

ENVIRONMENTAL UNCERTAINTY AND CIOS' ASSESSMENTS OF INFORMATION SYSTEMS ISSUES

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ABSTRACT

Employing information systems (IS) issues which have appeared in a series of MIS Quarterly articles and a scale for the perceived environmental uncertainty (PEU) construct, the authors surveyed CEOs and senior information systems managers to examine the relationship between PEU and top IS issues. The results showed different rankings between firms reporting low versus high levels of PEU for a number of IS issues. Overall, information systems issues are more important at high PEU firms than at low PEU firms.

Keywords: Information Systems Issues; Environmental Uncertainty; Computing; CIO; PEU.

INTRODUCTION

Over the last two decades information systems (IS) scholars have found the study of IS issues a fertile ground for research (1, 2, 3, 4, 8, 9, 10, 12, 13, 16, 20, 21, 22, 24). Nevertheless, Palvia and Basu (21) recently cast some doubt on the relevance of IS issues research. The current study addresses the question raised by Palvia and Basu and examines the relationship between continuing IS issues and perceived environmental uncertainty (PEU).

Organizations do not operate in a vacuum but must deal with external factors in the environment. Information systems can serve as a mechanism to deal with environmental uncertainty. We are specifically interested in the perception of uncertainty in the firm's environment. Since Duncan (11) first coined the term, perceived environmental uncertainty (PEU), researchers have sought to understand the impact of PEU on the organization. Also since the definition of the concept, researchers have examined PEU as a possible influence on information systems (5, 6, 7, 14, 15, 17, 18, 23).

While the impact of PEU on a number of IS-related variables has been the subject of inquiry, the relationship between PEU and the importance attached to various IS issues has not been addressed. The studies described above indicate that different levels of PEU affect the design of IS, the information requirements of the firms, and additional aspects of IS. Varied levels of PEU may therefore also influence the views of Chief Information Officers (CIOs) as to the relative importance of IS issues facing their organizations. We hypothesize that CIOs of firms in highly uncertain environments view the importance of IS issues differently than CIOs in less uncertain environments.

The reason for this difference is that people value certainty. By definition, information reduces uncertainty about the state of nature. Thus, if people think they are in an uncertain environment

(e.g., if they perceive environmental uncertainty), they will seek information in order to reduce the uncertainty. This desire for information will have an impact upon how they think about the systems which systematically generate information. Furthermore, since PEU deals with the conditions outside of the firm, we hypothesize that IS issues related to factors external to the organization are more important to CIOs in firms with a high level of PEU than to CIOs in firms experiencing lower levels of PEU. These ideas are expressed in the following two hypotheses:

- H1: CIOs in high PEU firms attach a different level of importance to IS issues in general than CIOs in low PEU firms.*
- H2: CIOs in high PEU firms attach a higher level of importance to external IS issues than CIOs in low PEU firms.*

The relationship between the importance of IS issues and PEU is the focus of this study.

METHODS

Five articles from *MIS Quarterly* (1, 2, 3, 10, 20) over the last two decades provide the population of IS issues for potential inclusion in this study. Issues of great concern at a given moment may not warrant much attention at a later date. These fleeting issues typically arise from technological concerns whose impacts are short-lived as the IS profession struggles to address them. As the profession learns to deal with them, these concerns diminish in importance. Examples of issues that appear on surveys of CIOs and later disappear are decision support tools and CASE tools. Perhaps the Internet is a significant issue today, but it will shrink in importance as its capabilities and business implications are better understood. In contrast, other issues remain relevant over time and continue to present long-term concerns for IS professionals. These more-durable issues include using IS for competitive advantage, promoting the effective use of the data resource, and aligning the IS organization with that of the enterprise. Gilbert, Pick, and Ward (12) address the transitory nature of IS issues.

This study focuses on lasting IS issues. These are defined as those which appear in a majority (at least three) of the *MIS Quarterly* articles listed above. Although they may not all turn out to be important in the future, they do have a track record of importance in the past. Concentrating on issues which have withstood the test of time provides some assurance that they are relevant and remain of interest to the IS community. By including only issues that have surfaced repeatedly over a number of years, we address Palvia and Basu's (21) claim that IS issues studies have no current relevance. We argue that IS issues that have a record of persistence are likely to remain relevant. As the wording for a given issue may vary from one study to the next, the various articles were carefully examined to identify when IS issues appeared to be the same despite slight differences in phrasing. The issues were evaluated independently by each author with a consensus required for inclusion of the issue in the analysis. The questionnaire presents the IS issues with the exact phrasing used by the middle study (2). (The wording has been omitted from this paper for brevity, but it is available from the authors.) Following this procedure, fifteen continuing issues were identified. The survey instrument asked respondents to rate the importance of each issue using a seven-point Likert scale with anchor values of 1 = "Not Important" to 7 = "Extremely Important."

Perceived environmental uncertainty (PEU) was measured through a psychometric scale developed by Miller and Droge (19). This scale measures the degree of change and unpredictability in market-related and technological factors facing the organization. For brevity, this scale is not shown, but is available from the authors.

The survey instrument was sent to all firms in the *Compact Disclosure* database which confine their operations to a single industry as identified by four-digit Standard Industrial Classification (SIC) code. The sample was limited to firms operating in single industries to minimize the confounding effects that competition in multiple industries might introduce. The level of uncertainty reflected in different industries might be markedly different. In addition, firms having operations in multiple industries might have different IS issues facing them in each line of business. The selection criterion resulted in 1,948 firms being chosen for this study. Two survey instruments were mailed to the chief executive officer (CEO) of each firm. A cover letter accompanying the instruments requested that the CEO answer the questions concerning PEU and forward the questionnaire addressing the IS issues to the person considered "most knowledgeable about the organization's information system." Inasmuch as the titles of IS managers vary among firms, the authors felt this would be the most effective way to route the survey instrument to the senior IS manager, regardless of that person's formal title. For the remainder of the paper, we will operationalize our use of CIO to refer to this senior IS manager.

Survey instruments were received from 210 CEOs (10.8 percent response rate) and 228 IS managers (11.7 percent response rate). Both the CEO and CIO from 106 firms returned questionnaires for an effective response rate of 5.4 percent. Of these, 102 survey instruments were complete and are included in this study. The anonymity of the respondents or the firms could not be guaranteed because the responses from the two respondents from each firm had to be paired and then joined with additional data from *Compact Disclosure*. Considering that two very high-level individuals in each organization were required to complete the questionnaires and anonymity could not be assured, this response rate was deemed acceptable.

RESULTS

The PEU construct reflects a mean value of 3.8248 and acceptable reliability of .8371 (Cronbach's Alpha). For this study, firms with a PEU value of 3.8248 or lower are classified as low PEU firms (N=46). Those with a PEU value above 3.8248 are classified as high PEU firms (N=56).

For low PEU firms, the five most important issues, in declining order of importance, are End User, Data Resources, Alignment, Competitive Advantage, and Organizational Learning, respectively. The five most important issues, in declining order of importance, for high PEU firms are Alignment, Competitive Advantage, Information Architecture, Strategic Planning, and Data Resources/End User (tie), respectively. Means and ranks for each type of firm are presented in Table 2. The average level of importance per issue reported for low PEU firms is 4.88 while high PEU firms report an average level of importance of 5.29 per issue.

To determine whether there is a statistical difference in the level of importance attached to IS issues in general by CIOs of firms operating in more uncertain environments relative to those CIOs whose firms are in low uncertainty environments, multivariate analysis of variance was conducted. Results are presented in Table 1. A significant difference at the 90% level is demonstrated in the level of importance attached to IS issues in general by high PEU firms versus low PEU firms. Hypothesis 1 is supported.

**Table 1: Multivariate Analyses of Variance
Low Versus High Levels of PEU**

Multivariate Test	Value	Multivariate F	P-Value
Pillais	.23	1.73	.06
Hotelling	.31	1.73	.06
Wilks	.76	1.73	.06
Roys	.23		

Univariate analyses of variance were then performed on the IS issues. These results are found in Table 2. CIOs of high PEU firms rated Competitive Advantage, Strategic Planning, Alignment, Human Resources, and Information Architecture as significantly more important (90% or higher level) than did CIOs of low PEU firms. The CIOs of firms experiencing high levels of uncertainty in the environment rated EDI, Software Development, Effectiveness & Productivity, Organizational Learning, Data Resources, Applications Portfolio, Telecommunications, Role of IS, and Security & Control as more important than the CIOs of firms in more certain environments, but the difference was not significant. End User was the only issue which was rated more important in a low PEU setting, and the difference was not significant. Many of the issues are more important in a high-PEU setting than in a low-PEU setting, but we did not see a definite pattern of importance attached to externally-focused issues exclusively. Hypothesis 2 is not supported.

**Table 2: Univariate Analyses of Variance
Low Versus High Levels of PEU**

Issue	PEU (Rank)Level	Mean	Std. Dev.	Univariate F (P-Value)
Competitive Advantage	(4) Low	5.23	1.99	2.89
	(2) High	5.78	1.46	(.09)
EDI	(14) Low	4.37	2.08	.89
	(15) High	4.75	1.72	(.35)
Strategic Planning	(6) Low	5.02	1.78	3.45
	(4) High	5.50	1.19	(.07)
End User	(1) Low	5.50	1.46	.00
	(6) High	5.46	1.01	(.97)
Software Development	(11*) Low	4.74	1.96	1.49
	(9) High	5.16	1.52	(.23)
Effectiveness & Productivity	(9) Low	4.87	1.69	.98
	(10*) High	5.11	1.12	(.33)
Organizational Learning	(5) Low	5.09	1.35	1.62
	(7) High	5.30	1.26	(.21)
Alignment	(3) Low	5.30	1.60	9.21
	(1) High	6.04	1.01	(.00)
Human Resources	(15) Low	3.74	1.89	13.71
	(12) High	4.98	1.59	(.00)
Data Resources	(2) Low	5.32	1.42	.63
	(5) High	5.46	.99	(.43)
Applications Portfolio	(12*) Low	4.74	1.69	.79
	(13*) High	4.96	1.29	(.38)
Telecommunications	(10) Low	4.81	1.84	1.83
	(8) High	5.21	1.56	(.18)
Role of IS	(8) Low	4.91	1.64	.92
	(11*) High	5.11	1.29	(.34)
Security & Control	(13) Low	4.57	1.65	2.44
	(14*) High	4.96	1.29	(.12)
Information Architecture	(7) Low	4.93	1.63	5.70
	(3) High	5.59	1.08	(.02)

*Tie in rank for that PEU level.

CONCLUSION

We argue that managers who believe they are operating in an uncertain environment will have a greater need for information to determine the state of that environment than managers of firms operating in relatively certain environments. The need for information to reduce uncertainty affects how managers think about the systems capturing that information and presenting it. The dissimilar environments in which the two groups of firms operate are reflected in the importance attached to various IS issues.

The analysis shows that the continuing IS issues addressed in this study are considered differently, in terms of importance, in low-PEU firms relative to high-PEU firms. High-PEU organizations attach a higher level of importance to many of these continuing IS issues than do low-PEU organizations. Many of the issues are more important at high-PEU firms than at low-PEU firms. This appears to support the contention that high-PEU firms place greater importance on information systems in dealing with key issues and maintaining their competitive position than do low-PEU firms. In addition, the ranking of issues in terms of relative importance is different in the two groups.

In summary, we see that the perception of environmental uncertainty does affect the CIO's feelings about information systems issues that have been repeatedly rated as important in a series of studies in the literature. Information systems issues are more important overall in high-PEU firms than in low-PEU firms. Also, the relative importance among issues differs between high-PEU firms and low-PEU firms.

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