of the offices of state attorneys and public defenders within a single, large southeastern State. This State government has received national recognition for its efforts to coordinate information resources across agencies [1]. A major step in this effort was the establishment of the Information Resource Commission (IRC) in 1983. The IRC's responsibilities include overseeing information resource planning and policy development through, among other vehicles, (1) development of uniform policies, procedures, and standards for IT planning, which is referred to hereafter as *IRM planning* in order to remain consistent with the terminology used by the State, (2) provision of planning consultants to agencies, (3) review and approval of the IT plans and budgets developed by agencies, and (4) identification of opportunities for, and coordination of initiatives involving, multi-agency use of specific IT resources. Each agency is assigned an IRC planning consultant, who is then responsible for providing direction and assistance regarding that agency's IRM planning efforts. In addition, each agency designates a senior executive as that agency's Information Resources Manager (IRMGR), whose responsibilities include "shepherding" the IRM plan through the agency. The IRMGR facilitates development of the agency's plan through the involvement and consultation of key personnel (constituting the IRM planning group) within the agency. State law requires each agency to participate in a rolling, two-year planning cycle and requires the IRC to review agency plans against statutory criteria. A planning cycle begins with the issuance of planning instructions in the November of each odd-numbered year. The planning methodology advocated by IRC provides a template for all agencies to conduct their IRM planning process; however, individual agencies exercise discretion in their planning actions and behaviors. That this would be the case is not surprising as many of the State's agencies differ significantly in terms of their "business"

environments, organizational structures, management cultures, extent of IT usage, and organizational histories. However, since all agencies are required to follow the IRM planning methodology developed by the IRC, we are able to control the effects due to variations in planning methodologies.

Further, we narrowed our research attention to the IRM planning process within the 40 offices of state attorneys and of public defenders. Consultations with the senior IRC managers revealed that these agencies were fairly homogeneous in terms of their internal operations and underlying motivations for IT use. Discussions with the IRC managers revealed that other agencies were either quite large in size or fairly idiosyncratic in their IT use; we were concerned that the organizational context in these agencies would confound the nature of our study. Further, one IRC consultant was assigned to provide guidance and direction in IRM planning for all the 40 offices. By limiting our attention to these agencies, we could also control for effects due to differences between individual IRC consultants.

Research Strategy

The study was done in three phases: the first two phases involved administration of questionnaires mailed to agency IRMGRs in the 40 offices of public defenders and state attorneys, while the third phase involved evaluation of decision-making performance of the IRM planning groups from these agencies. The agency IRMGRs, viewed as key informants for the IRM planning processes in their agencies, were identified in consultation with a senior executive responsible for coordinating the IT initiatives of all the 40 agencies. These IRMGRs were then recruited for participation by one of the authors at two joint meetings of IRMGRs.

The first questionnaire, sent to the IRMGRs at the beginning of the IRM planning cycle, was designed to elicit responses regarding contextual and pre-cycle organizational variables. The second questionnaire was administered toward the end of the planning cycle and tapped responses regarding specific contingent and structural planning mechanisms employed during the planning cycle that had just concluded.²

Completed copies of the two questionnaires were received from 29 of the 40 agencies (a response rate of 73%). Finally, data on organization size and the quality of each agency's submitted IRM plan was gathered from IRC consultants.

² Copies of the two questionnaires can be obtained upon request from the first author.

Measurement of Variables

Performance, the dependent variable in this research, was measured through the use of the IRC consultant as an expert for evaluating the quality of IRM plans produced by individual agencies. A substantial volume of research on group decision-making indicates that decision-quality is one of the salient outcomes associated with the nature of the decision-making process. During the IRM planning cycle under investigation, the quality of IRM plans is expected to reflect the effects of process comprehensiveness. Admittedly, the ultimate outcome sought for IT planning is improved organizational performance. As we argued in this manuscript, such outcomes are quite distant in a causal sense from IT planning processes. IT plan quality has a very direct

causal relationship with the nature of the IT planning process. And, as these IT plans are used to justify these agencies' annual budget authorizations, there is an instrumental reason to expect a relationship with agency performance.

Higher quality IRM plans explicitly address issues across the business and technology domains and balance the conflicting concerns over IT issues within an agency. Since a single IRM consultant was formally assigned to all the 40 agencies examined in this research, the services of this consultant were used for evaluating the quality of IRM plans. Through discussions with this and other IRC consultants, a questionnaire was developed to tap various dimensions of IRM plan quality. The questionnaire contained 14 items with each item evaluated on a 5-point Likert scale. These evalua-

Table 2
Measurement Schemes for Key Variables

Variables	Items ¹	Reliability ²
Process comprehensiveness ⁴	Approach employed in: * determining the cause of major planning problems * generating alternatives * evaluating particular actions	.83
Quality of IRM Plan³		
a. Business planning	* clarity of strategic direction * reference to other planning processes within agency * joint attention to business and IT capabilities * futuristic orientation * cost-benefit justification of IT applications	.82
b. IT infrastructure planning	* clarity of IT infrastructure direction * identification of resources and databases required for implementation of IT applications * identification of critical success factors for IT applications	.80
Moderating Factors		
a. Environmental complexity	Extent of demands placed by: * legislature * governor's office * federal agencies	
b. Environmental turbulence	Changes in demands placed by: * clients * suppliers * vendors	.70
c. Level of existing consensus	* agreement on IRM needs, opportunities, and problems * pursuit of same goals and objectives * sharing of same IRM priorities	.91

¹ all items measured using a five-point Likert scale

² indicated by using Cronbach's alpha as the criterion

³ measured through expert evaluation; all the other variables measured through a questionnaire

⁴ questionnaire adopted from Frederickson and Mitchell (1984), Frederickson (1984)

tions were factor analyzed and produced two dimensions of IRM plan quality (Table 2): *quality of business planning* and *quality of IT infra-structure planning*. Notice that these measures represent the business and the technology domains of IT planning that were mentioned earlier in this paper. A copy of the instrument can be obtained from the first author.

Process comprehensiveness was measured through a three-item questionnaire adapted from the work of Frederickson ([9]; [10]). The three items tap characteristics of the approach employed in determining the cause of major planning problems, generation of alternatives, and evaluation of particular actions. The items comprising this scale and the scale reliabilities are displayed in Table 2.

Environmental complexity and turbulence and the level of *existing consensus* were measured through items refined from instruments used in earlier research [19]. The items comprising each scale and the scale reliabilities are shown in Table 2.

Control variables. Three different control variables were included into the research model in order to isolate their possible influences on the quality of IRM plans: *size*, *earliness of IT adoption*, and *extent of IT infusion*. Several authors have recommended that organizational size could affect the conduct of planning processes [16]. Organizations characterized by greater *size* generally possess more numerous resources, including those associated with IRM planning. Pugh, Hickson, Hinings, and Turner (1969) advocate the use of number of employees as one of the measures of organizational size. Thus, size was measured as a headcount of the number of personnel in the individual agencies (a logarithmic transform of size was used in order to ensure distribution normality).

Earliness of IT adoption assessed the innovation adoption behaviors of the agencies with respect to micros, database management systems, information centers, database administration, local area networks, and electronic mail technologies. High earliness of adoption signals that the agency has accumulated IT-related knowledge and expertise that may be reflected in the quality of its IRM plans. Thus, we deemed it important to control for this variable. The scale was adopted from earlier research by Rockness and Zmud [19]. Respondents were presented with a timeline from pre-1982 to 1990

and asked to circle the year when each innovation was installed in their organization. These responses were transformed to a five-point Likert scale that assessed the relative earliness of adoption of each innovation³ (Cronbach's alpha=.84).

Extent of IT infusion refers to the degree to which an agency has integrated its activities on the platform of specific information technologies. High IT infusion implies that the agency has deeply infused IT within its core activities and developed extensive capabilities for handling IT activities, including IRM planning. The scale was again based on earlier research by Rockness and Zmud [19]. The scale focused upon the extent to which agencies had infused database management systems, interactive applications, and local area networks into their core operations (Cronbach's alpha=.65). While this scale reliability is marginally below Nunnally's recommended value of .70, the variable was still included in order to generate insights that can trigger future research with more rigorous instrumentation.

Analysis and Results

Table 3 provides summary statistics on the study variables. As size and extent of IT infusion were significantly correlated with the dependent variables, they were included in the subsequent analyses as control variables. Though Table 3 depicts the presence of correlations between certain predictor variables, the manner in which these variables were actually used in the regression models obviated major concerns about multicollinearity.

In order to examine the hypotheses, two separate sets of regression equations were constructed, one each for the quality of business and infrastructure plans as dependent variables. For each dependent variable, the following regression model was used for hypothesis testing:

where,

Y_{1i} = quality of IRM plan in *i*th agency (business or infrastructure)

X_{1i} = size (log) of the *i*th agency

X_{2i} = extent of IT infusion at the *i*th agency

X_{3i} = environmental complexity at *i*th agency (Hypotheses H1a)

³ The transformation was achieved as follows: First, standardized z-scores were computed for the adoption behavior at each agency with respect to each technology, where

$y_{it} = (t_{it} - t_{.}) / sd_{it}$
with y_{it} = year in which agency *i* adopted technology *t*,
 $t_{.}$ = mean year in which the study's sample of agencies adopted technology *t*, and
 sd_{it} = standard deviation of the responses for technology *t*.

The highest negative z-score indicates early adoption of that technology relative to other agencies in the sample and, hence, deserves the highest score on the earliness of IT adoption scale (value=5). The highest positive z-score indicates late adoption of that technology relative to other agencies in the sample and, hence, deserves the lowest score on the earliness of IT adoption scale (value=1). Intermediate z-scores were interpolated between these two scale ends. Next, the scores of earliness of IT adoption thus derived were subjected to factor and reliability analysis to assess unidimensionality of the measures.

Table 3
Summary Statistics on Study and Control Variables

	Mean	Standard Deviation	Correlations								
1. Complexity (COMPL)	2.30	.87									
2. Turbulence (TURB)	2.57	.89	.17								
3. Agreement (AGREE)	4.18	.75	.34*	.02							
4. Comprehensiveness (COMPRES)	3.18	.94	-.42*	-.31*	.05						
Quality of IRM plans											
5. Business Planning (QUALIT1)	3.21	.60	.05	.47***	-.21	-.31					
6. Infrastructure Planning (QUALIT2)	3.36	.65	-.10	.14	-.14	.02	.67***				
Controls											
7. Earliness of IT adoption	1.30	.61	.005	.04	.03	-.25*	.006	-.21			
8. Extent of IT infusion	2.47	1.13	.10	.62***	-.13	-.22	.46**	.26*	-.06		
9. Size (log)	2.07	.32	.06	.02	.03	-.007	.04	.32*	.06	.38*	

* p<.10 ** p<.01 *** p<.001

environmental turbulence at ith agency (Hypotheses H1b)

level of existing consensus in ith agency (Hypothesis H2)

X₄₁ = process comprehensiveness at ith agency (Hypotheses H1a, H1b, H2)

The detailed results of the regression models are available from the first author. In order to overcome statistical problems of potential multicollinearity between the main and interaction terms in these regression models, attention was focussed upon the values and the statistical significance of this value as each set of independent variables was hierarchically entered into the regression equation. A significance level of .05 was chosen as evidence supporting the existence of hypothesized effects.

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