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Impact of Environmental Uncertainty and Task Characteristics on User Satisfaction with Data

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Today, more than ever before, organizations are faced with the task of processing volumes of information under more uncertain and more competitive environments. This study investigates the impact of environmental uncertainty and task characteristics on user satisfaction with data by using IS and organizational theories. Responses were matched from 77 CEOs and 166 senior managers, who were end users of IS. The partial least squares technique indicated that environmental uncertainty has a positive impact on task characteristics. Task characteristics have a direct and mediating impact on user satisfaction with data. Our findings also demonstrated that user satisfaction with data could be better understood by overlapping IS and organizational theories, rather than by treating the subject matter in disjoint fields. The paper concludes with discussions and implications for researchers and practitioners.

Key words: environmental uncertainty; task characteristics; task technology fit; user satisfaction
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1. Introduction

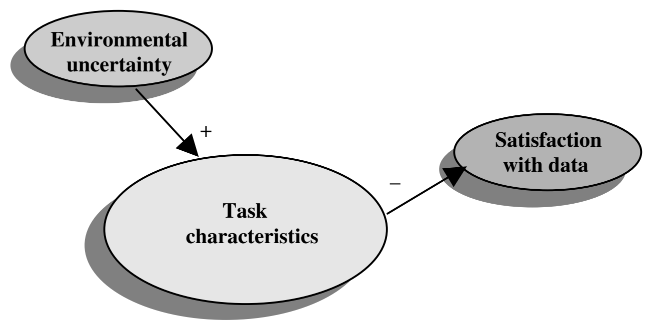
Firms in every industry have encountered increased environmental uncertainty and rapid changes in their external environments (Castrogiovanni 2002). In some industries, the rate of competitive and technological change has been so extreme that the cost of a single decision error has triggered a company's failure. D'Aveni (1994) terms this competitive environment hyper competition. "The frequency, boldness, and aggressiveness of movement by [industry] players," he writes, "creates a constant state of disequilibrium and change. Market stability is threatened by short product life cycle, short product design cycles, new technologies, frequent entry by unexpected outsiders ... In other words, environments escalate toward higher and higher levels of uncertainty, dynamism, heterogeneity of the players, and hostility" (pp. xiii–xiv).

To be effective, organizations must tolerate and manage uncertainty. To cope with environmental uncertainty, firms are investing heavily in information technologies (IT) to increase their information processing capacity and their flexibility to adapt to environmental changes (Watson and Fenner 2000, Wilder 1999). Organizational theories have suggested that organizations succeed or fail due to their managers' decisions, which are based on their own perceptions and interpretations of the organizations' environments (Chenhall and Morris 1986). In high-uncertainty environments, organizational decisions may produce many errors, and organizations may make mistakes simply because managers cannot determine or predict which alternative will solve a problem (Daft 2001, Schoemaker 1993).

Several researchers have stressed the influence of the firm's environment on information systems (IS) requirements (Allen and Boynton 1991, Gordon and Narayanan 1984, Sambamurthy 2000), on user evaluations of IS and IS use (Lederer and Mendelow 1990), on IS success (Sanders and Courtney 1985, Yaverbaum 1988), and on technology-structure relationships (Miller et al. 1991). Environmental uncertainty, however, has been overlooked in most empirical studies that examine the IS implementation process (i.e., initiation, adoption, and adaptation) and user behavior and perceptions (i.e., acceptance, intention to use, use, and user satisfaction) (Larsen 2003). This is a serious lapse in IS research because (1) user behavior and perceptions can change with changes in organizational task environments over time, and (2) IS implementation impacts user task, interorganizational relations, user behavior and perceptions, and individual and organizational performance. However, technologies are social and physical artifacts that represent particular sets of choices made by designers at a point in time (Bucciarelli 1994). By the time systems are developed, decision makers may face more uncertain environments related to changes in competitive and economic markets (due to the regulatory or legislative changes or new terrorism threats for example). By not considering uncertainty, designers may never be adequately prepared to account for it in advance in the IS implementation process.

Two important research questions have been neglected: Does environmental uncertainty impact users' task characteristics? And, do task characteristics mediate the impact of environmental uncertainty on user satisfaction with data? This study attempts (1) to provide common definitions and assumptions for studying the relationship between IS and the organizational environment, and (2) to investigate how environmental factors may influence the design, use, and consequences of IS use. By including environmental factors, the present study attempts to forge links with other contextual factors used in organizational and behavioral research, thereby connecting organizational theories with IS research, which is viewed as a matter of critical importance (Orlikowski and Barley 2001). Figure 1 illustrates our research model. In this model, we suggest that an increase in environmental uncertainty is related to managers' experiencing more nonroutine and interdependent tasks, which will result in lower user satisfaction with data. Further, task characteristics mediate the impact of environmental uncertainty on user satisfaction with data.[1]

Figure 1 Research Model



We discuss theory development in the following section and provide arguments that motivated this study. Section 3 presents hypotheses development. Section 4 provides research methodology and the measurement of research variables. Section 5 provides our analysis and results. Section 6 presents discussions and implications. Lastly, §7 presents conclusions and limitations.

2. Theoretical Development

2.1. Organizational Theories

According to the *information processing view,* organizations process information to reduce uncertainty and equivocality, and their effectiveness depends on their capacity to process information and match their information processing capacities with the uncertainty and equivocality they face (Daft and Lengel 1986, Galbraith 1974, Tushman and Nadler 1978). Three sources of organizational uncertainty and equivocality are associated with the analyzability of cause-effect relationships in managerial tasks, interdepartmental relations, and environment (Tushman and Nadler 1978, Daft and Lengel 1986). *Uncertainty* is associated with an absence of information. Uncertainty leads to acquisition of more data and results in the inability to confidently assign probabilities about how environments will affect the success or failure of

[1] Although practitioners differentiate data from information intuitively, and describe information as data that has been processed in some manner, in this article we use data and information interchangeably.

a decision-making task (Nadler and Tushman 1988, Milliken 1987). *Equivocality* refers to ambiguity, lack of understanding, and the existence of multiple and conflicting interpretations about an organizational situation. Equivocality leads to an exchange of existing views among managers about how to define problems and to resolve conflicts (Daft and Lengel 1986). Information processing must meet the dual needs of equivocality and uncertainty reduction (Daft and Lengel 1986). Firms in uncertain environments require a greater amount of information processing, and, in turn, decision makers in these firms need more data to reduce uncertainty. To reduce equivocality, they need various structural mechanisms for coordination, control, and generation of rich information (Daft and Lengel 1986). Under conditions of high equivocality, there is no basis to forecast the future, and managers exchange opinions using rich media (e.g., group meetings, direct contact, planning) to clarify ambiguities, define problems, and reach agreement (Daft and Lengel 1986). According to the *decision-making paradigm* of organizational design, decision-making tasks are the central activities of organizations, and environmental uncertainty impacts the urgency, frequency, complexity, and outcome of the decision-making tasks (Huber and McDaniel 1986).

Organizational task environments are sources of uncertainty. They include all the sectors with which organizations interact directly and have the potential to impact organizations' ability to achieve their goals (Dess and Beard 1984). These sectors typically include industry, market sectors, raw materials, human resources, and, perhaps, international sectors (Daft 2001). They affect the needs for information from the environment and the resources in the environment. Such needs impact decisions to acquire more data and to devise structural mechanisms for differentiation and integration in departments, control processes, future planning, and forecasting (Daft 2001). Organizational task environments also impact managerial perceptions of the environment (Jauch and Kraft 1986, Randolph and Dess 1984, Thompson 1967). These perceptions significantly impact the psychological states and cognitive processes of decision makers; they influence both the decision makers' assessment of uncertainty and equivocality, and their reactions to these factors (Daft and Lengel 1986, Gerloff et al. 1991, Jauch and Kraft 1986, Milliken 1987). The greater the complexity and uncertainty in organizational task environments, the more frequent, fast, and complex will be the organizational decision-making tasks, which cause the information acquisition to be more continuous, variant, and wide ranging (Huber 1984).

2.2. Task Characteristics

The uncertainty and ambiguity that confronts managers in organizations will impact their tasks requirements (which may be unexpected, constantly changing, difficult to analyze, and interdependent) and the technology required for processing information. According to Daft and Macintosh (1981), *task variety* is the frequency of unexpected and novel events that occur in performing a task. Low task variety implies that decision makers experience considerably low uncertainty about the occurrence of future activities. On the other hand, high variety implies that decision makers typically cannot predict problems or activities in advance. *Task difficulty* refers to the way individuals respond to problems that arise and refers to the degree to which a decision maker lacks a formal, well-defined search procedure to solve a given problem (Larsen 2003, Van de Ven and Delbecq 1974). It also refers to the analyzability and predictability of work undertaken by an organization unit (Van de Ven and Ferry 1980). In practice, task variety and difficulty are correlated and difficult to distinguish, so they have been combined into a single dimension of *task nonroutineness* (*routine versus nonroutine*) (Daft and Macintosh 1981). In addition, *task interdependence* is defined as an exchange of output that takes place between segments within a subunit and/or with other organizational units (Fry and Slocum 1984). Uncertainty and equivocality increase task interdependence because action by one department can unexpectedly force adaptation by other departments in the production chain (Daft and Lengel 1986). High interdependent tasks require more data and a rich information exchange to clarify task assignments, develop effective task performance strategies, make decisions, and obtain performance feedback (Andres and Zmud 2002).

2.3. User Satisfaction
User satisfaction is "the affective attitude towards a specific computer application by someone who interacts with the application directly" (Doll and Torkzadeh 1988, p. 261). Factors influencing user satisfaction are often difficult to isolate due to their complex interrelationships (Zviran and Erlich 2003), and the fundamental similarity of user satisfaction and user attitude (Melone 1990). Nevertheless, prior research identified user involvement, belief, attitude, the quality of information received from the IS, IS features, and IS support and services as key factors for assessing user satisfaction (Bailey and Pearson 1983, DeLone and McLean 2003, Goodhue 1995, Ives et al. 1983, Jiang et al. 2002, Pitt et al. 1995, Zviran and Erlich 2003).

3. Hypotheses Development
Environmental uncertainty has been described as the degree to which an environment is stable-unstable, simple-complex, and concentrated-dispersed (Aldrich 1979). Using industrial classification data, these dimensions were measured by *dynamism* (stability-instability, turbulence), *homogeneity-heterogeneity* (complexity, concentration-dispersion), and *hostility* (capacity, munificence) of the organizational task environments (Dess and Beard 1984). While the concept of uncertainty, itself, has undergone additional development (Priem et al. 2002), and different authors have used different dimension labels, the three-dimensional triad remains intact (Castrogiovanni 2002).

The *stable-unstable dimensions* refer to whether the elements in organization task environments are dynamic. With unstable conditions, organization task environments shift abruptly, and competitors react with aggressive moves and countermoves regarding advertising and new products. *Dynamism* is characterized by the rate of change and innovation in production and service technologies, as well as the uncertainty or unpredictability of customer taste and actions by the firm's principal industries. Firms in more unstable environments face a number of similar external elements that change frequently and unpredictably. Environmental dynamism makes managerial planning and control difficult due to low task predictability. For example, subunits that face unpredictable change may find that static budgets become ineffective control devices because initial standards rapidly become outdated (Chenhall and Morris 1986). In dynamic task environments, decision makers must cope with unpredictable external events and must seek to integrate and continuously improve operating processes (Daft et al. 1988). To succeed, decision makers need detailed, timely information that allows them to coordinate the flow of activities and provides them, at all levels in the organization, with a thorough understanding of process dynamics and their relationship to both local and organizationwide performance. As environmental uncertainty increases, interdependent tasks become more important due to the increased need for coordination to resolve equivocality and the need to link an organization with the key elements in its task environments to detect, bring, and send information about changes in the environments (Maier et al. 1997, Schwab et al. 1985). Therefore, one would expect under more dynamism, decision makers would be more likely to face a higher frequency of nonroutine and interdependent tasks.

Hypothesis 1a (H1a). *Higher levels of dynamism in the organizational task environments will increase the nonroutineness of the assigned tasks.*

Hypothesis 1b (H1b). *Higher levels of dynamism in the organizational task environments will increase the interdependence of the assigned tasks.*

The *simple-complex dimensions* concern environmental complexity and refer to *heterogeneity*, which is the degree of similarity or differentiation within the organization task environments (Hall 1999). Firms in heterogeneous environments face numerous distinctive elements that remain the same or change slowly and require very different marketing, production, and administration practices (Daft et al. 1988, Miller and Friesen 1983). Organizations with heterogeneous task environments have a greater need for information processing to reduce uncertainty and equivocality (Daft and Lengel 1986). The decision makers in these organizations need to see the effect of their decisions and actions and to understand how their actions will influence interrelated activities across boundaries within their organization and across organizational boundaries. For equivocality resolutions, by using judgment or trial and error to solve decision-making problems, decision makers will likely face many nonroutine and interdependent tasks in building coalitions, exchanging information, and establishing goals and priorities (Chidambaram and Jones 1993). One would expect, then, that under more heterogeneous environments, decision makers are more likely to face a higher frequency of nonroutine and interdependent tasks.

Hypothesis 2a (H2a). *Higher levels of heterogeneity in the organizational task environments will increase the nonroutineness of the assigned tasks.*

Hypothesis 2b (H2b). *Higher levels of heterogeneity in the organizational task environments will increase the interdependence of the assigned tasks.*

The *concentrated-dispersed dimensions* refer to scarce material and financial resources and the need to ensure the availability of resources. It uses a resource-dependence perspective, focuses on environments' restrictiveness, and refers to both availability of resources and the degree of competition for these resources. *Hostile task environments* are characterized by severe regulatory restrictions; a harsh and overwhelming business climate; intense competition in price, product, technology, and distribution; a shortage of labor or raw materials; and the relative lack of exploitable opportunities and resources (e.g., the drying up of markets; Miller and Friesen 1983, Mintzberg 1979). Thus, under more hostile environments, decision makers face a greater frequency of change and need greater environmental scanning for more data (Maier et al. 1997), exploration (e.g., search, variation, risk taking, innovation, discovery) and exploitation (e.g., refinement, choice, efficiency, selection, implementation, execution) (March 1991). When hostility creates a threat to an organization's primary goals, to better understand its task environments, reduce uncertainty and equivocality, and ensure access to scare resources, the organization's responses can be in the forms of greater integration and coordination and establishing favorable linkages with key elements of its task environments. These are accomplished by joint ownership, contract, joint ventures, cooperation, interlocking directorates, executive recruitment, advertising, and public relations (Daft 2001). Therefore, one would expect that the greater the magnitude of hostility in the environment, the greater the frequency of nonroutine and interdependent tasks.

Hypothesis 3a (H3a). *Higher levels of hostility in the organizational task environments will increase the nonroutineness of the assigned tasks.*

Hypothesis 3b (H3b). *Higher levels of hostility in the organizational task environments will increase the interdependence of the assigned tasks.*

When decision makers are confronted with fewer unexpected problems, they experience fewer surprises. They can avoid the need to process large amounts of information and can preplan and use small sets of predictable and routine applications. However, when tasks are nonroutine, decision makers often experience unfamiliar, unexpected, and novel situations, which results in variety in the contexts of their decision-making tasks. Consequently, they will require a wide scope of information processing and sharing for decision support. As they attempt to identify, acquire, and interpret data, they find data to be inadequate, less relevant, less satisfactory, and require higher levels of sense making. Moreover, preplanning in these situations generally tends to be extremely difficult and leads to a greater need for acquiring information on an ongoing basis. Thus, it is plausible that task nonroutineness would adversely affect user satisfaction with data. Specifically, we propose:

Hypothesis 4 (H4). *Task nonroutineness has negative effects on user satisfaction with data.*

Chenhall and Morris (1986) argued that *task interdependence* leads to a heightened need by decision makers for data that are timely, have broad scope, have various forms of aggregation, and are integrated. Under increased uncertainty, decision makers need to identify, access, and integrate data from a variety of systems, or need more aggregate and summarized data (versus operational data) from common systems to support decisions (Daft and Macintosh 1981, Inmon 1996). They need to locate and have reliable access to the right level of accurate data for analysis, innovation, and decision support (Miller and Friesen 1983). However, it is likely that they will become frustrated by incompatibilities and access routines for different systems (Martin 1982). Therefore, one would expect task interdependence to adversely impact user satisfaction with data.

Hypothesis 5 (H5). *Task interdependence has negative effects on user satisfaction with data.*

4. Research Methodology

A cross-sectional field survey was conducted with data collected from profit-oriented organizations. The organizations were selected randomly from the Dun and Bradstreet Database (D&B Canada). The respondents were employed in a variety of organizations. As seen in Table 1, they represent organizations from a number of different industries. Over one-third (34%) were banking, finance, and manufacturing firms. Another 19% were wholesale, transportation, and services firms.

The perceptual data for this study was gathered through a self-administered questionnaire. Prior to mailing the questionnaires, the chief executive officer (CEO) of a large corporation (who was also the chair of the board of advisors for a business school) sent a personalized letter to the CEOs of the target organizations that explained the study's purpose and invited them to participate. Two sets of questionnaires were mailed to CEOs to distribute randomly among managers. One questionnaire for completion by the CEO and three others for completion by senior managers who were also end-users of IS. The CEOs were asked to distribute the second set of questionnaires to three senior managers and to make sure that a mix of senior managers received it. This ensured that one or more managers provided responses, minimizing the extent of common method variance bias. Although it might have been preferable if the CEO's and senior managers' questionnaires were mailed independently, this would have made the identification of senior managers difficult in each organization. Secondly, if the two sets of questionnaires had been mailed independently, the response rate for the combined final usable set (i.e., at least one senior manager and one CEO) could have been extremely low.

Table 1 Industry Type and Sales Revenue of Sample Organizations

Industry	Percent	Sales	Percent
Agriculture and forestry	4.9	Under $20M	9.8
Automotive products	2.9	$20M–$99M	50.0
Chemical and petroleum	2.9	$100M–$299M	13.7
Construction	3.9	$300M–$399M	3.9
Banking and finance	13.9	$400M–$499M	5.9
Healthcare	2.9	$500M–$599M	2.9
Insurance	3.9	$600M–$699M	3.9
Manufacturing and processing	21.4	$700M–$799M	1.0
Mining	1.9	$800M–$899M	0.0
Retail	3.9	$900M–$1B	2.0
Services	5.8	Over $1B	6.9
Transportation	5.8		100.00%
Wholesale	7.8		
Other	18.1		
	100.00%		

Questionnaires were sent to 500 CEOs and 1,500 senior managers. CEOs returned 111 completed questionnaires, and senior managers returned 199. Only a few returns were not useable (six from CEOs and nine from managers). The remaining questionnaires from 105 CEOs and 181 managers represent a response rate of 21% and 12%, respectively (105/500 and 181/1500) by company or 14.3% (286/2000) by the total number of questionnaires sent. To assess the possibility of a nonresponse bias, a chi-square test showed no significant differences between the responding and nonresponding organizations, based on industry sectors (chi-square = 25.56; d.f. = 12; $p > 0.05$) and sales revenue (chi-square = 16.23; d.f. = 6; $p > 0.05$).

4.1. Measurement and Evaluation of the Research Variables

All measures were reviewed by a panel of four academicians and pretested with a small sample of (four) CEOs to ensure that all directions and items would be clearly understood by the respondents. Questions related to environmental uncertainty were completed by the CEOs, as it was likely managers might not have an adequate understanding of their organizational task environments. Managers answered questions related to user satisfaction with data, IS, IS support, and task characteristics. Responses for the multi-items were averaged and used in subsequent analyses. The final sample consisted of 77 matched responses from CEOs and 166 from senior managers (representing a response from at least 1 manager and the CEO from any given organization).

4.2. Environmental Uncertainty

There have been many debates in the literature as to whether the environment should be treated as an objective reality or a perceptual phenomenon.

Researchers have questioned the relationship between managerial perceptions and more "objective" indicators (Sapienza et al. 1988, Dess and Robinson 1984). While some have found perceptual and objective measures to be unrelated (Downey et al. 1975, Tosi et al. 1973), others have suggested that perceptions of uncertainty, rather than actual uncertainty, are important determinants in decision making and strategy formulation (Tung 1979). Researchers have also tried, with limited success, to develop a set of conceptualizations and objective measures for the environment that are consistent with existing theory and managerial perceptions (Gerloff et al. 1991, Sharfman and Dean 1991, Dess and Rasheed 1991). In this study, we used both perceptual and objective measures to avoid problems associated with using either measure alone and to determine which one is the better predictor of task characteristics. Miller and Friesen's (1983) perceptual measures were used to measure *dynamism*, *heterogeneity*, and *hostility* (see Appendix A). Employing a variety of archival data, we applied the Dess and Beard (1984) approach to objectively measure organizational task environments.

4.3. Task Characteristics

Three dimensions of task characteristics (variety, nonroutineness, and interdependence) were measured by using previously developed items (Goodhue 1998, 1995). Following Goodhue (1995), we eliminated variety for not being measured successfully. We used questions developed by Goodhue (1995) for nonroutineness and interdependence (see Appendix B).

4.4. User Satisfaction with Data

Researchers have proposed several contingency formulations and constructs for measuring user satisfaction (Au et al. 2002, DeLone and McLean 2003, Goodhue 1998). They have employed user information satisfaction (UIS), end-user computing satisfaction (EUCS), and task-technology fit (TTF) to measure user satisfaction (Bailey and Pearson 1983, Doll and Torkzadeh 1988, Goodhue 1998). UIS is defined as the extent to which users believe that the IS available to them meets their information requirements (Ives et al. 1983). EUCS measures focus on individual end-user computing applications, while both UIS and TTF are intended to assess all systems and services in an IS department. TTF measures user satisfaction with IS and addresses technology support for managerial decision-making tasks. In this context, technology refers to computer systems (hardware, software, and data) and user support services (training, help lines, etc). Technologies are the tools used by individuals to carry out their tasks. Tasks are broadly defined as the actions carried out by individuals to turn inputs into outputs. The UIS measure captures *beliefs* and *attitudes* about IS systems and services, while TTF elicits only beliefs. Attitude has been criticized as a casual factor for measuring IS success because it does not clearly distinguish between *feelings of satisfaction* (whether an individual feels his/her personal needs are met by using a system) and *objective beliefs of satisfaction* (whether an individual believes the system is assisting him/her in performing his/her job) (Goodhue 1998, Melone 1990). Beliefs about a system, however, impact attitudes and cause a user to accept or reject an innovation. Beliefs are the drivers for the decisions to adopt (Rogers 1983) and intentions to use a technology (Davis et al. 1989, Taylor and Todd 1995).

DeLone and McLean (2003) have suggested that "the selection of IS success dimensions and measures should be contingent on the objectives and context of empirical investigation, but, where possible, tested and proven measures should be used" (p. 27). TTF is defined as the correspondence between task requirements, individual abilities, and the functionality of the technology. It is measured by assessing beliefs about how satisfactorily a system meets user task needs, and the degree to which the technology assists an individual in performing the tasks in his/her portfolio. In addition, prior research has shown that data quality characteristics should be evaluated relative to task context (Strong et al. 1997). The TTF instrument was, therefore, appropriate for measuring the impact of environmental uncertainty on task characteristics and on user satisfaction with data. The instrument was developed, used, and subsequently modified by Goodhue (1988a, 1988b, 1995, 1998). To assess the validity of the TTF instrument, Goodhue (1998) used 47 questions to assess 16 TTF dimensions (see Appendix C). In testing the discriminant validity of the TTF dimensions, Goodhue (1998) found that a model with 12 separate dimensions provided a better fit to the data than a model that assumed a single factor. The 12 dimensions were derived from a task model for quantitative data in managerial tasks and did not include all the relevant aspects of user evaluations of TTF for wider task domains (Goodhue 1995).

To isolate the impact of task characteristics on user satisfaction with data, we used *satisfaction with IS* and *satisfaction with IS support* as two control variables. Previous research suggested that *user satisfaction with data* is influenced by its accuracy, currency or timeliness, the consistency of presentation on screen and reports, its meaning or interpretability, and its granularity (or containing the right data at the right level of detail to be relevant) (Bailey and Pearson 1983, Doll and Torkzadeh 1988, Fox et al. 1994, Gray and Watson 1997, Wang and Strong 1996, Zmud 1978). *User satisfaction with IS* was influenced by data accessibility, ability to locate data (or locatability), ease of hardware and software use, system reliability, flexibility in meeting users' changing data needs, confusion, and compatibility of data (Bailey and Pearson 1983, DeLone and McLean 2003, Doll and Torkzadeh 1988, Jiang et al. 2002, Gray and Watson 1997, Pitt et al. 1995, Wang and Strong 1996). *User satisfaction with IS support* was influenced by assistance, security authorization, and training (Bailey and Pearson 1983, DeLone and McLean 2003, Sammon and Finnegan 2000).

User satisfaction with data was measured by six TTF dimensions of accuracy, meaning, currency, presentation, the right data, and the right level of detail. User satisfaction with IS was measured using 7 of the original 16 TTF dimensions of compatibility, confusion, ease of use hardware and software, system reliability, flexibility, accessibility, and locatability. User satisfaction with IS support was measured using three TTF dimensions: assistance, authorization, and training. Following Goodhue (1998), questions for all constructs were randomized in the questionnaire to minimize the potential for artificially inflated reliabilities that could arise from items grouped by dimension. Descriptive statistics for the research constructs are shown in Table 2. Each multi-item scale had adequate internal reliability.

Table 2 Descriptive Statistics

Variables	Questions retained[1,2]	Mean	Standard deviation
Environmental uncertainty:			
Dynamism	3 (0.83)	3.39	2.50
Hostility	3 (0.80)	3.12	2.22
Heterogeneity	1	3.36	2.43
Task characteristics:			
Nonroutine	3 (0.84)	3.78	2.41
Interdependent	2 (0.70)	3.63	2.10
Satisfaction with data:			
Accuracy	2 (0.70)	4.28	2.03
Meaning	2 (0.78)	4.47	1.85
Currency	2 (0.83)	3.84	2.08
Presentation	2 (0.79)	5.41	2.05
The right data	3 (0.64)	3.90	2.21
The right level of detail	2 (0.81)	4.20	2.14
Satisfaction with IS:			
Compatibility	2 (0.73)	4.06	1.95
Confusion	2 (0.79)	4.41	2.19
Ease of use of hardware and software	2 (0.76)	4.04	1.58
System reliability	3 (0.74)	4.27	1.76
Flexibility	3 (0.66)	4.64	1.90
Accessibility	2 (0.85)	4.67	1.91
Locatability	2 (0.78)	3.93	1.83
Satisfaction with IS support:			
Assistance	2 (0.86)	4.83	1.87
Authorization	3 (0.70)	4.67	2.03
Training	2 (0.70)	4.88	1.97

[1] Number of questions omitted from constructs due to measurement concerns: task variety (4), nonroutine tasks (1), compatibility (1) locatability (1), meaning (1), currency (1).
[2] Cronbach alpha coefficient in parentheses.

5. Analysis and Results

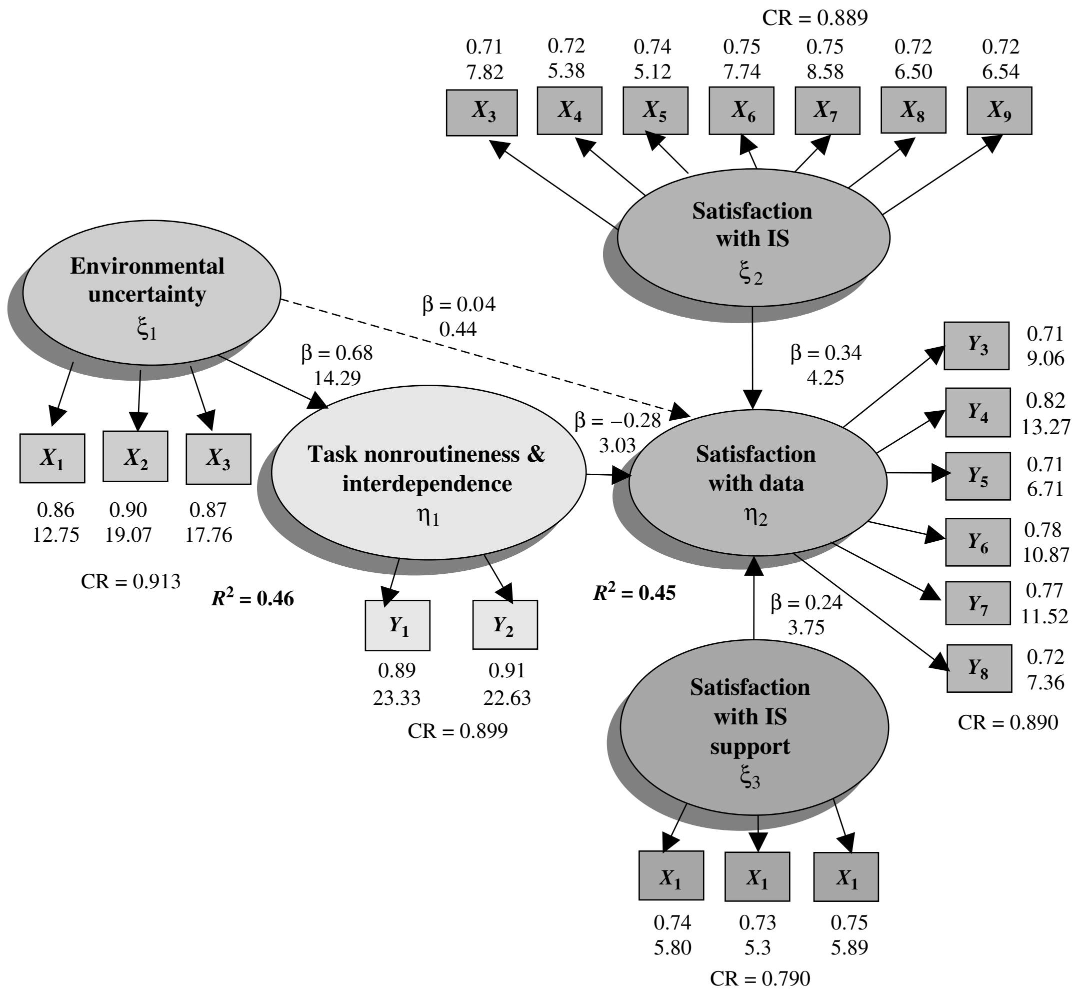
To assess validation and test linkages in the theoretical model, partial least squares (PLS) was conducted using *PLS-Graph Version 3.0* (Chin and Frye 1998). The covariance matrix for the measures is shown in Table 3.

Although the measurement and structural parameters were estimated together, the results were interpreted in two stages: first by an assessment of the measurement model's reliability and validity, and then by an assessment of the structural model. Convergent validity was assessed by examining factor loadings, the internal consistency reliability or composite reliability (CR), and the average variance extracted (AVE) by each construct. Figure 2 provides the model results. The standardized item-construct loadings were high (>0.707) and significant at the 0.01 level. Each of the constructs had consistent positive

Table 3 Covariance Matrix

	X1	X2	X3	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13
X1	6.614																				
X2	1.033	5.445																			
X3	−1.930	1.986	5.287																		
Y1	0.150	−1.269	−0.585	6.603																	
Y2	0.748	−1.090	0.077	1.395	5.575																
Y3	−0.802	−0.068	−0.852	−2.226	−1.56	3.193															
Y4	−1.095	0.241	−0.663	−1.669	−2.049	2.21	3.984														
Y5	−1.149	−0.486	−1.155	−1.705	−1.248	1.268	1.825	3.496													
Y6	−1.283	0.116	−0.514	−1.401	−1.038	1.586	2.388	2.160	4.337												
Y7	−2.204	0.463	0.093	−2.994	−1.818	1.464	1.913	2.100	2.392	4.444											
Y8	−2.649	0.869	−0.287	−1.678	−2.432	1.416	2.073	1.412	1.761	2.762	3.995										
X4	−0.777	−0.198	−0.775	−1.502	−0.577	1.555	1.592	1.028	1.238	1.286	1.056	3.877									
X5	−0.823	0.702	0.037	−1.571	−0.376	0.569	1.313	0.857	1.528	1.124	0.652	2.212	4.224								
X6	−0.776	0.174	−0.309	−0.822	0.135	0.658	1.123	0.549	1.025	0.732	0.567	1.798	2.249	3.217							
X7	−1.613	0.397	0.649	−2.801	−1.222	1.046	1.779	1.075	1.767	1.514	1.188	1.522	1.847	1.661	3.431						
X8	−0.880	0.406	0.226	−2.184	−0.983	1.699	2.578	0.705	1.509	1.351	1.536	1.499	1.633	1.411	2.031	3.655					
X9	−1.615	−0.046	−0.227	−1.007	−0.983	1.154	1.513	1.081	1.418	1.341	1.112	1.402	1.466	1.589	1.327	1.668	3.678				
X10	−0.315	−0.263	−0.541	−2.419	−0.489	1.069	1.329	1.710	1.354	1.059	0.678	1.738	1.685	1.641	1.308	1.313	2.244	3.568			
X11	−0.464	0.4770	0.286	−1.316	0.045	1.219	1.808	1.077	1.226	0.988	0.859	1.287	1.08	1.259	1.484	1.939	1.020	0.997	3.471		
X12	−0.142	−0.262	−1.281	0.599	0.073	0.596	0.843	0.643	1.009	0.696	0.621	0.933	0.990	1.012	0.234	0.856	1.066	0.710	0.796	3.538	
X13	−0.937	−0.914	−1.616	−0.388	−0.293	0.669	1.059	0.999	1.182	0.902	0.743	1.264	1.408	1.020	0.843	1.166	0.956	1.010	0.763	2.268	3.739

Figure 2 PLS Model Results



Notes. Loadings and path coefficients, β_i are shown above with their corresponding t-critical ratio below. All were significant at $p < 0.01$.

loadings, which indicated the general convergence of the indicators to their construct. Moreover, each indicator loaded more highly on constructs it was intended to measure than on any other construct. The CRs ranged from 0.790 to 0.913 and were above the 0.70 acceptable thresholds (Gefen et al. 2000). The statistical significance of the loadings and path coefficient estimates were assessed using a "bootstrapping" resampling method (with 166 resamples) (Chin 1998).

Table 4 presents the means, standard deviations, intercorrelations, and AVEs for the five constructs. The AVEs, shown in the diagonals, ranged from 0.729 to 0.903. Furthermore, when the interconstruct correlations and AVEs were compared, all constructs shared more variance with their indicators than with other constructs. The results suggested sufficient convergent and discriminant validity to allow an interpretation of structural parameters.

The structural model was evaluated on the basis of the R^2 values, effect sizes, redundancy measure of the dependent constructs, and structural paths for each endogenous construct. As shown in Figure 2, the model explained a substantial amount of variance for task characteristics ($R^2 = 0.46$) and satisfaction with data ($R^2 = 0.45$), which were both greater than the recommended 0.10 (Falk and Miller 1992). Effect size gauges whether a predictor latent variable has a small, medium, or large effect on the dependent

Table 4 Means, Standard Deviations, Intercorrelations, and AVEs of Constructs[1]

Construct	Mean	S.D.	1	2	3	4	5
(1) Environmental uncertainty	3.72	1.83	**0.827**				
(2) Task characteristics	4.20	1.63	0.681	**0.903**			
(3) Satisfaction with IS	4.49	1.49	−0.368	−0.481	**0.729**		
(4) Satisfaction with data	4.11	1.40	−0.341	−0.480	0.608	**0.757**	
(5) Satisfaction with support	4.81	1.47	−0.210	−0.172	0.568	0.481	**0.745**

[1] Diagonal entries **(bold)** are the square root of the average variance extracted (AVE).

latent variable, respectively, when the predictor is omitted from the structural model (Chin 1998, p. 317). When task characteristics are removed from the structural model, the effect size (0.08) is considered in the small to medium impact range, but nonetheless has a meaningful and relevant impact within this context (Aguinis et al. 2003). Moreover, 38% of the variance in the indicators for task characteristics was explained by the observables for the independent construct. Similarly, 26% of the variance in the indicators for satisfaction with data was explained by the observables of the independent constructs. Another meaningful indicator of the model's measurement fit, the average communality coefficient (0.610) was consistent with recommendations for a value greater than 0.30.

The PLS results shown in Figure 2 provide strong support for Hypotheses 1 to 5. Consistent with H1a, H1b, H2a, H2b, H3a, H3b, environmental uncertainty demonstrated significant direct effects ($\beta = 0.68$, $p < 0.01$) on task characteristics. Consistent with H4 and H5, task characteristics ($\beta = -0.28$, $p < 0.01$) demonstrated a significant negative relationship with satisfaction with data. Both control variables, satisfaction with IS ($\beta = 0.34, p < 0.01$), and satisfaction with IS support ($\beta = 0.24, p < 0.01$), were significantly and directly related to satisfaction with data. All standardized path coefficients exceeded the suggested minimum standard of significance at 0.20 (Chin 1998). To examine the mediation role, we added an additional direct path from environmental uncertainty to satisfaction with data, without dropping task characteristics from the model to allow for the presence of both direct and mediated effects. The path coefficient ($\beta = 0.04, t = 0.44, p > 0.05$) was not significant, indicating the importance of task characteristics as a mediator.

A comparative approach was used to mitigate concerns about perceptual measures of environmental uncertainty. Dess and Beard (1984) defined 23 variables to measure Aldrich's (1979) environmental dimensions. The measures are computed here from the publicly available industry data for each organization by their respective four-digit SIC code. A confirmatory factor analysis (CFA)[2] was performed using PLS to determine measurement validity of the objective environmental measures. Guided by the work of Dess and Beard (1984), the environmental measures were specified to load onto the three factors. As seen in Table 5, 14 (out of 20) measures significantly loaded onto their respective construct. The six measures with nonsignificant coefficients and three other internally inconsistent variables were excluded from further analysis. The results shown in Tables 5 and 6, suggest convergent and discriminant validity are met with one exception (V6 has a small loading of 0.468, but is nonetheless statistically significant at the 0.05 level), and are consistent with Dess and Beard (1984).

As shown in Table 7, the correlations between the factor scores from the PLS analyses indicate a significant correlation between perceptual and objective measures for hostility and dynamism. These results provided partial support for the external and concurrent validity of the perceptual measures, and suggest that perceptual measures can be useful when objective measures are unavailable. The results further challenge the notion that CEOs perceptions are inclined to be imprecise, erroneous, or inferior to objective measures. Especially because of the fact that most CEOs have access to the aggregated information

[2] The more commonly used exploratory factor analysis (EFA) does not validate the convergent and discriminate validities of latent variable indicators.

Table 5 PLS Measurement Model for Organizational Task Environments

SIC code for industries in sample[1,2]	Industry variable[3,4]	Factor loading (std. err.)	Critical ratio
	Hostility		
Agriculture (0191, 1291)	Sales (V_1)	**0.968 (0.006)**	**146.61*****
Forestry (0811, 0831)	Price-cost margin (V_2)	**0.762 (0.092)**	**8.26*****
Automotive product (3711, 3714)	Total employment (V_3)	**0.665 (0.160)**	**4.02*****
Chemical (2833, 2851)	Value added (V_4)	**0.912 (0.059)**	**15.23*****
Petroleum (2911, 2951)	No. of establishments (V_5)	**0.963 (0.009)**	**107.15*****
Construction (1521, 1541)	Industry sales concentration (V_6)	**0.468 (0.164)**	**2.84****
	Dynamism		
Banking (6011, 6019, 6021)	Sales (V_{11})	**0.844 (0.040)**	**20.79*****
Finance (6211, 6221)	Price-cost margin (V_{12})	**0.947 (0.017)**	**52.91*****
Hospital and healthcare (8011, 8062, 8082)	Employment (V_{13})	**0.906 (0.039)**	**23.24*****
Insurance (6321, 6411)	Value added (V_{15})	**0.952 (0.020)**	**47.29*****
Manufacturing (3052, 3363, 3541)	Intermediate market orientation (V_{22})	–0.295 (0.226)	1.30
Mining (1011, 1081)	Proportion of industry shipments sold for investment (V_{23})	–0.221 (0.204)	1.07
	Heterogeneity		
Retail trade (5311, 5511)	Concentration of inputs (V_7)	0.171 (0.184)	0.93
Services (7011, 7538)	Diversity of industry products (V_8)	0.157 (0.208)	0.74
Transportation (4111, 4512)	Specialization ratio (V_9)	–0.187 (0.121)	1.54
Wholesale trade, durable and nondurable (5012, 5141)	Concentration of industry outputs (V_{10})	–0.110 (0.188)	0.58
	Sales (V_{16})	**0.728 (0.138)**	**5.24*****
	Value added (V_{17})	**0.958 (0.034)**	**28.04*****
	Employment (V_{18})	**0.968 (0.021)**	**45.30*****
	No. of establishments (V_{19})	**0.968 (0.030)**	**31.90*****

[1] The sample of standard industrial codes (SIC) may not reflect a representative sample of establishments within their respective industry groups.
[2] The small ratio of number of industries in sample ($n = 35$) to the number of variables operationalized ($n = 20$) required the use of partial least squares analysis.
[3] Data for these variables were obtained from several secondary sources: (1) CANSIM II (via the University of Toronto), Statistics Canada's time series database contains 1.2 million series tables that cover a variety of economic aspects in Canada; (2) Canadian Census Analyzer; (3) Data Liberation Industry Initiative (DLI) provides access to Statistics Canada's geography and statistical microdata; (4) Strategies, Canada's web portal economic analysis and statistics on many aspects of industry; (5) Statistics Canada, Canada's central statistical agency and other publication serials, for example, Bank of Canada, and Canadian Economic Observer. Access to online catalogues was provided by the Leddy Library, University of Windsor, Windsor Ontario, Canada.
[4] For operationalization of V1 to V23, see Dess and Beard (Appendix, 1984, pp. 71–73).
** $p < 0.01$ level ($n = 35$, $t_{cv} = 2.750$); *** $p < 0.001$ level ($n = 35$, $t_{cv} = 3.646$).

from their organizational environments, and they may form their perceptions based on such information. Moreover, the results are consistent with Sharfman and Dean (1991).

Table 6 Intercorrelations Among *Objective* Measures of Environmental Uncertainty

Objective measures	Fornell and Larcker internal consistency	(1)	(2)	(3)
(1) Hostility	0.916	**0.810**		
(2) Dynamism	0.959	0.349*	**0.923**	
(3) Heterogeneity	0.953	0.288	0.390**	**0.915**

Note. Diagonal entries **(bold)** are the square root of the average variance extracted (AVE).
* Correlation is significant at the 0.05 level (two-tailed); ** Correlation is significant at the 0.01 level (two-tailed).

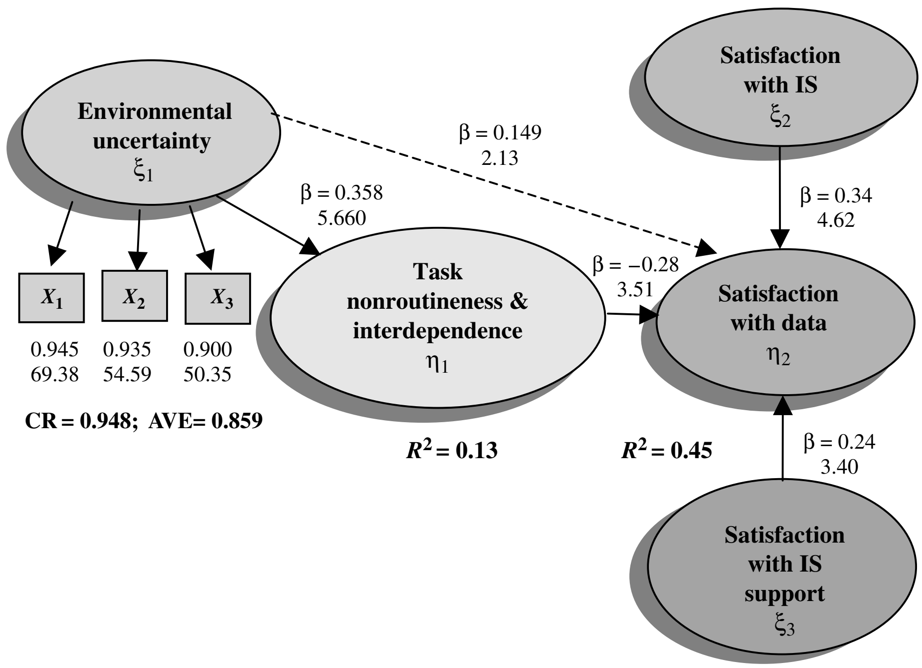
The research model shown in Figure 1 was further examined using the objective measures of environmental uncertainty. The three objective measures explained 13% of the variance in task characteristics, significantly much less than the 46% explained by the perceptual measures (see Figure 3). Similar to

Table 7 Correlations Among *Objective* and *Subjective* Measures of Environmental Uncertainty

	Objective measurement		
Subjective measurement	Hostility	Dynamism	Heterogeneity
Environmental uncertainty	0.479** $p = 0.004$	0.413* $p = 0.014$	0.319 $p = 0.062$

* Correlation is significant at the 0.05 level (two-tailed); ** Correlation is significant at the 0.01 level (two-tailed).

Figure 3 PLS Model Results for Objective Measures of Environment



Notes. Loadings and path coefficients, β_i are shown above with their corresponding t-critical ratio below. All were significant at $p < 0.01$.
The significant measures, shown in Table 5, for dynamism, hostility, and heterogeneity were aggregated to form a single average indicator.

the model results using perceptual measures, all the path coefficients relating environmental uncertainty to task characteristics were significant, but slightly stronger. We also examined the mediation impact of task characteristics. The results indicate task characteristics mediate the link between hostility, heterogeneity, and satisfaction with data. A significant path coefficient ($\beta = 0.149, t = 2.13, p < 0.01$) indicated no mediation effect.

6. Discussions and Implications

This study extended previous findings on user satisfaction by linking environmental uncertainty dimensions to TTF theory and by measuring user satisfaction with data, IS, and IS support as three measurable constructs using TTF dimensions. It suggested that user satisfaction with data is understood better by its evaluation in organizational contexts. This study added to our understanding of the reasons for user satisfaction/dissatisfaction with data and for IS success. It suggested that to cope with the environmental uncertainty, user behavior and perceptions need to be evaluated in dynamic organizational contexts to design better systems and/or to redesign or discontinue current systems or support policies. Designers can no longer presume the external environment is either certain and open to precise predications or uncertain and completely unpredictable. They need to investigate the level of uncertainty surrounding system use and accommodate a more flexible approach to requirement analysis and system design.

The research model defined in Figure 1 has several implications for IS research. Because the future holds more uncertainty in organizational task environments (Castrogiovanni 2002), researchers will need to investigate how to design better systems that support users facing uncertain future environments. The constructs in the model should be embedded as one part of a larger complex of contextual variables associated with organizational task environments, task-technology fit, individual, group, and organizational performance, and user satisfaction. The model could evolve to include levels of uncertainty, other task types (e.g., problem, judgment, fuzzy, group, and multipart tasks) (Zigurs and Buckland 1998), and interdependence modes (i.e., pooled, sequential, and reciprocal) (Bensaou and Venkatraman 1996, Thompson 1967). For example, Courtney et al. (1997) suggest that *residual uncertainty* (i.e., the uncertainty that remains after the best possible analysis has been done) facing most decision makers falls into one of four broad levels: (1) *a clear-enough future*, where a single forecast may be precise enough for determining strategy (e.g., a decision to respond to a new low-cost service offered by a competitor); (2) an *alternate future*, where there are few discrete outcomes that define the future (e.g., a decision that involves prospects of changes in regulatory, legislative, or a competitor's strategy); (3) *a range of future*, where there is a range of possible outcomes but no natural scenarios (e.g., a decision to enter new geographic markets or to invest in a new technology); and (4) *true ambiguity*, where there is no basis to forecast the future (e.g., a decision to make major entry investment in post-communist Russia in 1992). Prior research also suggested that task structure (i.e., techniques, rules, or models for analyzing task-related information) and task support (i.e., IT artifacts to support task-related activities) are dependent on task characteristics (Nunamaker et al. 1991, Zigurs and Buckland 1998), and the fit between task characteristics and technology will impact individual and group performance (Goodhue and Thompson 1995, Zigurs and Buckland 1998). The impact of the four levels of residual uncertainty on different task type, task structure, task support, IS implementation, and user behavior and perceptions needs to be investigated further. For example, in uncertain environments, user satisfaction with data might be increased where there is a good fit among task type, task structure, and support. Task type and task structure and support (in varying contexts) need to be evaluated over time in high-velocity environments, which represent the extreme end of the dynamism continuum (Judge and Miller 1991), to achieve a more complete task analysis, information sharing, and idea generation.

For practitioners, our findings highlight the need to pay close attention to both organizational task environments and the users' needs for better data to further support their decision-making tasks. We found they also need to consider environmental uncertainty, task characteristics, satisfaction with data, IS and IS support when deciding whether to redesign or discontinue current systems or support policies. They also need to consider whether to redesign tasks, task structure, or task support to take better advantage of IT potential. For firms that face rapid changes in their organizational task environments, developers can enhance user satisfaction with data by making real-time data sharing among applications easier to provide the right data at the right level of detail with better accuracy, presentation, meaning, and currency. To do so, they need to understand the changing nature of tasks and apply task-oriented analysis techniques to the processes that produce this data because users evaluate data quality relative to their own tasks (Strong et al. 1997). Creating awareness of the issues associated with the organizational task environments within the enterprise is the first obstacle that practitioners must overcome when addressing user satisfaction/dissatisfaction with the data. Because characteristics of data can change over time as task requirements change, providing high-quality data implies tracking an ever-moving target. Providing such data places a premium on designing reliable and flexible systems for data that can be easily aggregated and manipulated. Such integration is necessary to address user needs in rapidly changing external environments; it has also been recognized as an appropriate mechanism to attenuate problems caused by those environments (Benanati and Lederer 2001, Lederer and Mendelow 1990). The findings from this study can serve as the basis for a strong diagnostic tool for evaluating whether IS and IS services are meeting needs in a given environment. Such evaluations should specifically identify the gaps between systems and support capabilities and needs for data.

Although our model focused on the nature of the association among environmental uncertainty, task characteristics, and user satisfaction with data, it did not examine other contingency factors, such as users' expectations, organizational size, culture, and politics, which might have also mediated the hypothesized effect. Future research should examine these and other potentially mediating factors that affect the association between environmental uncertainty and user satisfaction with data. It should also examine how environmental uncertainty might impact other user's behavior and perceptions, especially with respect to technology acceptance, intention to use, and actual use. The impact of organizational task environments on various phases in the IS implementation process (Cooper and Zmud 1990) needs to be tested. Contemplating the impact of environmental uncertainty on initiation, adoption, and satisfaction, the absolute lack of research in remaining phases highlights potential avenues for future research. Because technological discontinuities may cause environmental uncertainties for a short period of time (Andreson and Tushman 1990) and decreases in uncertainties tend to occur in individual environments (Castrogiovanni 2002), future research should also assess the effects of the change on the IS implementation process for a particular task environment.

7. Conclusions and Limitations

Today's organizations are generally faced with the task of processing volumes of information in more uncertain environments. This study suggests that managerial decision-making tasks are affected by rapid changes that occur in organizational task environments, and that when confronted with environmental uncertainty, users experience more nonroutine and interdependent tasks. Combining perceptual and objective measures of the environment, this study provided a more comprehensive understanding of the relationship between the two, and showed their respective abilities to predict variation in users' task characteristics. The findings suggest that task characteristics have both a direct and mediating impact on user satisfaction with data. The "more" tasks are nonroutine and interdependent, the lower user satisfaction is with data. Any impact of environmental uncertainty on user satisfaction with data is completely mediated by task characteristics for the perceptual measures. Users are more satisfied with data when they are more satisfied with the IS and with IS support.

As in most studies, the research presented here was limited by the measures used. Because environments are comprised of numerous uncorrelated facets, such as politics and technology, perceptual measures or market-driven measurement scales cannot fully assess every environmental dimension across all facets. It is also impossible to utilize separate scales for every conceivable facet in a single study, and environmental uncertainty varies across "subenvironments" within the broader task environments. Also, our measures for task characteristics did not include time-critical tasks, decision-making speed, and decision making in high-velocity environments. Managers at each stage of decision making are likely to be concerned with different types of uncertainty and different types of data, which need to be investigated further. As a caveat to the significant relationships we observed in this study, causal relationships could not truly be tested with cross-sectional data. The use of a longitudinal research design is another potential avenue for research.

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Appendix A. Environmental Uncertainty

How would you describe changes in the company's (division's) external environment over the past five years?

Dynamism (X_1)**:**

- D_1: Market activities of your key competitors (1 = have become far more predictable; 4 = no change; 7 = have become far less predictable).
- D_2: The tastes and preferences of your customers in your principal industry (1 = have become far more stable and predictable; 4 = no change; 7 = have become much harder to forecast).
- D_3: Rate of innovation of new operating processes and new products or services in your principle industry (1 = rate has fallen dramatically; 4 = no change; 7 = rate has dramatically increased).

Hostility (X_2)**:**

- H_1: Your principal industry's downswings and upswings (1 = have become far more predictable; 4 = no change; 7 = have become far less predictable).
- H_2: Market activities of your key competitors (1 = have become far more hostile; 4 = no change; 7 = have become far less hostile).
- H_3: Market activities of your key competitors (1= now affect the firm in far fewer areas; 4 = no change; 7 = now affect the firm in many areas, e.g., pricing, delivery, etc.).

Heterogeneity (X_3)**:**

• HET: Needed diversity in your production methods and marketing tactics to cater to your different customers (1 = diversity has dramatically decreased; 4 = no change; 7 = diversity has dramatically increased).

Appendix B. Task Characteristics

Please indicate the extent to which you agree or disagree with the following statements about your use of corporate or divisional data (1 = *strongly disagree to* 7 = *strongly agree*).

Nonroutineness (Y_1)**:**

• NR1: I frequently deal with ad hoc, nonroutine business problems.

• NR2: I frequently deal with ill-defined business problems.

• NR3: Frequently, the business problems I work on involve answering questions that have never been asked in quite that form before.

• NR4: Frequently, in the mindset of using data to address some issue, I may decide to restate the problem and access slightly different data than I had at first planned.*

Interdependence (Y_2)**:**

• IN1: The problems I deal with frequently involve more than one business function.

• IN2: The business problems I deal with frequently involve more than one organization group.

Variety*:

• Frequently, my need for information arises on an irregular schedule and is not predictable in advance.*

• There is a great deal of variety in the problems, issues, or questions for which I need data in my work.*

• Frequently, it is necessary to spend a fair amount of time thinking about how best to address a business problem before I begin an analysis.*

• Frequently, after I see what data are available or what the data say, I change my view of the problem and of what data are needed.*

* indicate questions that were dropped due to measurement concerns.

Appendix C. User Satisfaction

TTF Dimensions for Satisfaction with Data

Accuracy (Y_3) (correctness of the data)

• The data that I use or would like to use are accurate enough for my purposes.

• There are accuracy problems in the data I use or need.

Meaning (Y_4) (ease of determining what a data element on a report or file means, or what is included or excluded in calculating it)

• On the reports or systems I deal with, the exact meaning of data elements is either obvious or easy to find.

• The exact definition of data fields relating to my tasks is easy to find out.

• Data dictionaries or data directories are useful to me in locating or understanding the meaning of corporate or divisional data.

Currency (Y_5) (the data that I use or would like to use is current enough to meet my needs)

• I cannot get data current enough to meet my needs.

• I need some data on the up-to-the-minute status of operations or events but cannot get it.

• The data is up-to-date enough for my purposes.

Presentation (Y_6)

• The data that I need is displayed in a readable and understandable form.

• The data is presented in a readable and usefuls format.

The Right Data (Y_7) (maintaining the needed basic field or elements of data)

• The computer systems available to me are missing critical data that would be very useful to me in my job.

• The data maintained by the corporation or division is exactly what I need to carry out my tasks.

• It is more difficult to do my job effectively because some of the data I need is not available.

The Right Level of Detail (Y_8) (maintaining data at the right level or levels of detail)

• Sufficiently detailed data is maintained by the corporation or division.

• The company maintains data at an appropriate level of detail for my purposes.

TTF Dimensions for Satisfaction with IS

Compatibility (X_4) (ease with which data from different sources can be aggregated or compared without inconsistencies)

• When it is necessary to compare or aggregate data from two or more different sources, there may be unexpected or difficult inconsistencies.*

• There are times when supposedly equivalent data from two different sources is inconsistent.

• Sometimes it is difficult or impossible to compare or aggregate data from two different sources because the data is defined differently.

Confusion (X_5)

• There are so many different systems or files, each with slightly different data, that is hard to understand which one to use in a given situation.

• The data are stored in so many different places and in so many forms, it is hard to know how to use it effectively.

Ease of Use of Hardware and Software (X_6) (ease of doing what I want to do using the system hardware and software for submitting, accessing, and analyzing data)

• It is easy to learn how to use the computer systems that give me access to data.

• The computer systems that give me access to the data are convenient and easy to use.

System Reliability (X_7) (dependability of access and up-time of systems)

• The data is subject to frequent system problems and crashes.

• I can count on the system to be "up" and available when I need it.

• The computer systems I use are subjected to unexpected or inconvenient down times, which makes it harder to do my work.

Flexibility (X_8) (ease of changing the content or format of he data to meet changing business needs)

• Our computer systems are too inflexible to be able to respond to my changing needs for data.

• When business requirements change, it is easy to change the selection and format of data made available by our computer systems.

• I am not getting as quick a turnaround as I need on requests for new reports or data.

Accessibility (X_9) (ease of getting help on problems with the data)

• I can get data quickly and easily when I need to.

• It is easy to get access to data that I need.

Locatability (X_{10}) (ease of determining what data is available and where)

• It is easy to locate corporate or divisional data on a particular issue, even if I have not used that data before.

• It is easy to find out what data the corporation maintains on a given subject.

• Ease of determining what data is available and where*

TTF Dimensions for Satisfaction with IS support

Assistance (X_{11}) (ease of getting help on problems with the data)

• I am getting the help I need in accessing and understanding the data.

• It is easy to get assistance when I am having trouble finding or using data.

Authorization (X_{12})

• Data that would be useful to me is unavailable because I do not have the right authorization.

• Getting authorization to access data that would be useful in my job is time consuming and difficult.

• Data are safeguarded from unauthorized changes or use.

Training (X_{13}) (Can I get the kind of quality computer-related training when I need it?)

• There is not enough training on how to find, understand, access, or use corporate or divisional data.

• I am getting the training I need to be able to use corporate or divisional data effectively in my job.

* indicate questions that were dropped due to measurement concerns.

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