Continuing Information Systems Issues: A Comparison Of The Manufacturing And Non-Manufacturing Sectors

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Abstract

The CIOs of a sample of publicly-traded U.S. corporations were surveyed about the relative importance of information systems issues. The issues were selected from a series of MIS Quarterly studies of information systems issues. An analysis of the differences in the responses from manufacturing firms versus non-manufacturing firms discovered that non-manufacturing firms view these issues as more important than manufacturing firms do. There is also a difference in the underlying factor structure for manufacturing as opposed to non-manufacturing firms. The differences suggest that manufacturing firms are not as focused upon strategic uses of information systems as non-manufacturing firms.

Introduction

*I*t has been suggested that the manufacturing sector has failed to realize the same level of benefits from information technology as the non-manufacturing sector has enjoyed (Gupta and Capen, 1996; Xu and Kaye, 1997; and Kempis and Ringbeck, 1998). Perhaps this is due to the different perspectives of the two industrial sectors. According to an interview with Peter Drucker (Panchak, 1998), traditionally manufacturing has looked on the physical process of production as the focal point for its emphasis. In contrast, service companies do not view production as the process that adds value. They concentrate on the customer and service. Gupta and Capen (1996) suggest that senior manufacturing executives suspect that information systems in their organizations are under-utilized. Xu and Kaye (1997) believe that information system applications in manufacturing firms lack a strategic orientation.

Readers with comments or questions are encouraged to contact the authors via email.

Regardless of the reason, there appears to be a wide-spread belief that a disparity exists between manufacturing firms and non-manufacturing firms as to the benefits gained from information technology. The relative importance of various issues to management suggests priorities for allocation of staff, capital, and management attention. The purpose of the research described herein is to examine the relative priorities assigned to information systems issues by firms in these two industrial sectors. This may provide additional insights into the differential benefits from the application of information technology accruing to firms in these two sectors.

Review Of The Literature

A significant body of literature has developed over the last two decades dealing with information systems issues. Some general studies have addressed IS issues from the perspective of IS management in multi-industry settings (Ball and Harris,

1982; Neiderman, Brancheau, and Wetherbe, 1991; Brancheau, Janz, and Wetherbe, 1996; and Gilbert, Pick, and Ward, 1999). Others have limited the scope of their research. Caudle *et al.* (1991) examine public affairs. Watson (1989), Wang (1994), and Yang (1996) address information systems in particular countries. MIS issues and the human resources function are addressed by Couger (1988). Gilbert, Pick, and Ward (2000) examine IS issues in manufacturing firms.

There appears to be, however, a dearth of research examining the relative priorities assigned to IS issues within different industrial sectors. Comparing priorities among sectors may provide insights into the factors influencing organizations= attitudes towards IS and the allocation of resources within the IS functional area. The research described herein empirically addresses the differences in the prioritization of the importance assessed various IS issues between the manufacturing and non-manufacturing sectors.

Methodology

Selection of Issues and Questionnaire Design

A series of articles from *MIS Quarterly* (Ball and Harris, 1982; Dickson *et al.*, 1984; Brancheau and Wetherbe, 1987; Neiderman, Brancheau, and Wetherbe, 1991; and Brancheau, Janz, and Wetherbe, 1996) over the last two decades provide the population of information system issues for this study. As is the case with Palvia and Basu (1999), the authors of the present study are concerned with the relevance of research which concentrates on current IS issues due to the ephemeral nature of many of the issues. Issues of concern at a given moment may not warrant significant attention at a later date. Gilbert, Pick, and Ward (1999) address the transitory nature of IS issues reported in current research. These issues typically arise from technological concerns whose impact is brief as information systems professionals struggle successfully to deal with them. Very rapidly, these concerns cease to be issues as the profession learns to manage these technologies. Examples of these transitory issues are artificial intelligence, decision

support systems, and CASE tools. In contrast, other issues seem to remain relevant over time and represent long-term problems for IS professionals. Examples of these long-term issues include promoting effective use of data resources, aligning the information systems organization with that of the enterprise, and using information systems for competitive advantage.

For the reasons stated above, continuing IS issues are addressed in this study. These are defined as those issues which appear in a majority (at least three) of the five *MIS Quarterly* articles listed above. Concentrating on concerns which have withstood the test of time provides some assurance that the issues addressed are relevant and continue to warrant the attention of information systems professionals. As the wording for a given issue may vary from one study to the next, the authors independently examined the various articles to identify different phrasing of the same issue. Differences were reconciled by the authors with a consensus required for inclusion of the issue. For this study, the nomenclature of the issues was as used in the middle study (Brancheau and Wetherbe, 1987). Based on the methodology described above, fifteen continuing issues were identified for inclusion in this study. These issues are shown in Table 1. 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."

The survey instrument was sent to all firms in the *Compact Disclosure* database which confined their operations to a single industry as identified by four-digit Standard Industrial Classification (SIC) codes. This was done to eliminate firms which might have operations in both the manufacturing and non-manufacturing sectors. In addition, firms having operations in multiple manufacturing industries or multiple non-manufacturing industries might have different issues for each line of business. Limiting the study to firms operating in single industries serves to minimize sources of such potential confounding. The selection criteria resulted in 713 manufacturing firms and 1,235 non-manufacturing firms being chosen for this study.

Table 1
List Of Issues

Short Title	Full Text of Survey Item
STRTPLNG	Improving information systems strategic planning.
ENDUSER	Facilitating and using end-user computing.
SOFTWARE	Improving the effectiveness of software development.
EFFPROD	Measuring information systems effectiveness and productivity.
ORGLRNG	Facilitating organizational learning and the use of information systems.
ORGALGN	Aligning the information systems organization with that of the enterprise.
HUMRES	Specifying, recruiting, and developing information systems human resources.
DATARES	Promoting effective use of the data resource.
APPLPORT	Planning and managing the applications portfolio.
TELECOM	Planning, implementing, and managing telecommunications.
ROLECONT	Increased understanding of the roles and contributions of information systems.
COMPADV	Using information systems for competitive advantage.
EDI	Enabling electronic data interchange and multi-vendor integration.
SECCONT	Improving information security and control.
INFARCH	Developing an information architecture.

Manufacturing firms were identified as those operating in an SIC code in the 2000 to 3999 range. Firms operating in all other SIC codes were identified as non-manufacturing firms.

The survey instrument was mailed to the chief executive officer of each firm with the request that it be forwarded to the person considered "most knowledgeable about the organization's information systems." Survey instruments were returned by 64 manufacturing firms and 106 non-manufacturing firms resulting in response rates of 9 percent for both sectors. Questionnaires with all items completed were received from 62 manufacturing firms and 100 non-manufacturing firms. Considering the indirect method of reaching the desired respondent and the level of that individual in the organization, this response rate was deemed acceptable. Furthermore, this level of response is not uncommon in industrial research. For example, Dwyer and Welsh (1985) reported a response rate of 6.3 percent in their survey of industrial firms.

Respondents

Manufacturing firm respondents represent thirty-nine industries while non-manufacturing firm respondents represent sixty-two industries. Table 2 shows the distribution of respondents in each industrial sector by two-digit SIC code for brevity. The selection criterion of single-industry operations serves to skew the population toward smaller firms, but the sample does include a small number of very large firms. The mean number of locations with information processing for each manufacturing firm is 4.9 with a median of 2 while the comparable values for non-manufacturing firms are 117.0 and 4, respectively. The mean information systems staff for manufacturing firms is 88.0 with a median of 6. Non-manufacturing firms report a mean information systems staff size of 191.4 with a median of 18.5.

Results

Ranking of Issues

The ranking of issues based on level of importance is shown in Table 3 for both manufacturing and non-manufacturing firms. The mean level of importance on the Likert scale reported for manufacturing firms was 4.79 while non-manufacturing firms reported an mean level of importance of 5.20.

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Table 2
Distribution Of Respondents By Two-Digit Sic Code

SIC Code	Description	Responses
	Manufacturing Firms	
20	Food & Kindred Products	1
22	Textile Mill Products	2
26	Paper & Allied Products	1
27	Printing & Publishing	2
28	Chemicals & Allied Products	10
30	Rubber & Misc Plastic Products	3
31	Leather & Leather Products	1
32	Stone, Clay, & Glass Products	1
33	Primary Metal Industries	5
34	Fabricated Metal Products	1
35	Industrial Machinery & Equipment	12
36	Electronic & Other Electric Equipment	10
37	Transportation Equipment	1
38	Instruments & Related Equipment	11
39	Misc Manufacturing Industries	3
	Total	64
	Non-Manufacturing Firms	
07	Agricultural Services	1
10	Metal Mining	1
13	Oil & Gas Extraction	7
45	Transportation by Air	3
47	Transportation Services	2
48	Communications	6
49	Electric, Gas, & Sanitary Services	13
50	Wholesale Trade-Durable Goods	1
52	Building Materials & Garden Supplies	1
53	General Merchandise Stores	3
55	Automotive Dealers & Service Stations	2
56	Apparel & Accessory Stores	1
57	Furnishings & Home Furnishing Stores	3
58	Eating & Drinking Establishments	6
59	Miscellaneous Retail	5
60	Depository Institutions	7
61	Nondepository Institutions	4
62	Security & Commodity Brokers	2
63	Insurance Carriers	4
65	Real Estate	2
70	Hotel & Other Lodging Places	3
72	Personal Services	2
73	Business Services	7
79	Amusement & Recreation Services	
80	Health Services	9
83	Social Services	2
87	Engineering & Management Services	9
	Total	106

Table 3
Comparison Of The Ranking Of Issues
Manufacturing Versus Non-Manufacturing Firms

Issue	Manufacturing		Non-Manufacturing	
	Rank	Mean	Rank	Mean
DATARES	1	5.43	3	5.40
COMPADV	2	5.25	2	5.65
ORGALGN	3	5.14[A]	1	5.75
ENDUSER	4	5.14[A]	5	5.36
ORGLRNG	5	5.03	8	5.24
STRTPLNG	6	5.00	4	5.37
INFARCH	7	4.94	7	5.25
ROLECONT	8	4.78	11	5.10
SOFTWARE	9	4.67	10	5.11
EFFPROD	10	4.64	9	5.16
APPLPORT	11	4.52	12	5.05
EDI	12	4.48	14	4.78
SECCONT	13	4.39	13	4.92
TELECOM	14	4.27	6	5.28
HUMRES	15	4.21	15	4.62

[A]Tie

Univariate and multivariate analyses of variance were conducted to determine whether there is a statistical difference in the level of importance attached to the issues by manufacturing and non-manufacturing firms. Significant differences were found at the 95 percent level for ORGALGN (organizational alignment), APPLPORT (application portfolio), SECCONT (security & control), TELECOM (telecommunications), and for the issues taken as a whole. These results are shown in Table 4. (See Table 1 for the correspondence between the short title of an item, shown in ALLCAPS in the text of this paper, and the full text used in the questionnaire.) Each of these four issues is more important to non-manufacturing firms than for manufacturing firms.

Factor Analysis

As Palvia and Basu (1999) point out, some of the issues may in fact be aspects of a single underlying issue. They start out with a list of ten *a priori* underlying issues. This study, instead, lets the data dictate the number of underlying issues for the purpose of data reduction. Depending upon the study=s goal, each of these uses of factor analysis

is appropriate (Gorsuch, 1983, page 4). Factor analyses were performed to reduce the number of issues and to provide a basis for understanding the underlying structure of the information systems issues confronting manufacturing and non-manufacturing firms. A varimax rotation was employed to facilitate interpretation of the factors. The correlation matrices providing the basis for the factor analyses are shown in Table 5.

Scree plots were used to judge the appropriate number of factors to include. As recommended by Cattell (1966), scree plots were prepared for both the manufacturing and non-manufacturing firms. The plot of eigenvalues for the manufacturing firms flattens out with the third factor. Eigenvalues for the first three factors are 8.13, 1.54, and .99, respectively. The rule of thumb that the model include factors with eigenvalues greater than one is approximated by including three factors. On the other hand, the plot of eigenvalues for non-manufacturing firms flattens out with the second factor, with eigenvalues for the factors of 8.30 and 1.06, respectively. This suggests a two-factor model for non-manufacturing firms.

Table 4
Univariate And Multivariate Analyses Of Variance

Issue	Industry Sector	Standard Mean	Deviation	Univariate F (P-Value)
DATARES	Mfg	5.43	1.24	.12
	Non-Mfg	5.40	1.28	(.73)
COMPADV	Mfg	5.25	1.65	1.79
	Non-Mfg	5.65	1.75	(.19)
ORGALGN	Mfg	5.14	1.62	5.12
	Non-Mfg	5.75	1.48	(.03)
ENDUSER	Mfg	5.14	1.38	.68
	Non-Mfg	5.36	1.35	(.41)
ORGLRNG	Mfg	5.03	1.58	.23
	Non-Mfg	5.24	1.27	(.63)
STRTPLNG	Mfg	5.00	1.49	1.45
	Non-Mfg	5.37	1.59	(.23)
INFARCH	Mfg	4.94	1.78	1.31
	Non-Mfg	5.25	1.49	(.25)
ROLECONT	Mfg	4.78	1.55	1.31
	Non-Mfg	5.10	1.43	(.25)
SOFTWARE	Mfg	4.67	1.68	2.47
	Non-Mfg	5.11	1.81	(.19)
EFFPROD	Mfg	4.64	1.50	3.66
	Non-Mfg	5.16	1.53	(.06)
APPLPORT	Mfg	4.52	1.61	3.99
	Non-Mfg	5.05	1.43	(.04)
EDI	Mfg	4.48	1.92	1.06
	Non-Mfg	4.78	1.83	(.30)
SECCONT	Mfg	4.39	1.59	3.95
	Non-Mfg	4.92	1.47	(.04)
TELECOM	Mfg	4.27	1.86	12.51
	Non-Mfg	5.28	1.62	(.00)
HUMRES	Mfg	4.21	1.93	1.75
	Non-Mfg	4.62	1.79	(.19)

Multivariate Test	Value	Multivariate F	P-Value
Pillais	.16	1.88	.03
Hotellings	.19	1.88	.03
Wilk	.84	1.88	.03
Roys	.16		

Table 6 shows the factor matrix of issues for manufacturing firms. Items loading most heavily on the first factor are DATARES (data resource), COMPADV (competitive advantage), ROLECONT (role & contribution), ENDUSER (end-user computing), ORGLRNG (organizational learning), and SECCONT (security & control). These issues concern the IS function's relationship with external entities, the rest of the firm and entities external to the firm. This factor is therefore labeled "External Issues."

Issues loading most heavily on the second factor are INFARCH (information architecture), HUMRES (human resources), ORGALGN (organizational alignment), STRTPLNG (strategic plan-

Table 5
Correlation Matrix Of The Variables*
Manufacturing And Non-Manufacturing (In *Italics*) Firms

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 DATARES	1.00														
2 COMPADV	.59	1.00													
	.49														
3 ORGALGN	.38	.47	1.00												
	.50	*.47*													
4 ENDUSER	.74	.61	.54	1.00											
	.55	*.44*	*.48*												
5 ORGLRNG	.62	.75	.41	.60	1.00										
	.67	*.42*	*.50*	*.55*											
6 STRTPLNG	.43	.54	.74	.48	.60	1.00									
	.52	*.58*	*.67*	*.36*	*.50*										
7 INFARCH	.34	.31	.77	.41	.32	.72	1.00								
	.52	*.45*	*.73*	*.57*	*.56*	*.62*									
8 ROLECONT	.77	.67	.50	.65	.74	.61	.46	1.00							
	.73	*.68*	*.53*	*.44*	*.55*	*.61*	*.52*								
9 SOFTWARE	.36	.44	.54	.45	.46	.54	.43	.35	1.00						
	.62	*.35*	*.46*	*.53*	*.51*	*.51*	*.61*	*.50*							
10 EFFPROD	.42	.45	.52	.34	.55	.69	.67	.57	.42	1.00					
	.58	*.47*	*.58*	*.64*	*.61*	*.59*	*.72*	*.57*	*.69*						
11 APPLPORT	.47	.43	.52	.47	.61	.52	.45	.50	.68	.62	1.00				
	.59	*.30*	*.52*	*.54*	*.61*	*.47*	*.56*	*.42*	*.76*	*.58*					
12 EDI	.45	.44	.47	.41	.42	.48	.36	.47	.44	.47	.46	1.00			
	.40	*.46*	*.43*	*.44*	*.47*	*.50*	*.42*	*.51*	*.39*	*.53*	*.49*				
13 SECCONT	.57	.66	.48	.55	.55	.60	.54	.62	.39	.60	.40	.31	1.00		
	.53	*.43*	*.46*	*.41*	*.41*	*.49*	*.46*	*.53*	*.50*	*.61*	*.50*	*.35*			
14 TELCOM	.55	.48	.59	.52	.40	.49	.61	.49	.37	.57	.44	.50	.66	1.00	
	.53	*.53*	*.63*	*.51*	*.46*	*.53*	*.68*	*.48*	*.57*	*.67*	*.53*	*.53*	*.57*		
15 HUMRES	.40	.23	.58	.37	.39	.57	.70	.49	.36	.51	.47	.38	.31	.49	1.00
	.41	*.45*	*.54*	*.42*	*.51*	*.48*	*.55*	*.42*	*.51*	*.49*	*.41*	*.37*	*.39*	*.54*	

Table 6
Factor Matrix
Manufacturing Firms

Variable	Internal	External	Applications
DATARES	.822	.200	.178
COMPADV	.792	.137	.300
ROLECONT	.783	.333	.218
ENDUSER	.746	.235	.246
ORGLRNG	.725	.133	.469
SECCONT	.691	.473	.034
INFARCH	.150	.917	.168
HUMRES	.134	.738	.250
ORGALGN	.245	.730	.367
STRTPLNG	.354	.669	.401
TELECOM	.488	.645	.066
EFFPROD	.332	.636	.356
SOFTWARE	.186	.260	.808
APPLPORT	.285	.299	.778
EDI	.329	.302	.510

ning), TELECOM (telecommunications), and EFFPROD (effectiveness & productivity). All of these issues address concerns internal to the IS function. The second factor is thus labeled "Internal Issues."

The third factor is comprised of SOFTWARE, APPLPORT (application portfolio), and EDI. The common element among these issues is that they reflect specific concerns related to software applications. Therefore, the third factor is labeled "Applications Issues."

The factor matrix for non-manufacturing firms is shown in Table 7. Items loading heaviest on the first factor are APPLPORT (application portfolio), SOFTWARE, EFFPROD (efficiency & productivity), ENDUSER (end-user computing), INFARCH (information architecture), ORGLRNG (organizational learning), DATARES (data resource), TELECOM (telecommunications), and SECCONT (security & control). The common element among these issues is that they appear to deal with the essence of the IS function. Thus, this factor is labeled "Functional Issues."

Items loading most heavily on the second factor are COMPADV (competitive advantage), ROLECONT (role & contribution), STRTPLNG (strategic planning), ORGALGN (organizational alignment), EDI, and HUMRES (human resources). For the most part, these issues seem to be concerned with the strategic role of information systems in the organization. Hence, this second factor is labeled "Strategic Issues."

In addition to providing a mechanism for examining the strength of the relationship between measured variables and their latent constructs, factor analysis also serves as a data reduction tool. For manufacturing firms, the "External Issues" factor is composed of the six items (issues) ranked 1st, 2nd, 8th, 4th, 5th, and 13th for a mean ranking of 5.50 and a mean level of importance of 5.00. The "Internal Issues" factor is comprised of six issues ranked 7th, 15th, 3rd, 6th, 14th, and 10th resulting in a mean ranking of 9.17 and a mean importance score of 4.70. The three issues in the "Applications" factor are ranked 9th, 11th, and 12th for a mean ranking of 10.67 with a mean level of importance of 4.56.

Table 7
Factor Matrix
Non-Manufacturing Firms

Variable	Functional Issues	Strategic Issues
APPLPORT	.855	.165
SOFTWARE	.830	.225
EFFPROD	.720	.459
ENDUSER	.692	.287
ISARCH	.659	.480
ORGLRNG	.648	.398
DATARES	.594	.500
TELECOM	.574	.541
SECCONT	.498	.466
COMPADV	.122	.863
ROLECONT	.306	.794
STRTPLNG	.354	.737
ORGALGN	.490	.600
EDI	.383	.541
HUMRES	.472	.473

For non-manufacturing firms, the nine issues comprising the "Functional Issues" factor are ranked 12th, 10th, 9th, 5th, 7th, 8th, 3rd, 6th, and 13th for an mean rank of 8.11. The mean importance score for these items is 5.20. The six issues that make up the "Strategic Issues" factor are ranked 2nd, 11th, 4th, 1st, 14th, and 15th with a mean ranking of 7.833. The mean importance score for these issues is 5.21.

Discussion

The analysis clearly shows that the continuing information systems issues addressed in this study are perceived differently, in terms of importance, in manufacturing and non-manufacturing firms. With a single exception (DATARES -- data resource, but not at a statistically significant level), non-manufacturing firms rated each issue more important than did the manufacturing firms.

This serves to confirm the assertion of Kempis and Ringbeck (1998). They proposed that manufacturing firms no longer attempt to leverage their information systems investments for a strategic ad-

vantage and now view cost as the sole basis for managing information systems.

The factor analysis also supports this supposition. While the non-manufacturing factor analysis differentiates between functional and strategic issues, this is not evident in the factor analysis for the manufacturing firms. Issues of a strategic nature are found as components of all three factors. This may suggest an inability to identify issues of a strategic nature or a lack of concern for them.

These differences between the manufacturers = views of IS issues and the non-manufacturers' views of IS issues may suggest a more sophisticated view of what information technology can accomplish for the enterprise on the part of service and other non-manufacturing industries. In these industries, IT often appears to be integrated with the entire operation of the firm across functions and business processes both within and outside the firm. Manufacturing firms view concerns as being located within the IS function or outside the IS function; they do not seem to integrate the IS function with the entire enterprise to the same extent as non-manufacturers.

Suggestions For Future Research

We believe that further insights can be gained by comparison of the importance of information systems issues under differing levels of various contextual variables. For example, studies can profitably look at differences according to variations in environmental uncertainty, organizational size, degree of organizational formalization, or organization structure. Future studies comparing views of IS issues among functional areas, among other economic sectors (such as for-profit versus not-for-profit), and among countries may provide additional insights about top IS issues.⌘

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