Managerial and Technical Factors Related to Strategic Impact of Information Technology

ALBERTO M. BENTO
UNIVERSITY OF BALTIMORE

AND

GLEN L. GRAY
CALIFORNIA STATE UNIVERSITY
NORTHRIDGE

ABSTRACT

Information Technology seems to have a different strategic impact on organizations: in some it enables to obtain significant competitive advantages, while in others its contribution to strategy is marginal. This work proposes a conceptual framework to study these differences, and reports a pilot empirical study to measure the differences using the framework proposed. Strategic impact of information technology is the dependent variable. Technical (information technology stage, end-user computing level, systems development level), managerial (management style, management model, information resource management type) and control (MIS size, organization size, industry) variables are used to explain the differences in strategic impact of information technology. The main results are that management style, information resource management, industry and end-user computing are the most important factors to explain the differences in strategic impact of information technology (accounting for almost 70% of its variation). Management model was also found to have an indirect effect on strategic impact, and a strong direct effect on information resource management type. Furthermore, the results of the study seem to indicate that managerial variables play a stronger role to explain the different strategic impacts than technical or control variables.

INTRODUCTION

The objective of this work is to study what factors make information technology produce a strategic impact on business organizations. There is a reasonable agreement in the literature [2, 6, 9, 27] that not all organizations are affected equally by the use of information technology (IT). On the other hand, different competitive hypotheses are proposed in the same sources to explain why the strategic impact of IT varies among organizations. The present study is a contribution to measure the effect of the different hypothesized factors on the strategic impact of IT.

Information technology comprises the computer, voice and data communication resources available in an organization [9]. Information technology is used for management — transaction processing and decision support — and operations — office automation, computer-aided design, computer-aided manufacturing.

Information technology produces a strategic impact when it enables an organization to obtain a strategic advantage in regard to the competition [2, 23, 28]. For example, the use of CAD/CAM in car manufacturing can increase the product quality at the same time that it can decrease the product unit cost. Strategic impact is the use of information technology to make the firm more *effective*, in contrast with the traditional use for data processing that can make the firm more *efficient*.

A series of factors are identified in the literature [2, 9, 12, 27, 32] as possible explanations for the strategic impact of information technology. These factors are: size of the organization, type of industry, size of investments in IT, IT stage, type of information resource management, systems development level, end-user computing level, Chief Information Officer (CIO) management style, CIO management model, early adoption of IT and type of IT investment. This study includes all these factors but the last two.

This study was conducted using a survey instrument, both in diskette and printed format, applied to a sample of 22, out of 60 (36.6%), Fortune 500 companies located in New England, and included all, but the last two, factors listed in the previous paragraph as possible explanations for different strategic impact of IT.

RESEARCH VARIABLES AND HYPOTHESES

The overall research question is:

"What factors make information technology produce a strategic impact on business organizations?"

For the purposes of this research the strategic impact of IT was classified as an outcome variable, and the variables, or factors, affecting the strategic impact of IT were classified as decision variables (directly under management control) and control variables (indirectly under management control).

Outcome Variable

Strategic impact of IT was measured using the Cash, McFarland, McKenney [9] framework. Organizations with applications portfolios classified as:

(a) SUPPORT are neither operationally, nor strategically dependent on IT,
(b) FACTORY are heavily dependent on cost effective operational systems, but are not strategically dependent on IT,
(c) TURNAROUND are not substantially dependent on cost effective operational systems, but are strategically dependent on IT, and
(d) STRATEGIC are heavily operationally and strategically dependent on IT.

Decision Variables

The factors considered in this study as decision variables are: information technology stage, CIO management style, CIO management model, information resource management type, systems development level and end-user computing stage.

Information Technology Stage

The IT stage hypothesis is a controversial topic in the literature [14,26]. The framework used in this study emphasizes the hardware and software characteristics of the IT use. The CPU and file management types were used as indicators of four types of IT environments:

(a) BEGINNER — a PC or mini-computer as the main CPU would indicate a low level of IT use, since all organizations in the sample are Fortune 500 companies,
(b) TRADITIONAL — a single mainframe CPU and flat files would be indicators of a reasonable use of IT, without the integration of the applications portfolio provided by data bases (DB),
(c) MODERN — multiple mainframe CPUs and DB would be indicators of intense use of IT, with DB integration of applications, and
(d) ADVANCED — multiple mainframe CPUs, DB and substantial use of machine time for running 4th Generation Languages applications would be indicators of intense and integrated use of IT, with substantial prototyping development and/or end-user applications generation.

CIO Management Style

The management style was measured using a sub-set of the Myers-Briggs (MBTI) questionnaire, following the tradition in MIS research [20]. But unlike other studies [22, 30, 33] the dimensions chosen were Sensing-Intuition and Introversion-Extroversion. The Introversion-Extroversion dimension captures how much a manager is people oriented or not; while the Sensing-Intuition dimension identifies how much a manager is fact or concept oriented, defining four managerial styles:

(a) DECISIVE (SI)— oriented towards concepts and ideas, using hard data as evidence, and not taking into consideration interpersonal relations,
(b) AUTHORITATIVE (NI) — oriented towards concepts and ideas, using concepts and theories as evidence, and not taking into consideration facts and interpersonal relations,
(c) PARTICIPATIVE (SE) — oriented towards people and things, using hard data as evidence, and
(d) SUPPORTIVE (NE) — oriented towards people and things, using concepts and theories as evidence, and not taking into consideration facts.

CIO Management Model

The CIO management model was measured using the two-dimensional framework developed and tested empirically by Bento and Wysk [4] and later replicated in other studies [21] with comparable results. The present study also draws upon the recent discussions on the classical management functions [8].

The first dimension captures if the manager sees the managerial function as a dominant task, or a set of multiple, interrelated, tasks. The other dimension identifies the manager orientation towards process or task. The combination of these dimensions defines four management models:

(a) COORDINATION — process oriented and seeing the managerial task as to create and maintain a "cooperation among men that is conscious, deliberate, purposeful"[1],
(b) DECISION — task oriented and seeing the managerial task as making decisions that "affect the organizational capacity to function and to obtain results" [13],

(c) ACTION — process oriented and seeing the managerial task as interrelated interpersonal, informational, and decision-making roles [24], and
(d) ANALYTICAL OR CLASSIC — task oriented and seeing the managerial task as interrelated planning, organization, coordination, and control functions [15].

Information Resource Management

The information resource management framework was developed using in part the literature [3, 18, 26], and in part using insights from practice [19, 31]. The planning and control dimensions were used to identify three types of management of the information resources:

(a) TECHNICAL — the IT plan is comprised of a list of hardware, software and personnel resources to support generic computational user needs; the IT costs and expenses are absorbed as overhead by the organization,
(b) MIXED — the IT plan identifies specific organizational IT needs and priorities for the various functional areas, using methodologies like the IBM Business Systems Plan (BSP), and derives hardware, software and personnel requirements needed to develop, implement and maintain information systems to support these needs; the IT costs and expenses are either absorbed as overhead, or charge-out to the users, with the predominance of a cost-center structure (no profits added to the services provided), and
(c) MANAGERIAL — the IT plan is part of the organizational business plan, taking into consideration the organization culture and corporate strategy, from which information systems are identified, and hardware, software and personnel resources are allocated to specific projects; the IT costs and expenses are charged-out to the users, with the predominance of a profit-center structure (profits are added to the cost of the services provided).

Systems Development Level

The systems development (SD) level is measured using the following taxonomy, reflecting the extensive literature in the subject [7, 10, 11]:

(a) PROGRAM — program development rather than systems development. Applications are developed individually, creating "islands of software,"
(b) INFORMAL — systems development, but no standard methodology used. The need for application integration is recognized, but no standards to are adopted,
(c) FORMAL — systems development with standard methodology used. Application integration is accomplished through a set of standardized procedures, and
(d) AUTOMATED — systems development with standard methodology and automated tools. Formal development using CASE — Computer-Aided Software Engineering systems.

End-User Computing Stage

The end-user computing (EUC) level was measured using the framework derived from Gerrity and Rockart [16] and Henderson and Treacy [17]. The dimensions of objectives and control mechanisms were used to define three EUC stages:

(a) INITIATION — EUC is introduced as a mean to support end-user needs without any special organizational control mechanism, and with or without MIS management support (the so-called "PC revolution"),
(b) CONTROL — there is explicit recognition of the need to control expenditures and to provide standards for EUC, in addition to the need to support legitimate end-user applications development; basic control mechanisms are implemented, such as micro-managers and PC and 4th GL technical support groups, and
(c) MANAGEMENT — EUC is integrated in the IT management strategy as an alternative to traditional, in-house, systems development, and more elaborate and formal control mechanisms (information centers) are implemented to provide training, consulting, planning and control, and promote end-user systems development.

Control Variables

Organization size, industry type and MIS size are used in this study as control variables:

(a) Organization size as the total number of employees working in the organization.
(b) Industry as the SIC codes of the organizations.
(c) MIS size as the total number of employees working in MIS.

Hypotheses

The hypotheses of this study are:

H1. The size of the organization and the type of industry are related to the MIS size.

H2. The size of the organization, the type of industry and the MIS size are related to the CIO management style.

H3. The size of the organization, the type of industry, the MIS size and the CIO management style are related to the CIO management model.

H4. The size of the organization, the type of industry, the MIS size, the CIO management style and management model are related to the IT stage.

H5. The size of the organization, the type of industry, the MIS size, the CIO management style and management model and the IT stage are related to the type of information resource management.

H6. The size of the organization, the type of industry, the MIS size, the CIO management style and management model, the IT stage and the type of information resource management are related to the systems development level.

H7. The size of the organization, the type of industry, the MIS size, the CIO management style and management model, the IT stage and the type of information resource management are related to the end-user computing stage.

H8. The size of the organization, the type of industry, the MIS size, the CIO management style and management model, the IT stage, the type of information resource management, the systems development level and the end-user computing stage are related to the strategic impact of IT.

These series of hypotheses comprise a quasi-recursive model, suitable to be treated by causal path-analysis. However, given the exploratory nature of this study, a less ambitious design was used to test the hypotheses, as will be discussed in the methodology section.

RESEARCH METHODOLOGY

The study was conducted as a survey research using as the target population the sixty Fortune 500 companies located in New England. The data on industry type, number of employees and operating income were obtained from Fortune Magazine [29]. The data on all other variables were obtained using a survey instrument in a printed or diskette format. Twenty-six questionnaires were returned, of which 22 were usable, corresponding to a 36.6% sample of the organizations in the population.

The sample, although only representative of the population target, has enough variety to allow effective controls in regard to the three most common variables used in the literature — industry, organization size, and MIS size.

The present study was designed as the first of a series of studies on the subject and, therefore, is exploratory in nature. The New England region was selected as a target because it contains important centers of a variety of industries (construction, high tech, insurance, education, health) in very close physical and cultural settings. Therefore, the sample represents a diversified cross-industry panel, as shown in Table 1.

The size of the organizations in the sample also varies substantially, as shown in Table 2, although all are large-size organizations. The MIS size was also operationalized through the number of employees, as shown in Table 3.

Operationalization of the Research Variables

The research instrument was pre-tested and refined to guaranty internal validity. A weak external validity post-questionnaire interview test was conducted with five out of the twenty-two usable (and self-identified) respondents to evaluate how much the questionnaire captured the ideal types defined by the research variables.

Strategic Impact of IT

Strategic impact was measured using existing systems and applications development portfolio dimensions, where each one of the dimensions could assume the values of low (1) or high (2) importance. The combination of scores obtained would define the type of strategic impact as defined

Table 1
Industry Type

Code	Description	SIC	N	%
01	General Manufacturing	16,20,26,32	4	18.2
02	Chemicals	28	2	9.1
03	Metal Products	34,35	2	9.1
04	Electric & Electronic	36	2	9.1
05	Transportation Equipment	37	2	9.1
06	Scientific and Photographic	38	3	13.6
07	Transportation and Public Utilities	42,49	2	9.1
08	Finance & Insurance	63	5	22.7

Table 2
Organization Size

Number of employees	%
less than 3,000	13.6
3,000 to 6,000	13.6
6,000 to 9,000	22.7
10,000 to 19,000	13.6
20,000 to 49,000	18.2
50,000 to 99,000	9.1
more than 100,000	9.1

Table 3
MIS Size

Number of employees	%
less than 50	21.1
50 to 100	26.3
100 to 200	21.1
200 to 500	21.1
more than 1,000	9.1

previously.

The existing systems impact was measured by two variables: shutdown impact and business impact. The shutdown impact was derived from questions asking the CIO to evaluate what would be the impact on operations of one-hour and two-weeks shutdown of the main computer in their organizations. The business impact was derived from questions asking the CIO to evaluate what would be the impact of critical computer processing errors on external exposure, profits and operations in their organizations. All of these questions were measured in a Likert-like four-point scale, and each individual variable was classified as low (1) or high (2) impact by comparison with its median. The shutdown and business impact variables were obtained by averaging the low-high scores of the questions corresponding to each variable. The Cronbach alpha reliability index for shutdown impact was .83 and for business impact .68.

The development portfolio impact was measured by six questions asking the CIO the percentage of the development budget dedicated to research and development, cost displacement productivity applications, maintenance, decision support, IT based product development (like ATMs), and operational efficiency projects. All variables, but maintenance, were classified as high (2) impact if the expenditures with each type of project were above the mean, and low (1) otherwise. Maintenance was classified as low (1) impact if the expenditures were above the mean, or high (2) otherwise, following the rationale that the more resources were applied to maintenance, the less strategic impact the applications portfolio would have. The development portfolio impact was obtained by adding the low-high score of the six questions and comparing the sum obtained with the median for this variable.

The questions used in the questionnaire were inspired and adapted from Cash, McFarland and McKenney's [9,pp.220-223] example of how organizations are measuring strategic impact. The comparison with the median and mean, when appropriate, was used instead of the specific limits shown in the examples, to make the measures used in this work tailored to the sample.

Information Technology Stage

The information technology stage was measured using the main CPU and file management dimensions, as defined previously. The classification into the four types (beginner, traditional, modern and advanced) was made from descriptive questions asking about all main types of hardware and software the organizations had installed, asking what percentage of the files where organized using data base management systems, and what percentage of machine time was used for 4th GL applications.

Management Style

The management style was measured using a sub-set of the MBTI questionnaire, as discussed previously. The procedures recommended in Myers [25] were followed and the CIOs were classified accordingly.

Management Model

The management model was measured using the dominant-multiple activities and process-task orientation dimensions and the four management models defined previously were created as variables (coordination, decision, action and analytical), representing the percentage of time dedicated by the CIO to that specific set of tasks. The management model selected was the one that, discounting overlaps between the models, had the largest percentage of time allocated to it.

The coordination variable was defined through questions related to the percentage of time dedicated to interpersonal relations with subordinates, peers and superiors.

The decision variable was defined through questions related to percentage of time dedicated to operational decisions (e.g., authorizations, payments, prices, salaries, purchases, proposals, travel expenses) plus planning (defined as another variable).

The action variable was created by the sum of three variables: interpersonal relations, information and decision.

Interpersonal relations was defined through questions related to the time expended by the CIO in the figurehead role, plus the previously defined coordination variable. Information was defined through questions related to the percentage of time used in obtaining and transmitting information to subordinates, peers, superiors, and outsiders. Finally, the same value computed previously for decision was also used here.

The analytical variable was created by the sum of four variables: planning, organizing, coordination and control. Planning was defined through questions related to the time allocated to studies of possible future courses of action, to making decisions in regard to future actions and to how to carry out these decisions. Organizing was defined through questions related to the percentage of time allocated to decide what and how tasks should be performed in the CIO departments, and to define procedures to make these tasks efficient. Control was defined by questions related to the percentage of time used in studies to identify variations in regard to plan and to decide and implement corrective actions. The same values computed previously for coordination were also used here.

The questions used in the questionnaire were inspired and adapted from the descriptions for each of these variables provided by Mintzberg [24] and previously used in the instrument developed by Bento and Wysk [4], that also included questions related to planning, organizing and control, not available in Mintzberg.

Information Resource Management

The type of information resource management was measured using alternative descriptions of planning and control procedures. The three alternative scenarios for planning shown previously were presented for the CIOs to choose from. Likewise, the alternative scenarios for charge-out systems were also presented to the CIOs' choice. The combination of these choices was used to define the type of information resource management.

To guaranty that odd combinations were not considered (like a list of resources only as the plan with profit center as the control mechanism) a value of 9 (error) was assigned to all possible non-foreseen types in the formula that created the information resource management variable. Fortunately, no such cases happened in the sample.

Systems Development Level

The systems development level was measured using descriptions of the four levels shown previously. Other questions related to systems development alternatives and project management were also included in the questionnaire. Unfortunately, the reliability analysis has shown that these other two variables neither form a scale with the systems development level, nor between themselves. The values of Cronbach alpha obtained were all below .35.

End-User Computing Stage

The end-user computing stage was measured using descriptions of hypothesized objectives and control mechanisms. The three alternative descriptions for objectives shown previously were presented for the CIOs to choose from. Likewise, the alternative descriptions for control mechanisms were also presented to the CIOs' choice. The combination of these choices was used to define the EUC stage.

To guaranty that odd combinations were not considered (like pure end-user needs support and information center as the control mechanism) a value of 9 (error) was assigned to all possible non-foreseen types in the formula that created the EUC stage variable. Fortunately, again no such cases happened in the sample.

Statistical Procedures

The reliability procedure of SPSS was used to test for non-additivity and obtain the coefficients of reliability reported in the operationalization of the variables when this procedure was appropriate.

Three research variables were measured in the interval scale (organization size, MIS size and management model), six were in the ordinal scale (strategic impact of IT, IT stage, management style, IRM type, EUC level, SD level), and one in the nominal scale (industry).

The parametric and non-parametric correlation procedures of SPSS were used to compute the Pearson and Kendall Tau-c simple correlation coefficients between the research variables. The results were compared to check if the ordinal scales used have introduced significant differences in the results between the two methods. The only cases where major differences occurred were in correlations between interval variables — the Tau-c underestimated significantly the relation between the interval variables.

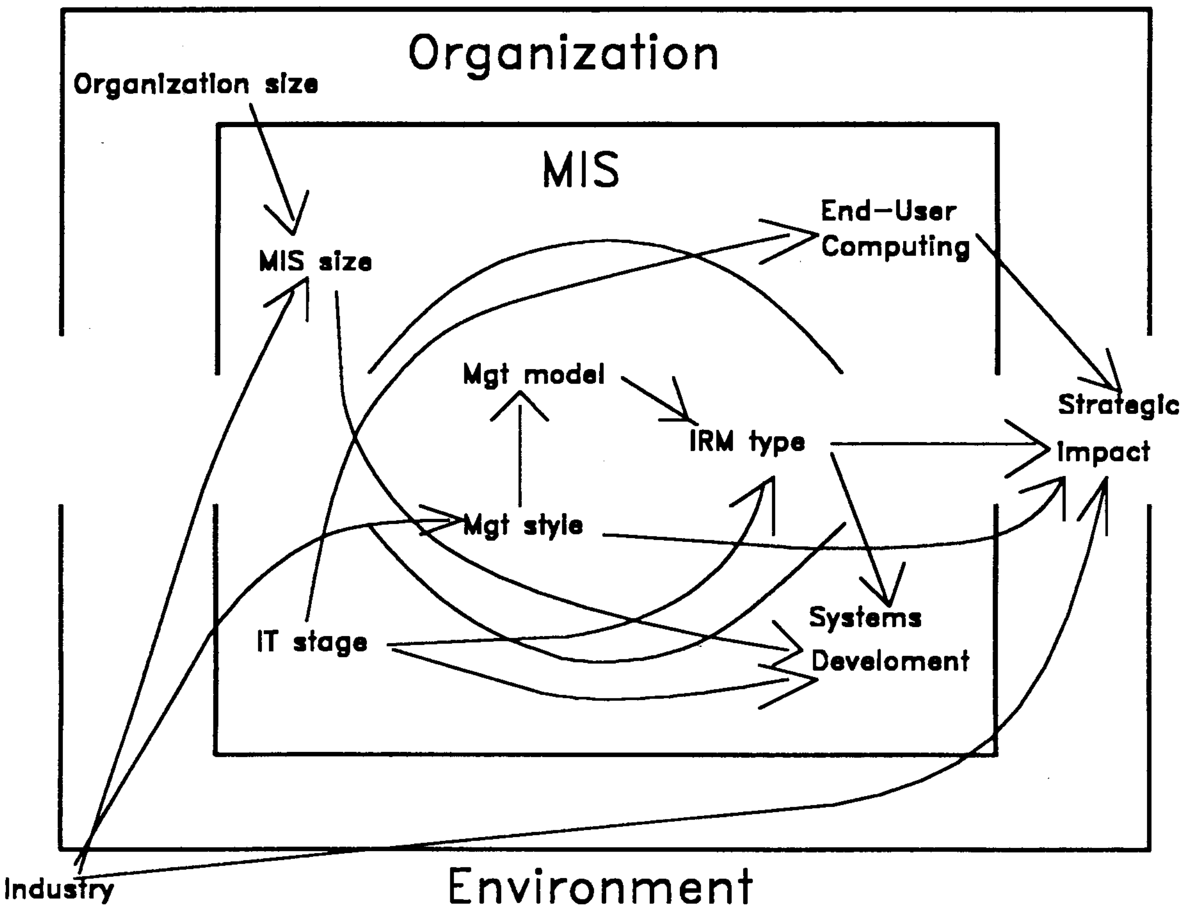
Finally, the SPSS stepwise multiple regression procedure was used to test the hypothesis, and compute beta weights, partial correlations and levels of significance. The level of significance chosen for the equations' F statistic was .05. Therefore, new variables were included in the equation if, and only if, the equations' F were significant at least at .05.

RESULTS AND CONCLUSIONS

The main results of this study are summarized in figure 1. Management style, information resource management, industry and end-user computing level are the most important of the factors considered to explain directly and indirectly the strategic impact of IT (see Table 4). Management model was also found to have an indirect effect on strategic impact (see Table 4).

These results seem to indicate, as pointed out in the literature [9], that the proper management of IT (IRM type

Figure 1
Main Results



and management style) is of paramount importance to achieve strategic impact of IT, and also that some industries can benefit more from IT use than others. End-user computing negative relation to strategic impact of IT seems to indicate that as more control and management support is applied to end-user development, less effective become the end-user systems — what contradicts our hypothesis. Let's consider the results for management style, IRM type and EUC level in more detail.

Strategic Impact and Management Style

All extroverted CIOs were found (Table 5) to be in organizations with strategic applications development portfolios; while only 22.2% of the introverted CIOs perceived to have strategic applications development portfolios. It seems that either the less strategic organizations attract more introverted CIOs, or that the more introverted CIOs do not realize and do not move their organizations towards the strategic impact of IT.

Strategic Impact and Information Resource Management

All organizations with managerial information resource management had strategic applications development portfolios, while only 16.6% of the organizations with technical information resource management had strategic applications development portfolios, as can be seen in Table 6. It seems, again, that either the less strategic organizations require more technical management, or that the more technical managers do not realize and do not move their organizations

Table 4
Regression Analysis
Strategic Impact of Information Technology

Adjusted R^2: .69644 Significance: .0008

Variables	Partial Correlation	Significance Level	Beta weights Direct	Beta weights Indirect	Beta weights Total
Mgt. Style	.50572	.003	.72849	.18702	.91551
IRM type	.38861	.015	.46543		.46543
Industry	.39751	.014	.46913	–.09206	.37887
EUC type	–.26278	.081	–.29751		–.29751
Mgt. model	...	n.s.	...	.28610	.28610

towards the strategic impact of IT.

Combining the two above findings it seems that organizations that recognize strategic opportunities of the IT use are much better off if their CIOs have an extroverted management style and adopt a managerial type of information resource management. All organizations in the sample with strategic applications development portfolios met these two conditions.

Strategic Impact and EUC Level

The negative partial correlation between strategic impact and EUC level is somewhat surprising both in logical and statistical terms. We would expect that as more management is provided to EUC the more integrated in the organization strategy it would be, and to contribute to the strategic impact of IT.

The hypothesis that EUC level would be related directly to IRM type was also not confirmed. EUC level is related only to IT stage (partial correlation = .52244, significant at .031). Also the simple correlation between the two variables is positive and non-significant as shown in table 7. It seems that either more control and support does not increase the strategic impact of IT derived from EUC, or other variables related to both are missing in the model, generating a spurious correlation between EUC level and strategic impact of IT.

Information Resource Management Results

Information resource management type was found to be directly related to management model and IT stage, and indirectly to management style and industry (Table 8).

It seems as if the IT stage represents the necessary infrastructure to allow information resource management to move from technical to managerial, while the CIO management model sets the stage for the kind of information resource management found in the sample.

Table 5
Contingency Analysis
Strategic Impact and Management Style

Strategic Impact — Count / Row Pct / Col Pct / Tot Pct	Management Style: Decisive 1.	Authoritative 2.	Participative 3.	Supportive 4.	Row Total
1.	0	3	0	0	3
	0	100.0	0	0	15.8
Support	0	50.0	0	0	
	0	15.8	0	0	
2.	3	1	0	0	4
	75.0	25.0	0	0	21.1
Factory	100.0	16.7	0	0	
	15.8	5.3	0	0	
3.	0	1	4	3	8
	0	12.5	50.0	37.5	42.1
Turnaround	0	16.7	80.0	60.0	
	0	5.3	21.1	15.8	
4.	0	1	1	2	4
	0	25.0	25.0	50.0	21.1
Strategic	0	16.7	20.0	40.0	
	0	5.3	5.3	10.5	
Column	3	6	5	5	19
Total	15.8	31.6	26.3	26.3	100.0

Chi Square = 23.35417 with 9 d.f., Significance=.0055
Contingency Coefficient = .74256
Kendall's Tau B = .52117 Significance = .0045
Kendall's Tau C = .50231 Significance = .0045
Pearson's R = .61313 Significance = .0026

Table 6
Contingency Analysis
Strategic Impact and Information Resource Management

Strategic Impact (Count / Row Pct / Col Pct / Tot Pct)	Information Resource Management: Technical 1.	Mixed 2.	Managerial 3.	Row Total
1. Support	4	0	0	4
	100.0	0	0	20.0
	66.7	0	0	
	20.0	0	0	
2. Factory	1	3	0	4
	25.0	75.0	0	20.0
	16.7	42.9	0	
	5.0	15.0	0	
3. Turnaround	1	2	5	8
	12.5	25.0	62.5	40.0
	16.7	28.6	71.4	
	5.0	10.0	25.0	
4. Strategic	0	2	2	4
	0	50.0	50.0	20.0
	0	28.6	28.6	
	0	10.0	10.0	
Column Total	6	7	7	20
	30.0	35.0	35.0	100.0

Chi Square = 17.08333 with 6 d.f., Significance = .0090
Contingency Coefficient = .67873
Kendall's Tau B = .59975 Significance = .0013
Kendall's Tau C = .62250 Significance = .0013
Pearson's R = .69461 Significance = .0003

Table 7
Contingency Analysis
Strategic Impact and EUC Level

Strategic Impact (Count / Row Pct / Col Pct / Tot Pct)	EUC Level: Initiation 1.	Control 2.	Management 3.	Row Total
1. Support	1		3	4
	25.0		75.0	20.0
	20.0		27.3	
	5.0		15.0	
2. Factory	2	1	1	4
	50.0	25.0	25.0	20.0
	40.0	25.0	9.1	
	10.0	5.0	5.0	
3. Turnaround	2	2	4	8
	25.0	25.0	50.0	40.0
	40.0	50.0	36.4	
	10.0	10.0	20.0	
4. Strategic		1	3	4
		25.0	75.0	20.0
		25.0	27.3	
		5.0	15.0	
Column Total	5	4	11	20
	25.0	20.0	55.0	100.0

Chi Square = 4.27273 with 6 d.f., Significance = .6398
Contingency Coefficient = .41956
Kendall's Tau B = .13750 Significance = .2470
Kendall's Tau C = .13500 Significance = .2470
Pearson's R = .13965 Significance = .2785

Table 8
Regression Analysis
Information Resource Management

Adjusted R^2: .40423 Significance: .0105

Variables	Partial Correlation	Significance Level	Beta weights: Direct	Indirect	Total
Mgt.model	.61211	.007	.61471		.61471
IT stage	.26496	.091	.26609		.26609
Mgt. style	...	n.s.	...	.40182	.40182
Industry	...	n.s.	...	–.19393	–.19393

Table 9
Contingency Analysis
Information Resource Management and Management Model

Information Resource Management (Count / Row Pct / Col Pct / Tot Pct)	Management Model: Coordination 1.	Decision 2.	Action 3.	Analytical 4.	Row Total
1.	4	1	1	0	6
	66.7	16.7	16.7	0	30.0
Technical	66.7	50.0	12.5	0	
	20.0	5.0	5.0	0	
2.	2	0	4	1	7
	28.6	0	57.1	14.3	35.0
Mixed	33.3	0	50.0	25.0	
	10.0	0	20.0	5.0	
3.	0	1	3	3	7
	0	14.3	42.9	42.9	35.0
Managerial	0	50.0	37.5	75.0	
	0	5.0	15.0	15.0	
Column Total	6	2	8	4	20
	30.0	10.0	40.0	20.0	100.0

Chi Square = 10.37698 with 6 d.f., Significance = .1096
Contingency Coefficient = .58447
Kendall's Tau B = .55696 Significance = .0027
Kendall's Tau C = .57000 Significance = .0027
Pearson's R = .63914 Significance = .0012

The technical information resource management type corresponds in 83.3% of the cases to CIOs with a dominant activity management model; while the managerial information resource management type corresponds in 85.7% of the cases to CIOs with multiple activities management models, as can be seen in Table 9. It also seems that CIOs with process orientation had more difficulties to move from a technical to a managerial (only 21.4%) information resource management type than the task oriented CIOs (50%) had. One could speculate that task oriented CIOs are more sensitive to results and, therefore, would promote changes at a faster pace than process oriented CIOs, concerned with people and the resistance to change process.

Other results

Management model was found positively correlated to management style, and is not related to any of the control variables. This seems to indicate that CIOs with a given management style tend to see the managerial tasks in the same way. As shown in Table 10, all introverted CIOs see one of the managerial tasks as dominant, while all extroverted CIOs see the managerial tasks as multiple and interrelated activities. Moreover, all but one of the sensing CIOs are process oriented, while the intuition CIOs are divided, almost equally, between task and process oriented management models.

It is interesting to note that the management model and the management style instruments have been validated externally and independently by other researchers prior to their use in this study. Therefore, considering the apparent robustness of the instruments used, a direct inference from the relationship found is that if a given CIO management model leads to a better information resource management type, as we will see ahead, then it is of paramount importance to recruit and hire CIOs with the correlated management style

Table 10
Contingency Analysis
Management Model and Style

Management Model (Count / Row Pct / Col Pct / Tot Pct)	Management Style: Decisive 1.	Authoritative 2.	Participative 3.	Supportive 4.	Row Total
1.	2	3	0	0	5
	40.0	60.0	0	0	26.3
Coordination	66.7	50.0	0	0	
	10.5	15.8	0	0	
2.	0	2	0	0	2
	0	100.0	0	0	10.5
Decision	0	33.3	0	0	
	0	10.5	0	0	
3.	0	1	5	2	8
	0	12.5	62.5	25.0	42.1
Action	0	16.7	100.0	40.0	
	0	5.3	26.3	10.5	
4.	1	0	0	3	4
	25.0	0	0	75.0	21.1
Analytical	33.3	0	0	60.0	
	5.3	0		15.8	
Column Total	3	6	5	5	19
	15.8	31.6	26.3	26.3	100.0

Chi Square = 22.40417 with 9 d.f., Significance = .0077
Contingency Coefficient = .73560
Kendall's Tau B = .59834 Significance = .0009
Kendall's Tau C = .62571 Significance = .0009
Pearson's R = .65367 Significance = .0012

Table 11
Regression Analysis
Systems Development Level

Adjusted R^2: .48294 Significance: .0086

Variables	Partial Correlation	Significance Level	Beta weights Direct	Beta weights Indirect	Beta weights Total
IT stage	.50552	.022	.46727	.09336	.59888
IRM type	.35085	.089	.35085		.35085
MIS size	–.39175	.053	–.39175	—	.39175
Mgt. model	...	n.s.	...	.21567	.21567
Mgt. style	...	n.s.	...	.14098	.14098
Organization size	...	n.s.	...	–.25752	–.25752

shown in Table 10.

It was an unexpected finding that systems development level is not related to the strategic impact of IT. On the other hand much more variables were found affecting directly (IT stage, IRM type and MIS size) and indirectly (management model and style, organization size) the systems development level than hypothesized (Table 11).

It seems that in the case of systems development level the technical aspects predominates over the managerial aspects. It seems that a higher level of sophistication of systems development tools and procedures is required when the complexity and variety of hardware and software utilized in an organization increases. It also seems that a more managerial IRM type facilitates the achievement of a higher level of systems development method. Finally, it seems that as larger the organization as more difficult is either to obtain consensus in the SD method, or to implement a given standardized procedure.

Management style is negatively correlated to industry (partial correlation = -.48262, significant at .049), and is not related to the IT stage. This probably indicates that either CIOs with different management styles are more attracted to some types of industries than others, or that the nature of the industry requires specific abilities of the CIOs, captured by the different management styles.

Finally, MIS size was found positively correlated to organization size (partial correlation = .65679, significant at .002) and industry (partial correlation = .31033, significant at .095). The adjusted R for the equation was .45059, significant at .0032. These results are in agreement with findings in the literature, as indicated previously.

CONCLUSIONS

Given the exploratory nature of this work, generalizations, other than to the target population, are premature. Nevertheless, it seems that the variety of industry types, organization and MIS sizes in the sample allows us to extrapolate (but not infer) to a richer set of situations than otherwise possible. A series of coincidences across-industry and size seem to indicate that traces of a larger phenomenon were identified. Such is the case of the constant findings in this research that managerial and not technical variables were the most important factors to explain the dependent variables.

Another important conclusion that is applicable not only to MIS is that management style and model are intimately related, and that the latter is contingent on the first. On the other hand, this study has not measured other task and environmental factors that might also have a bearing on how managers perceive and perform their managerial functions.

The specific findings of this research indicates that a careful match between the management style of potential CIO candidates and the strategic requirements of an organization, in terms of management model, information resource type, and strategic impact of IT, is in order. Organizations requiring strategic applications portfolios should attract extroverted candidates, with a history of seeing the managerial tasks as multiple interrelated activities, and promote the development of the managerial information resource management type.

Finally, the need for more research in the topic is not new. As always in MIS, the technological knowledge and resources are far ahead of our capacity to manage the technology. And yet it is the managerial component of MIS that has the greatest impact on the use of the technology, as once more was found in this research.

REFERENCES

[1] Barnard, C.I., *The Functions of the Executive,* Cambridge, MA: Harvard University Press, 1938, p.3.

[2] Benjamin, R.I., Rockart, J.F. Scott -Morton, M.S., Wyman, J. "Information Technology: A Strategic Opportunity," *Sloan Management Review,* Volume 25, Number 3, Spring 1984, pp.3-10.

[3] Benjamin, R.I.,Dickinson, Jr.,C., Rockart, J.F. "Changing Role of the Corporate Information Systems Officer," *MIS Quarterly,* Volume 9, Number 3, September 1985, pp. 177-188.

[4] Bento, A., and Wysk, R. "The Managerial Functions: A Pilot Field Study in Rio de Janeiro," *Revista de Administracao de Empresas,* Volume 23, Number 3, July-September 1983, pp. 5-14.

[5] Blalock, Jr., H.M., *Social Statistics,* 2nd.ed., McGraw-Hill, New York, New York, 1979, pp. 462-477.

[6] Boyton, A.C., Victor, B. and Pine II, B.J., "New Competitive Strategies: Challenges to Organization and Information Technology," *IBM Systems Journal,* Volume 32, Number 1, January 1993.

[7] Burns, R.N., and Dennis, A.L., "Selecting the Appropriate Application Development Method," *Data Base,* Volume 17, Number 1, Fall 1985, pp. 19-23.

[8] Carroll, S.J. and Gillen,D.J. "Are the Classical Management Functions Useful in Describing Managerial Work?," *Academy of Management Review,* Volume 12, Number 1, January 1987, pp. 38-51.

[9] Cash, J., McFarlan, F. and McKenney, J., *Corporate Information Systems Management,* Richard Irwin, Homewood, Illinois, 1983, p.26 (recent editions do not contain the text referenced here).

[10] Colter, M.A.,"A Comparative Examination of Systems Analysis Techniques," *MIS Quarterly,* Volume 8, Number 1, March 1984, pp. 51-66.

[11] Couger, J.D. and Knapp, R. *Systems Analysis Techniques,* John Wiley & Sons, New York, New York, 1974, pp. 43-81.

[12] Dos Santos, B.L. and Peffers, K., "The Effects of Early Adoption of Information Technology: An Empirical Study," *Journal of Information Technology Management,* Volume 3, Number 3, Fall 1992, pp. 1-12.

[13] Drucker, P.F., *The Practice of Management,* Harper & Brothers, New York, New York, 1954.

[14] Drury, D.H., "An Empirical Assessment of the Stages of DP Growth," *MIS Quarterly,* Volume 7, Number 2, June 1983, pp.70.

[15] Fayol, H., *General and Industrial Management,* Pitman, London, England, 1949.

[16] Gerrity, T.P. and Rockart, J.F., "Managing End User Computing in the Information Era," WP-120, Massachusetts Institute of Technology, *Center for Information Systems Research,* Cambridge, Massachusetts, October 1984.

[17] Henderson, J.C., and Treacy, M.E., "Managing End User Computing," WP-114, Massachusetts Institute of Technology, *Center for Information Systems Research,* Cambridge, Massachusetts, June 1985.

[18] Ives, B. and Olson, M.H., "Manager or Technician? The Nature of the Information Systems Manager's Job," *MIS Quarterly,* Volume 5, Number 4, December 1981, pp. 49-63.

[19] Jackson, L., "Organizing for the Merging Technologies in Information Management," *Journal of Information Systems Management,* Volume 4, Number 1, Winter 1987, pp. 88-90.

[20] Keen, P.G.W. and Bronsema, G.S.,"Cognitive Style Research: a Perspective for Integration," WP-82, Massachusetts Institute of Technology, *Center for Information Systems Research,* Cambridge, Massachusetts, December 1981.

[21] Kugler, J.C. and Fernandes, A.A., *Planejamento e Controle de Sistemas de Informacao,* Livros Tecnicos e Cientificos, Rio de Janeiro, Brazil, 1984.

[22] Mason, R.O. and Mitroff, I.I., "A Program for Research in MIS," *Management Science,* Volume 19, Number 5, January 1973, pp. 475-487.

[23] McFarland, F.W., "Information Technology Changes the Way You Compete," *Harvard Business Review,* Volume 62, Number 3, May-June 1984, pp. 98-103.

[24] Mintzberg, H. *The Nature of Managerial Work,* Harper & Row, New York, New York, 1973.

[25] Myers, I.B. *The Myers-Briggs Type Indicator,* Consulting Psychologist Press, Palo Alto, California, 1962.

[26] Nolan, R.L. and Gibson, C.F. "Managing the Four Stages of EDP Growth," *Harvard Business Review,* Volume 52, Number 1, January-February 1974, pp. 76-88.

[27] Parsons, G.L., "Information Technology: a New Competitive Weapon," *Sloan Management Review,* Volume 25, Number 1, Fall 1983, pp. 3 - 14.

[28] Porter, M.E. and Millar, V.E., "How Information Technology Gives You Competitive Advantage," *Harvard Business Review,* Volume 63, Number 4, July-August 1985, pp. 1400160.

[29] "Special Report: The Fortune 500," *Fortune,* Volume 117, Number 9, April, 1990.

[30] Taggart, W. and Robey, D. "Minds and Managers: on the Dual Nature of Human Information Processing and Management," *Academy of Management Review,* Volume 6, Number 2, April 1981, pp. 187-195.

[31] Umbaugh, R.E., "Corporate Responsibility and the MIS Manager," *Journal of Information Systems Management,* Volume 4, Number 1, Winter 1987, pp. 58-62.

[32] Weill, P., "The Relationship Between Investment In Information Technology and Firm Performance: A Study of the Valve Manufacturing Sector," *Information Systems Research*, Volume 3, Number 4, December 1992, pp. 307-332.

[33] White, K.B., "MIS Project Teams: an Investigation of Cognitive Style Implications," *MIS Quarterly*, Volume 8, Number 2, June 1984, pp. 95-101.

ABOUT THE AUTHORS

Alberto M. Bento, *Ph.D., is an Associate Professor of Information Systems at the Merrick School of Business, University of Baltimore. He received his Ph.D. in Information Systems from the University of California, Los Angeles. His research interest includes information resources management, end-user computing, information technology quality management, budgeting and decision making models, and alternatives for systems development. His recent publications have appeared in* Information and Management, Journal of Information Technology Management, Interface, Journal of Computer Information Systems, *and* Revista de Administracao de Empresas.

Glen L. Gray, *Ph.D., CPA, is an Associate Professor of Accounting & MIS at California State University, Northridge. He received his Ph.D. in Accounting Information Systems from the University of Southern California. His research interest includes artificial intelligence, expert systems, intelligent tutoring systems, and end-user computing and controls. His research has appeared in the* Journal of Information Systems, International Journal of Intelligent Systems, Accounting Finance & Management, *and* Advances in Accounting.