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An Exploratory Study of the Influence of the IS Function and Organizational Context on Business Process Reengineering Project Initiatives

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To help evaluate the risk of process reengineering failure and enhance the prospect of its success, three potential sources of influence on BPR initiatives and success are examined in this study. These include the innovative capacity of the organization, IS maturity and strategy-IS interface. It was found that while factors related to IT maturity and influence such as experience in mainframe and client/server computing may facilitate the decision to reengineer, they are not critical in the later stages of the initiative. On the other hand, factors having significant relationships beyond the initial decision include variables pertaining to innovative capacity of the organization and strategy-IS interface. These findings suggest that technical IT competence as a critical enabler is necessary but not sufficient for reengineering success. Based on study findings regarding the innovative capacity of the organization, guidelines for reengineering risk assessment are proposed. In addition, implications of the findings, limitations of the study and opportunities for further research are also discussed. © 1998 Elsevier Science Ltd. All rights reserved

Key words—business process reengineering, strategic-IS interface, organizational innovation, reengineering risk assessment, information systems maturity and influence, decision to reengineer

1. INTRODUCTION

OVER THE PAST decade, we have witnessed an increasingly convergent set of communications and computing technologies that are being recognized as facilitators of fundamental business change [61]. Davenport and Short [17] identified information technology (IT) capabilities that can be leveraged to redesign business processes. These include technologies that capture and disseminate expert knowledge, transform unstructured processes into routinized transactions, and enable changes in the sequence of tasks in a process, allowing the simultaneous execution of multiple tasks, etc. However, it should be noted that the concept of business process reengineering (BPR) has evolved over a long period of time, drawing elements from a number of business improvement methods such as industrial engineering, systems analysis and design, social-technical design, and total quality management [18]. In fact, for many decades since the introduction of electronic computers, the theme for computer applications in organizations has been gradually shifting from that of *automation*, i.e., the computerization of existing procedures, toward an attempt to modifying or even radically changing the traditional business processes [15].

As is often the case with other popular management methods before it, BPR is undergoing its own life cycle of evolution. With the initial bandwagon effect fading and reports of BPR failures surfacing, more attention is now focused on the implementation of reengineering [10]. There is growing realization that IT is a critical enabler, but reengineering involves complex socio-technical change in the organization [44, 57]. Sources of reengineering failure, according to Clemons *et al.* [11], can be attributed to behavioral factors such as employees' misconception of the organization's strategies. As process reengineering is a multi-faceted phenomenon, it would be difficult to interpret the complex organizational change involved with a single perspective, and the inclusion of multiple views is critical [31]. A number of previous BPR studies were based on this multi-dimensional perspective. Hall *et al.* [29], for example, have demonstrated the importance of a diverse array of organizational factors to BPR success. In an integrated BPR planning framework, Grover *et al.* [28] have recognized vital links between process reengineering initiation and success to corporate strategic planning, strategic IT planning and the innovative environment in the organization.

Adopting this multi-dimensional perspective of process and organizational change, the purpose of this study is *to explore what organizational, technological, and strategic elements need to be in place if radical process change is to take place and has a chance to succeed.* Specifically, the objective of the research is to examine the significance of three sources of influence on BPR initiatives and success: (1) the innovative capacity of the organization, (2) the information systems (IS) function maturity and influence and (3) the strategy-IS interface. In addition, we also attempt to uncover important patterns of reengineering practice such as the type of business processes reengineered and the relative importance of various BPR performance objectives.

1.1. Research model

The three potential sources of influence on BPR initiatives and success, as shown in the research model (see Fig. 1), were selected for study based on their theoretical linkage to and conceptual congruence with the nature of process reengineering. First, we seek to examine to what extent the *innovative capacity* of the organization would facilitate the adoption and implementation of the reengineering concept. Process reengineering often involves drastic departure from the status quo. In many cases, complete overhaul of current procedures is required. It is difficult to conceive that organizations steeped in tradition and lacking creative energy would attempt and succeed in such ultimate innovative endeavors. Next, we explore how the information systems function may affect reengineering initiatives in terms of *IS maturity and influence*, recognizing that IT often takes on an enabling role in altering traditional patterns of work flow through reengineering projects. Over the years IS has been instrumental in introducing innovative solutions to business problems in the organization [60], and we may expect that a significant level of expertise and availability of resources in IT may be important to BPR initiation and success. Thirdly, recognizing the potential influence of strategy on BPR, we attempt to understand how *strategy-IS interface* may facilitate BPR initiatives. A number of IS researchers have stressed the importance of strategy-IS interface in developing IT applications for competitive advantages [40, 49]. To the extent that this interface reflects the strategic importance of IS, more IS resources would be allocated to support IT-enabled strategic endeavor such as interorganizational systems that provide electronic linkages to suppliers and customers [35]. As process reengineering is often an IT-enabled strategic endeavor [15, 16], Strategy-IS interface can be expected to play an important role in BPR initiatives.

As stated earlier, the purpose of this study is to explore what organizational, technological, and strategic elements need to be in place if radical process change is to take place and has a chance to succeed. Radical process change is no ordinary project. Why have some organizations initiated this momentous change, while others decided not to? Given the gravity of the change, the obstacles to launching the effort can be multifarious. For example, if people in the organization have absolutely no willingness to cooperate with employees in other functions to accomplish a task, it would seem unlikely that they will

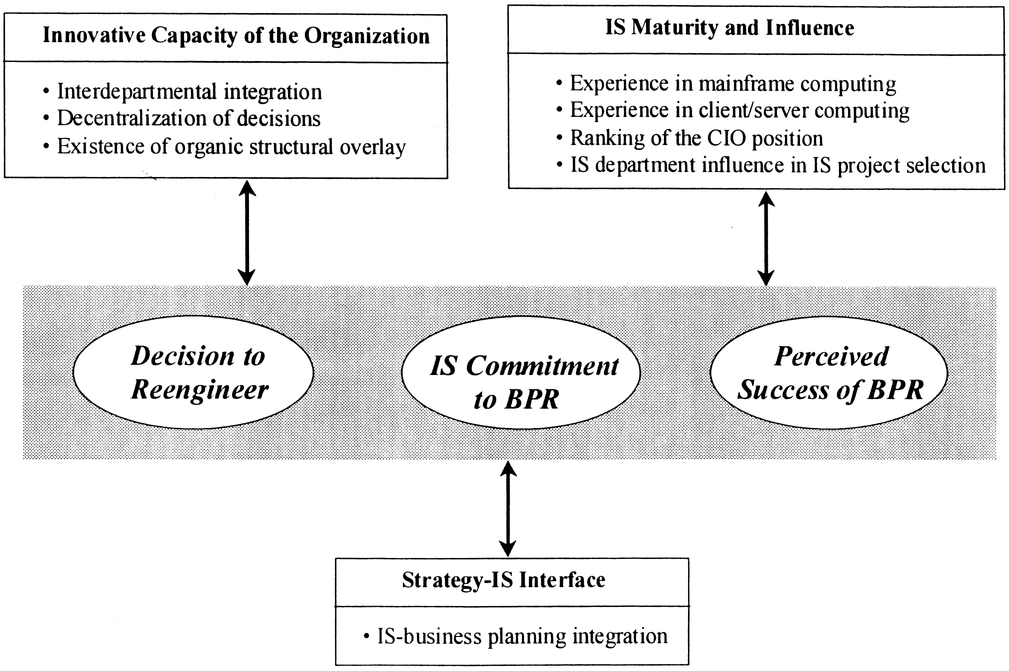

Fig. 1. Research model

enthusiastically embrace the BPR concept that demands cross-functional collaboration. It can be expected that organizations having the resolve to break the status quo did so because the conditions for launching such a momentous change effort were felt to be generally favorable. In other words, certain organizational, technological and strategic elements in the organization give them sufficient confidence in their ability to manage and, if necessary, overcome possible obstacles to change and bring about the reengineering project to its successful conclusion. Thus, for the dependent variable, the most critical question is whether the organization has undertaken the reengineering project initiative. With project initiative as the major dependent variable, two additional dependent variables are also included to explore aspects of the initiative related to IS and likelihood of project success. The reengineering project initiative, as shown in Fig. 1, is thus represented by three dependent variables: the decision to reengineer, IS commitment to reengineering and perceived level of reengineering success.

1.2. Intended contribution of the study

The contribution of this exploratory study lies in its significance for both theory and practice of process reengineering. For theoretical development, the study took a preliminary step toward understanding the multi-faceted complex organizational change phenomenon associated with reengineering. The three sources of influence we explored are based on innovation theories, IS implementation and strategy. Further advancement in this line of inquiry can lead to the development of a more comprehensive contingency model for change management involving reengineering adoption and implementation in organizations. While the factors included in the study are important, we recognize the complexity of organizational change and the significance of other factors that are not included in the study. These factors, such as culture and leadership, top management support, organizational learning, employees' perception of corporate strategy, organizational memory and knowledge sharing may play a potentially critical role in BPR initiation and success, and further studies incorporating these organizational conditions should prove very fruitful.

For practice, the study results may provide guidelines in assessing organization contextual conditions to help evaluate the risk of reengineering failures and enhance the likelihood of its success. For example, one aspect of an organization's innovative capacity is the extent of inter-departmental integration. This factor is included in the study since the focal concern of BPR, namely the business process, is often cross-functional, and much of the organizational change demanded by reengineering centers around breaking down the wall between departments and instilling a high level of collaboration across different functions in the organization. Thus, one wonders whether organizations that already have a high level of integration, i.e., collaboration across functions, might have more proclivity toward BPR initiatives and encounter less risk of BPR failures. If the research findings indicate that this is indeed so, then we would recommend that the assessment of inter-departmental integration be undertaken prior to the reengineering initiative to properly evaluate the risk involved and take necessary steps to enhance the prospect of success.

The paper is organized as follows. In the next section, we will discuss theories and previous studies related to the relationships explored in the research model. This is followed by a description of the study methodology and the measurement of research variables. Results of preliminary analysis and main study results are presented in the next two sections. We will then discuss the overall pattern of findings, their implications for practice and research, and the limitations of the study. This will be followed by concluding comments.

2. RESEARCH VARIABLES AND PREVIOUS STUDIES

The research model, as shown in Fig. 1, relates the three contextual conditions to three dependent variables. Within each contextual condition, a number of independent variables are identified. Based on this research model, a set of eight relationships were examined to explore the characteristics of firms that have attempted BPR (refereed to as "reengineering firms") and those that have not ("non-reengineering firms").

2.1. Innovative capacity of the organization

The application of IT in the organization invariably require changes to the status quo, and organizations intolerant of the confusion brought along by innovative change are unlikely to be leaders in new IT applications. Framing the introduction of new IT as organizational innovation [32], IS researchers have successfully studied the adoption and diffusion of modern software practice [64–66], PC [52], spreadsheet software [7], customer-based interorganizational systems [24], and database management systems [25]. A comprehensive survey and analysis of IS innovations can be found in Swanson [60]. IT-enabled BPR initiatives have been characterized as "business process innovation" by leading reengineering researchers [16]. As indicated in Fig. 1, three variables are included to assess the innovative capacity of the organization as it relates to the BPR innovation. These variables — interdepartmental integration, centralization of decisions, and structural overlay — pertain to some of the most widely accepted notions in the innovation literature.

Interdepartmental integration refers to the extent of interaction between different functional departments through activities such as the free exchange of ideas and participation in common projects. Integration and decentralization of decisions in the organization are related to the idea of organic organization, one of the oldest and most intuitively appealing notions in innovation literature [13]. In contrast to mechanistic organizations, organic organizations can be expected to foster a higher level of individual initiatives and innovative behaviors, as these organizations decentralize decision making, have flexible work rules and encourage lateral communication between departments [8]. Innovation studies conducted by Angle [3] revealed the importance of frequent communication across departmental lines, and among people with dissimilar viewpoints in enabling innovative behavior. Other studies indicated that poor communications between marketing and the R and D departments was detrimental to product innovations [55, 58]. Daft [12] reports a positive relationship between decentralization and technical innovation. Aiken and Hage [1] found that higher levels of centralization have negative effects on innovation adoption.

In addition to innovation-theoretic perspectives, the very nature of reengineering makes it a "natural" for organic organizations. While strategic leadership may steer a mechanistic organization in the direction of BPR, the chance that such initiatives would eventually take place may be higher among organic firms with higher interdepartmental integration and decentralization. As BPR often requires collaboration between different departments participating in the same business process, interdepartmental integration may provide a more receptive environment for not only launching a reengineering project, but facilitating its implementation also. Some innovation studies suggest that the coordination of implementation efforts following the initiation stage may be facilitated by more centralized control [13]. However, the very success of BPR may require more decentralized structure as reengineering typically calls for the empowering of on-site personnel in the field [47]. *Thus, both innovation theories and reengineering principles suggest that the extent of interdepartmental integration and the degree of decentralization of decisions may be associated with BPR project initiatives and success.*

To compensate for the possible loss of innovative capacity in mechanistic organizations that are high in centralization and low in integration, a structural "organic overlay" may be superimposed on top of these organizations [48]. Unencumbered by the regular bureaucracies, such structural overlays typically take the form of a "venture group" dedicated to searching and introducing innovative ideas into the organization. The efficacy of organic overlay in IS management has received support in a study by Zmud [64]. Thus, these prior theories and research results suggest *that the role of organic structural overlay in reengineering initiatives and success may be significant* and should be explored.

2.2. IS maturity and influence

While process reengineering entails complex organizational change and strategic direction, IT is an important and often essential enabler of BPR. The likelihood of successful launching and completion of IT-enabled reengineering initiatives would diminish if the importance of IS in the organization is low and the function lacks maturity. Attention to IS maturity among IS researchers can be traced back to Nolan's stage model of IS evolution [23, 45]. Previous studies involving IS maturity used such technology benchmarks as the prevalence of on-line over batch processing and the adoption of database management systems [5, 45]. Several generations of new technologies have since been adopted. Rather than parsing through a long list of "cutting edge" IT currently being introduced, we choose to look at the two extremes of the spectrum of "old" and "new" technologies — mainframe computing and client/server (C/S) computing. Experience with mainframe computing would generally be indicative of IS maturity in terms of technical competence accumulated. Although still in constant flux and development, C/S is an "umbrella" term encompassing a variety of new technologies such as distributed databases and window-based rapid application development. It has been pointed out that C/S represents a revolutionary departure from the traditional environment through its enabling role in facilitating the emerging management and organizational forms based on empowering on-site personnel and lateral collaborations, which are consistent with the principles of process reengineering [47]. In this study we seek to explore *the facilitating role of mainframe and C/S computing experience in BPR project initiatives and success.*

Several researchers have studied the power and influence of the IS function in the organization [38, 56]. In this study, we choose one decision area that is integral to IS responsibility — the selection of IS projects, and attempt to explore *how the influence of IS in this vital decision may be related to reengineering project initiatives and success.*

Another indicator of the influence of IS in the organization is the relative rank of the CIO (chief information officer) position. In a large sample field study, Raghunathan and Raghunathan [51] have found significant relationship between the ranking of CIO and the sophistication of IS planing practice. As IS planning is an integral element of BPR planning [28], we intend to examine *the potential influence of CIO's relative ranking on reengineering project initiatives and success.*

2.3. Strategy-IS interface

Prior to launching a BPR program in the organization, it is important to realize at the outset that BPR, being capable of achieving significant performance improvement (or catastrophic failure), is a strategic endeavor, and the processes selected for reengineering should be critical to the firm's strategic objectives. In addition, as typical BPR projects involve significant organizational change, the planning for BPR is difficult to conduct without strategic direction from the top. As IT often plays an essential enabling role in reengineering, active IS participation in the strategic management process involving reengineering should contribute to the BPR initiatives. This strategy-IS interface, which has evolved and expanded over the years [14], has contributed greatly to the successful development of strategic information systems [24, 35]. The experience gained in developing this interface can now be fruitfully applied in launching BPR initiatives.

As indicated in Fig. 1, the variable included to represent strategy-IS interface is IS-business planning integration which refers to the extent to which IS planning activities are aligned with and influence overall strategic planning of the business. This two-way link between corporate strategy and IT strategy is particularly appropriate when the advancing IT allows companies to not only develop systems that support corporate strategy, but can be configured to change it [50]. Many organizations recognize the importance of IS-business planning integration to BPR. At PHH, for example, this integration led to an overall assessment of IT use in the firm and rethinking its strategy in relation to IT. As a result, a major part of the strategic plan is to freeze investment in traditional IT applications for automating existing procedures and redeploy the resources to redesigning age-old processes [6]. Indeed, the empirical study reported by Grover *et al*. [26] revealed a significant role of IS-business planning integration in the success of cross-functional BPR initiatives. Thus, field experience and previous studies suggest that *IS-business planning integration may play a significant role in reengineering project initiatives and should be examined.*

3. RESEARCH METHOD AND MEASURES

To accomplish the research objectives, we have conducted an empirical field study by gathering data through a research questionnaire. In selecting the survey respondents, we followed the guidelines prescribed by Huber and Power [30] who recommend that the individual most knowledgeable about the subject matter should be selected as respondent in the case when only one respondent per unit is solicited. As the instrument includes questions related to IT, strategy, and the IS function, senior IS executives were chosen as survey respondents rather than CEOs or other top managers. Further, with IT being an important enabler in many reengineering projects, the involvement of IS executives in BPR initiatives would make them the most informed respondents.

The survey instrument was developed and iteratively refined through a multistage process to enhance its content validity [46]. First, measurement of research variables was carefully planned. Previously validated instruments were used either directly or modified for many of the items contained in the questionnaire. Others were developed from a review of the literature. Next, the preliminary questionnaire was pretested on MIS academics for clarity and focus. This was followed by interviews with 12 senior IS executives in the United States and Canada. One major improvement resulting from these interviews concerns the clarification of the definition of BPR on the questionnaire.

The unit of analysis for this research is an organization which was described in the questionnaire as "the corporation, business unit, subsidiary or division that is served by your IS department". The final questionnaire was administered to a sample of 900 executives drawn from a database of 5,000 IS executives in the United States provided by an information service firm. The sample was selected on the basis of revenue (greater than $50 million).

3.1. Dependent variables

As shown in Fig. 1, three dependent variables are selected to depict reengineering project initiatives and success: the decision to reengineer, IS commitment to reengineering and perceived reengineering success. Information on the *BPR decision* was obtained with a simple yes/no question: have you attempted business process redesign in your organization? For those that have attempted BPR, we gauge the extent that the IS function was mobilized to implement the BPR initiative, e.g., IS commitment to BPR, by the percentage of current IS projects involving BPR.

In attempting to measure reengineering project success, the BPR research community may benefit from the considerable experience gained in developing measures of information systems success [19]. For this exploratory study, a preliminary measure of perceived success was included as one aspect of the project initiative. The respondents were asked to answer one seven-point scaled question about the perceived success level of their reengineering projects (1: unsuccessful, 7: successful). While the scales used are primarily ordinal, as are most perceptual or psychological scales, we assume equal intervals for purposes of analysis. Kerlinger [34] in his chapter on measurements states that, "...many of the methods of the analysis we use work quite well with most psychological scales. This is the results we get from using scales and assuming equal intervals are quite satisfactory" [34, p. 402]. He concludes by adding "the best procedure would be to treat ordinal measurements as though they were interval measurements, but be consistently alert to the possibility of gross inequality of intervals" [34, p. 403]. In this study the scales used are classical 7-point scales with polar opposite anchors. There is no reason to assume gross inequality of intervals. Hence parametric statistics will be used.

3.2. Independent variables

Measurement for all independent variables in the three categories are presented in Table 1. Three variables are included to assess the innovative capacity of the organization. The measure for interdepartmental integration was adopted from the work of Grover [24] who developed and validated the scale based on the work conducted by Ein-Dor and Segev [21] on IS structure. Centralization of decision making in the organization was assessed via a measure developed and validated by Ramamurthy [53] based on the work of Miller and Friesen [41]. Measurement of the existence of organic structural overlay is objectively accessed.

As can be seen in Table 1, all variables for IS maturity and influence are assessed objec-

Table 1. Measurement of independent variables

Innovative capacity of the organization
(1) *Interdepartmental integration*. Measured by four 7-point items (1: strongly disagree, 7: strongly agree):
1 Our organization encourages exchange of ideas between departments;
2 Applications are often shared among departments;
3 Information is often shared among departments;
4 In our organization, joint development of projects between departments occurs frequently.
(2) *Centralization of decision making*. Respondents were asked to indicate "to what extent the following decisions are centralized at the top levels of your organizations" (1: very decentralized, 7: very centralized) for the following five types of decisions:
1 Capital budgeting;
2 New product/service introduction
3 Entry into major new markets
4 Pricing of major product lines
5 Personnel selection
(3) *The existence of organic structural overlay*. Respondents were requested to answer yes or no to indicate whether "there is a formal group of personnel for introducing new information technologies into the organization."
IS Maturity and Influence
(1) *Experience in mainframe computing*. Respondents were asked to indicate the year of first adoption of the technology, which was then subtracted from the date the questionnaire was received.
(2) *Experience in client/server computing*. Same as 1) above.
(3) *Ranking of the CIO position*. Respondents were asked to answer this question: "how many ranks below the highest ranking executive is your top MIS executive?"
(4) *IS department influence in IS project selection*. Assessed by one 7-point scale (1: user influence dominates; 7: IS department influence dominates).
Strategy-IS Interface
(1) *IS-business planning integration*. Measured by four 7-point items (1: strongly disagree, 7: strongly agree):
1 IS planning incorporates strategic priorities of top management;
2 Top management understands the role of IT in supporting strategy;
3 IT opportunities to support the strategic directions are identified;
4 Top management is committed to IS projects.

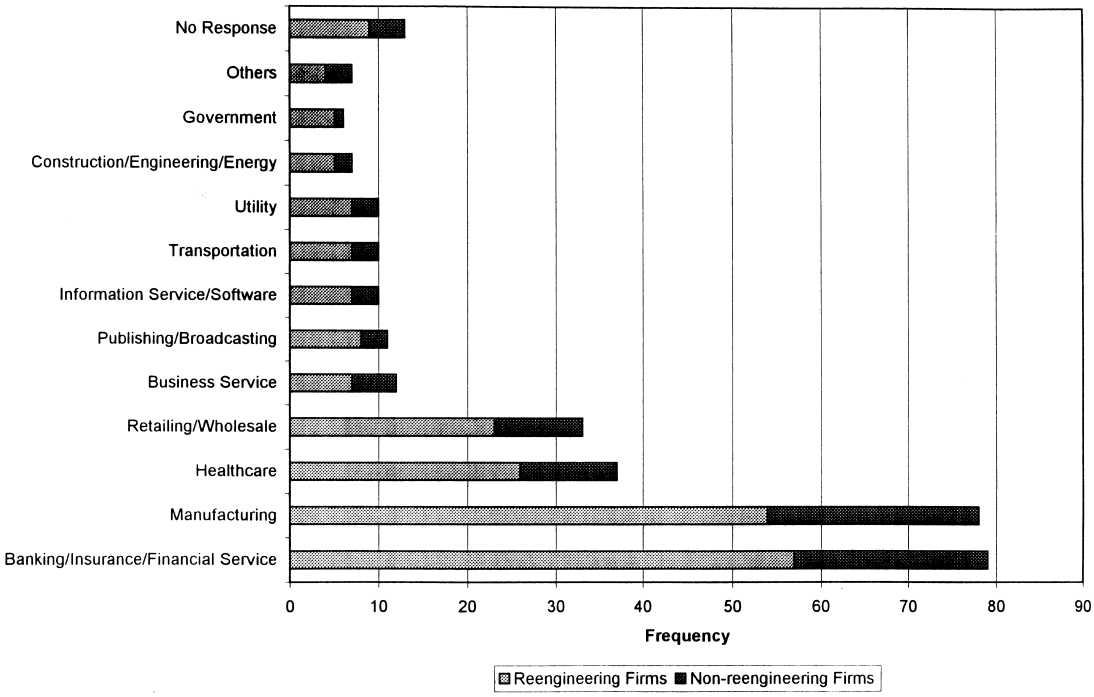

Fig. 2. Industry classification of respondents

tively. For strategy-IS interface, the scale for IS-business planning integration was based on the work of Premkumar and King [50].

3.3. Assessing patterns of current practice

Several questions were presented to the respondents regarding the type of business processes reengineered and the relative importance of various reengineering objectives. These questions not only provide general information of current practice, they also serve the purpose of ensuring that the respondents who indicated that they had undertaken BPR projects, had indeed attempted it and can provide some descriptive details about the projects. The first question asked for a description of the first BPR project attempted. As reengineering has been conceptualized as a deliberate change initiative aimed at "breakthrough" performance gains, and the setting of performance improvement goals is central to the concept, we also asked the respondents to rank the importance of four common BPR performance objectives: better customer service, reduced cycle time, improved quality and lower cost [16, 22, 43]. These are the substantive improvement objectives that precede and underlie bottom-line financial measurements and market performance such as higher revenue, greater market share and greater profitability. Further, by assessing measures closest to the unit of analysis, we hope to improve internal validity of the study.

4. PRELIMINARY ANALYSIS

The questionnaire was sent to 900 IS executives with two separate mailings one month apart. Respondents were encouraged to call with any question they had regarding the instrument. To provide additional incentive for completing the questionnaire, the respondents were given the opportunity to choose one of several charitable organizations for the researchers to make a $2.00 donation on their behalf. Of the 900 initial mailings, 45 were returned as undeliverable. A total of 313 completed responses were received yielding an effective response of 36.6%. This response rate compares very favorably to many mail surveys reported in the literature.

To ensure the survey results are free from various sources of bias, and the measurements of the variables satisfy validity and reliability requirements, we followed widely accepted procedures based on psychometric analysis. Readers interested in these validity and reliability issues can refer to Appendix A.

4.1. Sample profile

The industry affiliation of the responding firms is summarized in Fig. 2. As can be seen, the top two categories, financial service and manufacturing, account for over half of the respondents. This is followed by healthcare and retail/wholesale. As indicated in the table, a wide variety of industries were represented in the sample. Of the 313 firms, 219 (70%) indicated that process reengineering has been attempted in their companies. Notice that the industry classifications of reengineering firms as shown in the table parallel almost completely to that of the overall sample, alleviating the concern that potential industry-related response bias may occur.

Information on size of the responding companies is displayed in Fig. 3. For the overall sample, a significant proportion (21.1%) of companies is small or medium in size with up to 1,000 employees. However, over half of the sample (56.2%) represents larger companies having 1,000 to 10,000 employees. Very large organizations (10,000 or more employees) account for 16.6% of the sample. Thus, the sample contains larger as well as smaller companies, enhancing the representativeness of the sample. Size distribution for the 219 reengineering firms shows a similar spread of small to large companies with a slight slant toward larger ones.

Means for the independent variables can be found in the first column in Table 4, which will be discussed in detail in Section 5. There are three dependent variables. For the decision to reengineer, we have indicated that of the

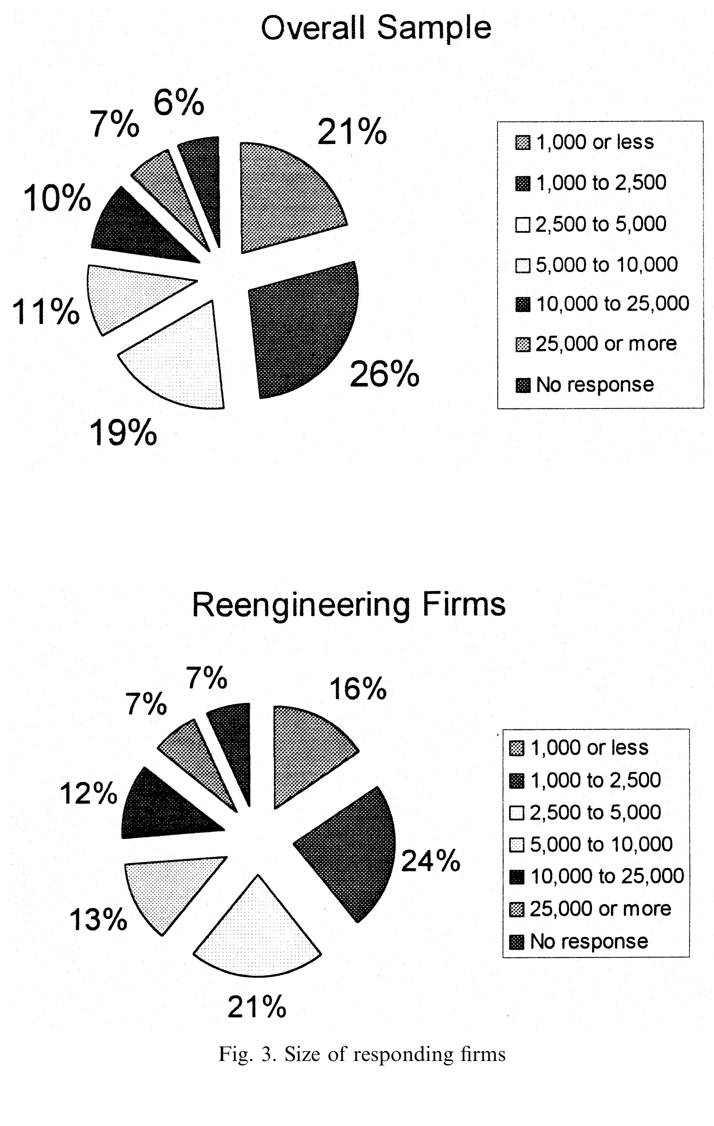

Fig. 3. Size of responding firms

Table 2. Characteristics of reengineering projects. Types of business processes reengineered

Process type	Frequency		
	overall	manufacturing	financial
General management and operation	30	1	4
Order processing	28	12	7
Accounting/Finance	26	6	5
Loan, mortgage and credit	15	1	12
Product development	15	6	1
Sales/Marketing	14	1	6
Manufacturing	13	10	0
Customer service	13	6	1
Shipping and distribution	9	2	0
Information systems	5	0	3
Material and inventory	4	1	0
Others	17	2	8
No response	30	6	10
Total	219	54	57

Table 3. Characteristics of reengineering projects. Importance of BPR performance objectives

Reengineering objective	Top ranking frequency[a]	Mean ranking		
		overall	manufacturing	financial
Better customer service	133	1.69	1.56	1.77
Improved quality	58	2.14	2.40	2.20
Lower cost	53	2.60	2.59	2.77
Higher speed	25	3.05	3.00	3.09

[a]A number of respondents rated more than one objectives as most important.

313 firms, a large majority (219 or 70%) has attempted process reengineering in their companies. To complement this binary yes/no measure of decision, we assessed the extent to which the IS function was mobilized to implement BPR, i.e., IS commitment to BPR. This measure, as reflected by the percentage of IS projects related to reengineering, was moderately high (34.5%). While the level is higher (38.4%) among manufacturing firms, financial firms showed a lower commitment (25.55%). Average perceived level of reengineering success is 5.18 on a 7-point scale, suggesting IS executives' positive reactions to project outcomes. This level of perception is generally consistent across industries with an average of 5.27 for the manufacturing and, 4.89, the financial sector[1].

4.2. Characteristics of reengineering projects

For the reengineering firms, respondents were asked to indicate the nature of the business process targeted in their first reengineering project, and the results are summarized in Table 2. For the overall sample, 30 cases were related to the miscellaneous processes for general management and operations. For more specific targets, order processing has the highest frequency (28) followed by accounting/finance (26) and loan, mortgage and credit (15). Another large scale industry survey of CIOs on current reengineering practice [9] reported similar findings: accounting/finance processes top the list, followed by order processing.

Tables 2 and 3 also shows types of processes attempted by manufacturing and financial sector firms (the two largest groups). The data clearly indicate that BPR initiative is often directed at the core business: most of the manufacturing processes (10 of 13) were initiated by manufacturing firms, and financial service firms reengineered most of the loan, mortgage and credit processes. It is also interesting to see that the process reengineered most in the manufacturing sector is order processing (12). These results indicate that BPR is effecting vital links of the value chain in a business,

[1]The industry survey conducted by Caldwell [9] reported similar results in the intensity of BPR activity and perceived success.

often the outbound logistics that directly impact customer satisfaction and the core product/service activities.

Respondents were given four common BPR objectives (better customer service, reduced cycle time, improved quality and lower cost) and asked to rank them "according to their importance in motivating your BPR projects". The results as shown in Table 3 indicate that better customer service was regarded as most important with 133 respondents ranking it as most important, and a mean ranking of 1.69. This is followed by improved quality (2.14), lower cost (2.60) and reduced cycle time (3.05)[2]. Also as shown in the table, the overall ranking pattern is preserved within the manufacturing and financial sectors, further reinforcing the validity of the results. Thus, we may state with a high degree of confidence that *improving customer interface and satisfaction is the major motivating force for the reengineering movement*.

5. STUDY RESULTS

Eight relationships were examined relating the reengineering initiatives and success to the three contextual conditions, and most of the results are presented in Table 4. The 3rd and the 6th relationships involve categorical and ordinal independent variable and the additional results are displayed separately in Tables 5–8. The first four columns in Table 4 contain results related to the first dependent variable: the decision to reengineer, which was examined through *t*-test on equality of means for reengineering vs non-reengineering firms. Results for the other two dependent variables: the extent of IS commitment and perceived level of reengineering success were based on correlation analysis and presented in the fifth and sixth columns. Extent of the relationship is shown in the last column of the table. In case one of the three dependent variables showed significance, *moderate* association was indicated. A relationship was considered as *strong* when at least two of the three depen-

[2]This result is consistent with a previous industry survey [9] which revealed that the top four benefits of BPR were improved service, improved quality, reduced cost and enhanced revenue.

Table 4. Study results[a]

Independent variables	Mean (overall) (N = 313)	Mean (BPR) (N = 219)	Mean (non-BPR) (N = 94)	*T*-test for BPR decisions	Correlation with IS commitment	Correlation with BPR success	Extent of relationship
			Innovative capacity of the organization				
(1) Interdepartmental integration	4.94	5.11	4.55	***	0.0295	0.2400***	strong
(2) Centralization of decisions	5.07	4.95	5.34	**	−0.0141	0.0252	moderate
(3) Existence of organic structural overlay (see Tables 5–6)							Strong
			IS maturity and influence				
(4) Experience in mainframe computing (years)	21.47	22.72	18.20	**	−0.1684*	0.0918	moderate
(5) Experience in client/server computing (years)	3.16	3.43	2.16	***	−0.0799	0.0547	moderate
(6) Ranking of the CIO position (see Tables 7–8)							moderate
(7) IS department influence in IS project selection	3.89	3.73	4.27	**	0.0053	−0.1598*	strong
			Strategy-IS interface				
(8) IS-business planning integration	5.12	5.32	4.67	***	0.1141	0.2203***	strong

[a]Maximum sample size (N) are indicated in the table. Actual N for the various cells vary slightly.
$*p < 0.05$; $**p < 0.01$; $***p < 0.001$.

Table 5. *Independent variable*: The existence of organic structural overlay for introducing new IT into the organization. *Dependent variable*: Decision to reengineer (Chi-squared test)

	Without overlay	With overlay
Non-reengineering firms	38	45
Reengineering firms	66	142

$\chi^2 = 6.33$; $p < 0.01$.

Table 6. *Independent variable*: The existence of organic structural overlay for introducing new IT into the organization. *Dependent variables*: IS commitment to BPR and perceived reengineering success (*t*-test)

	Without overlay	With overlay	*T*-test
IS commitment to BPR	29.11%	37.53%	$p < 0.05$
Perceived reengineering success	5.11	5.22	n.s.

Table 7. *Independent variable*: Ranking of the CIO position. High: 1 rank below CEO; Medium: 2 ranks below CEO; Low: 3 or more ranks below CEO; *Dependent variable*: Decision to reengineer. No significant relationship: Chi-square test and Kendall's tau)

	Ranking of CIO			
Reengineering decision	high	medium	low	Total
Non-reengineering firms	33	38	19	90
Reengineering firms	82	88	46	216

Table 8. *Independent variable*: Ranking of the CIO position. High: 1 rank below CEO; Medium: 2 ranks below CEO; Low: 3 or more ranks below CEO; *Dependent variables*: IS commitment to BPR and perceived reengineering success (one-way ANOVA)

	Ranking of CIO			
Dependent variables	high	medium	low	*F* value
IS commitment to BPR	35.6% ($N = 80$)	35.5% ($N = 85$)	31.3% ($N = 42$)	$F = 0.393$, not significant
Perceived reengineering success	5.32 ($N = 80$)	5.20 ($N = 86$)	4.76 ($N = 46$)	$F = 2.857$, $p = 0.06$

dent variables revealed significant association with the independent variable.

5.1. Innovative capacity of the organization

As shown in Table 4, the data showed a higher degree of interdepartmental integration for reengineering firms than non-reengineering firms ($P < 0.001$). Further, among reengineering firms, the extent of interdepartmental integration is significantly correlated to perceived level of reengineering success ($r = 0.24$, $P < 0.001$). The second relationship is moderate as reengineering companies showed less tendency to centralize decision making in the organization than non-reengineering firms ($P < 0.01$), but no relationship was detected for the other two dependent variables. Thus, in innovation theoretic terms, we conclude that organizations that are more organic are more likely to initiate reengineering projects than firms that are more mechanistic.

The result for relationship 3 can be found in Tables 5–6. It is evident from the chi-square table that, with the organic structural overlay, organizations are more likely to attempt BPR than without the overlay ($P < 0.01$). Among BPR firms, companies having the overlay showed significantly higher level of IS commitment to reengineering than those without it (37.53% vs 29.11%, $P < 0.05$). No difference was found between the two groups in perceived BPR success. Overall these results revealed a potentially strong influence of organic structural overlay on BPR initiatives.

The results for the first two relationships suggest that the expanded capacity for innovation in organic organizations, while important in innovation adoption in general, may be particularly helpful in initiating and implementing reengineering projects. It is instructive to note that, while decentralized decision making may facilitate the adoption of the reengineering concept, interdepartmental integration is important to both the BPR decision and success. This means that organic organizations that are high in integration and low in centralization are generally receptive to innovation, including process reengineering. However, the prospect of implementation and eventual success of BPR may have more to do with the extent of integration than decentralization. The efficacy of organic structural overlays, typically in the form of "venture groups" dedicated to the search for and introduction of new technologies, has been affirmed in other innovation contexts [48] including new IS practice [64]. As relationship 3 showed strong associations, we can be assured that such overlay structures may also facilitate the introduction of process reengineering practice into the organization. Taken together, the group of three relationships concerning the innovative capacity of the organization, while reaffirming some basic tenets of the innovation theories, also revealed certain interesting dynamics of BPR innovation. The importance of interdepartmental integration to reengineering project success is a testimony to the unique characteristics of BPR as an innovation.

5.2. IS maturity and influence

Results for all four relationships in this category can be seen in Table 4. The two relationships on IT experience were significant with respect to the decision to reengineer. Thus, we conclude that when compared to non-reengineering firms, reengineering firms have more experience in mainframe and client/server computing. This suggests that the enabling role of IT in reengineering is an important one. Firms with less technology competence would be less likely to undertake BPR initiatives. Specifically, the results reaffirm the importance of the client/server technology in reengineering initiatives [47].

However, the results also reveal a significant negative relationship between mainframe experience and IS commitment to BPR ($r = -0.1684$, $P < 0.05$). Thus, while mainframe experience might facilitate the decision to reengineer, it could also slow down the momentum of BPR. This seems to suggest that the traditional mainframe infrastructure, while more appropriate for functional hierarchy, may be at odds with the emerging networked organizational structure based on cross functional processes.

For the analysis of IS influence as reflected by the ranking of the CIO position, the results are presented in Tables 7–8. The CIO ranking variable (number of ranks below CEO) was treated as an ordinal measure, and was recoded into three groups: High (I rank below), Medium (2 ranks below) and Low (3 or more ranks below). No association was found between CIO ranking and the reengineering decision (using both the Chi-square test and Kendall's tau) and IS commitment (using one-way ANOVA). This result is in line with the observations made recently by Davenport and Stoddard [18] who have attempted to dispel the "myth" of IS leadership in reengineering initiatives and discussed their field experience which "suggests that IS partnership with business managers, rather than IS leadership of reengineering, is generally a key to successful reengineering" [18, p. 124]. For perceived level of BPR success, however, a moderately strong relationship was found ($P = 0.06$). The high ranking group and the medium group, respectively, has significantly higher perceived BPR success when compared to the low ranking group (family of contrasts with confidence level of 0.95). Thus, after the project is initiated, the quality of BPR implementation may be better if the CIO is ranked higher and has more influence in the actual conduct of the project. Given the important role of IT in enabling reengineering, it is conceivable that more input and expertise from IS can improve the overall project outcome.

Interestingly, for relationship 7 the data suggest that the extent of IS influence in IS project selection is higher among non-reengineering firms than reengineering firms. This means that user influence is higher among reengineering firms than non-reengineering firms. Further, this user influence is also significantly associated with perceived reengineering success (r = 0.1598, $P < 0.05$). This result suggests that, instead of focusing on *IS department influence*, we should have considered user influence as a indicator of *IS maturity*. Indeed, one significant trend in recent years is the expanding role of users in IS management. This has been manifested in user involvement and participation in systems development [33], and the emergence of end user computing and information center service for users [37, 42]. Previous studies (e.g., [20]) have demonstrated the relationship between user influence and systems success. It appears that if users have a great deal of experience in influencing the selection of regular IS projects, they can be expected to play a pivotal role in the reengineering initiative as well.

5.3. Strategy-IS interface

The relationship pertaining to IS-business planning integration showed strong positive associations. Not only is this planning integration for reengineering firms significantly greater than that for non-reengineering firms ($P < 0.001$), it is also significantly related to perceived reengineering success (r = 0.2203, $P < 0.001$). This IS-business planning integration has proved helpful in facilitating the successful launching and implementation of strategic information systems [50]. Results of this study demonstrated that IS-business planning integration may exert similar facilitating effects on process reengineering initiatives.

6. DISCUSSION

A set of eight relationships was explored based on the research model. As indicated in columns of Tables 4–8, these relationships showed either moderate or strong associations. This demonstrates the viability of the research model as a first step toward the development of a contingency model for the introduction of the process reengineering initiative into the organization.

6.1. Pattern of facilitating influence on BPR initiatives

To clarify the pattern of facilitating influence on BPR initiatives, several groups of independent variables were identified in Fig. 4 depending on whether the variable has positive association with only one dependent variable, or with two dependent variables. As can be seen, in terms of the number of potential sources of facilitating influence, the reengineering decision has the highest number (7), followed by perceived reengineering success (4) and then IS commitment to BPR (1). In fact, the adoption decision was strongly related to all three sets of independent variables, providing empirical support to the notion that BPR

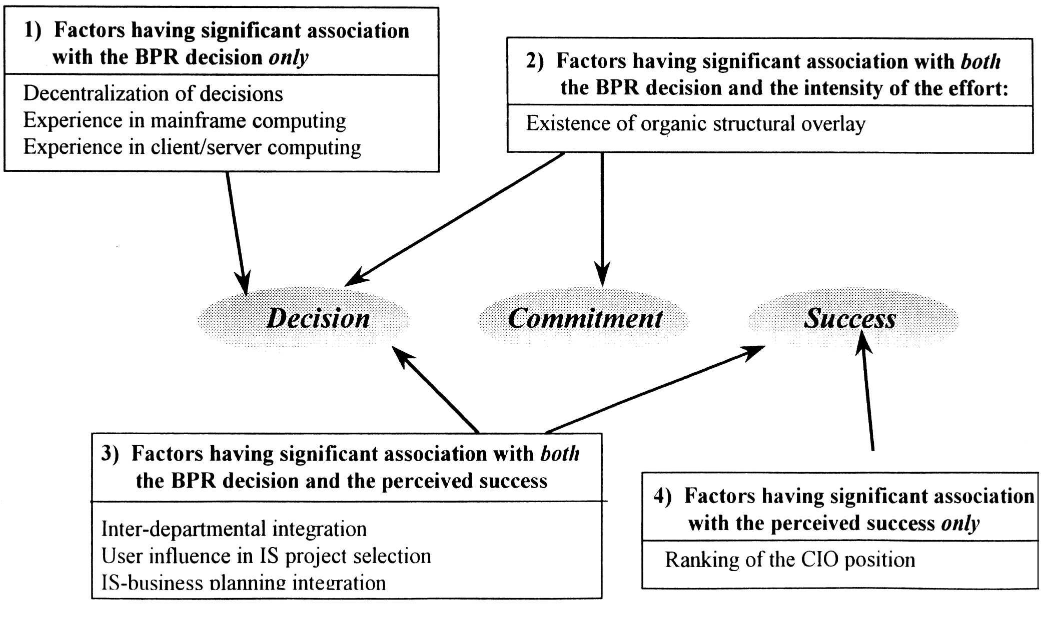

Fig. 4. Pattern of facilitating influence on BPR initiatives

involves multi-faceted complex organizational change that cannot be adequately conceptualized by any single theoretical perspective. In addition to a significant role of IS, the findings suggest that BPR initiative is an innovation as well as a strategy phenomenon.

Just one independent variable was significantly related to IS commitment to BPR. The process reengineering movement is only a few years old. With more experience and elapsed time, a number of these contextual factors may gain significance in determining IS commitment to BPR in organizations. For perceived reengineering success, the significant associations were related to organizational, people and strategy issues, rather than IT competence or the extent of IT resource.

As can be seen in Fig. 4, while factors related to IT competence such as experience in mainframe and client/server computing (block 1) may facilitate the decision to reengineer, they are not critical to the later stages of the initiative. On the other hand, factors having significant relationships beyond the initial decision (blocks 2 and 3) include mostly variables pertaining to innovative capacity of the organization and strategy-IS interface. The only IS factor in these two blocks, user influence in IS project selection, turned out to be related to the organizational context also. These study findings strongly suggest that technical IT competence as a critical enabler is necessary but never sufficient for reengineering success. Organization contextual conditions such as interdepartmental integration, user influence in IS decisions, IS-business planning integration and the existence of organic structural overlay, potentially have influence on reengineering implementation beyond the initial decisions. These results corroborate well with findings from an empirical study reported recently by Grover *et al.* [27] which revealed that, while both change management and technological competence problems were regarded as very difficult by project participants, the former was related much more strongly to reengineering success than the latter.

6.2. Implications of the study findings

The rapid successions of new generations of IT have been a constant source of stimuli for innovation for organizations seeking to improve their operating efficiency and strategic competitiveness. Over the years, a research tradition in the study of IS innovation has evolved [60]. In this study, we pay particular attention to variables that are potentially critical to BPR. This overlapping of innovation and reengineering perspectives led us to the notion of organic organizations, as such organizations have more capacity for innovation and are consistent with the principle of BPR which stresses cross-functional coordination as a point of departure from traditional "mechanistic" organizations stifled by vertical chains of command. Results of the study suggest that the reengineering team and the IS participants may wish to assess these conditions in order to evaluate the risk of failure and take steps to enhance the prospect of success. Based on the research finding, a "reengineering risk assessment grid" was prepared as shown in Fig. 5. The likelihood of succeeding in reengineering, which typically involves the institutionalization of inter-functional cooperation and free flow of ideas, would be higher for those organizations that have already been predisposed to this type of practice and culture (low risk column in the grid). On the other hand, highly decentralized organizations that are low in inter-functional collaboration may have greater readiness toward the BPR initiative, but extra efforts may be needed in breaking down the walls between functional departments in order to successfully implement it (the higher risk cell). If results of the assessment indicate a highly mechanistic organization that is low in both decentralization and integration, the risk of reengineering failure would be the highest. In such cases, a decision should be delayed and prodigious efforts may be required in improving these conditions prior to launching the reengineering initiative.

As interdepartmental integration is central to the principle of innovation as well as reengineering, a deficiency in this vital condition warrant serious attention. One compensatory step suggested by the results is the imposition of organic structural overlay in the form of a "venture group" dedicated to BPR in order to increase the organization's innovative capacity. A number of BPR pioneers have attempted this with success. At Federal Express, for instance, the traditional industrial engineering unit was renamed "strategic integrated system group" and placed within the IS department

		Degree of Inter-departmental Integration	
		Low	High
Degree of Decision Decentralization	Low	**Highest risk:** Mechanistic organizations with less readiness toward BPR initiation and higher likelihood of reengineering failure	**Lower Risk:** Organizations with less readiness toward BPR initiation but higher likelihood of reengineering success
	High	**Higher Risk:** Organizations with greater readiness toward BPR initiation but higher likelihood of reengineering failure	**Lowest Risk:** Organic organizations with greater readiness toward BPR initiation and higher likelihood of reengineering success

Fig. 5. Reengineering risk assessment grid

with the exclusive responsibility to design and implement major IT-enabled process change. In another case, the Productivity and Quality Center at Westinghouse has for many years initiated process improvement and reengineering projects throughout the company [28].

IS professionals have recognized the significance of strategy-IS planning integration in the context of strategic IT applications since the 1980s, and the results of this study pointed to its continual importance in BPR initiatives. Numerous approaches have been suggested to improve this interface through strategic IS planning [36]. These methods typically include a business model that depicts various sources and uses of data and information flows for various parts of the business. This business model can form a basis for defining a portfolio of applications, databases, and IT architectural priorities. This experience in enterprise modeling can be very useful in launching BPR initiatives. A particularly important element of this architecture is data, since properly designed databases can support cross-functional applications, and the database structure can remain stable while applications undergo changes [62]. This can be seen in the case of Continental Bank where the CIO initiated a thorough examination of the overall strategies and the various functions delivering products and services critical to the strategies. The interactions between these functions and their shared data were also examined. This led to the design of an enterprise model showing critical linkages across business units. Based on this model, a technology strategy was developed which included an IT platform, database design, and application development plan [2].

Attempting to align IT strategies with overall corporate strategies would lead to, among other benefits, better identification of candidate processes and IT enablers for reengineering, and the development of an information resource architecture that facilitate BPR. One technique for identifying business processes in an organization that has been applied extensively in the past in strategy-IS interface is the value chain method proposed by Porter and Millar [49]. Comprehensive identification of business processes can be achieved by tracing from the "upstream" processes associated with inbound logistics, through operations and those related to "downstream" processes such as marketing, sales and services. Once a set of business processes are identified, strategy-IS interface techniques such as the critical success factors method [54] can then be applied to evaluate each process as to its strategic relevance. This would help to identify a set of candidate processes for reengineering that are critical to the firm's strategic performance. Union Carbide, for example, made a strategic decision to emphasize commodity chemical rather than specialty products, which dictated the reengineering of its manufacturing process to achieve lowest possible cost and provide added value in delivery and service [59].

The exploratory results reported in this paper represent a preliminary step toward understanding the multi-faceted complex organizational change phenomenon associated with reengineering. The results, however, point to numerous future research opportunities. This study explored the factors influencing reengineering project initiation and success, drawing on the IS research tradition in inquiries on factors contributing to IS innovation [60, 66] and systems success [19]. This does not suggest that the same set of factors apply to both IS and BPR project initiatives. Some of the factors we included have special significance to reengineering. Inter-departmental integration, for example, does not seem to be particularly important for a traditional system project that is restricted within the confine of one function. Future studies may attempt to develop a more comprehensive contingency model by examining additional factors with potential relevance to reengineering initiation and success, including top management leadership, championship, competitive strategy, financial performance, employee reward systems, organizational learning and knowledge sharing. One way to accomplish this is to evaluate responses from BPR project participants in areas other than IS such as top management, human resource, planning, quality management, accounting, and other functional departments.

6.3. Limitations

As the study was based on a large field sample with firms varying in size and industry affiliation, the results should provide a reliable indication of the prevailing general patterns. However, in spite of the positive evidence of reliability and validity, we need to exercise caution in interpreting the study results. Claims to causality are risky as relationships between variables were examined in terms of bivariate associations such as *t*-test, correlation and Chi-square test. Do higher levels of organizational integration and decision decentralization facilitate the decision to reengineer? Or perhaps these are the results of the decision to reengineer, as BPR typically involves collaboration between departments and empowerment of on-site personnel. We believe the former is more likely since process reengineering is a relatively new phenomenon, and BPR projects are targeted at specific processes within a firm which may not immediately alter overall organizational characteristics. In fact, one of the "myths" of reengineering that may need to be dispelled is the tendency to equate BPR with organizational transformation [18].

As indicated in Appendix A, the validity and reliability of the research instrument have been rigorously established. This covers all the independent variables. The major dependent variable, the decision to reengineer, is an objective yes–no binary choice. There is, however, a need to consider the limitations of the two additional dependent variables. The IS commitment measure is intended to provides some indication of the extent to which the IS function was mobilized to implement BPR. This, however, should never be regarded as an indicator of overall BPR efforts in the firm, as we are not completely certain that all reengineering projects involve IS. Another consideration is the possibility that a low commitment score actually involves a few large BPR-related IS projects which consume a major portion of IS resources. This potential bias needs to be taken into consideration when interpreting the study findings. However, with a large sample size (219 reengineering firms) and the anticipation that a typical firm has a mixture of larger and smaller IS projects involving BPR, it is highly unlikely that such extreme cases would significantly distort the study results. For perceived reengineering success, the preliminary measure used in this study reflects IS executives' general assessment. It is not known whether this is consistent with assessments made by other participants in the BPR team or by those affected by the redesigned processes. However, BPR success level as perceived by IS executives should not be biased upward, as the IS group is typically just one of many participating functional specialist groups in the reengineering project. In fact, there is some likelihood that their assessment may be biased downward since they normally do not lead reengineering projects, are often left out of the project initially, and invited to participate later only after they have proved their trustworthiness [4].

7. CONCLUSION

In just a few years, the process reengineering concept has spread rapidly among organizations seeking breakthrough performance gains. In this study, we attempt to improve our understanding of this phenomenon by gathering evidence via broad-based samples from the field. In addition to presenting important patterns of reengineering practice, we have identified a number of potentially facilitating sources of influence on BPR initiatives in terms of the decision to reengineer, the extent of IS commitment to the effort, and perceived level of reengineering success. These sources of influence, which represent important attributes of the *innovative capacity of the organization, IS maturity and influence, and strategy-IS interface*, help us to better understand the potential influence of the IS function and organizational context on reengineering project initiatives. One pattern of findings that is particularly relevant to the IS profession is the role of technical IT competence in BPR initiatives. We found that experience in mainframe and client/server computing, while potentially facilitating the decision to reengineer, is not critical in the later stages of the initiative. On the other hand, factors having significant relationships beyond the initial decision include mostly variables pertaining to innovative capacity of the organization and strategy-IS interface. These study findings strongly suggest that, in order to contribute to the reengineering effort, IS professionals need to develop skill in analyzing the organization and interfacing with the corporate strategy. These organizational assessments, as demonstrated by the reengineering risk assessment grid (see Fig. 5), can be invaluable in evaluating the risk of failure and taking steps to enhance the prospect of BPR success. The overarching importance of "joint optimization" in process reengineering initiatives anchored on business strategy, IT strategy and organization strategy [39, 63] has been clearly demonstrated in this study.

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APPENDIX A

VALIDITY AND RELIABILITY OF THE RESEARCH INSTRUMENT

To ensure that the respondents correctly understood the meaning of reengineering and did not mistake MIS development projects as a reengineering initiative, BPR was carefully defined in the questionnaire as "a deliberate (planned) change", typically enabled by IT, in an attempt to redesign a business process to "achieve performance breakthrough in quality, speed, customer service, cost, etc". It was further pointed out that reengineering has often been contrasted to automation which mainly involves computerization of existing business processes with management information systems (MIS) applications. In addition, as indicated earlier, participants were asked to identify the first reengineering project attempted, and rank the relative importance of various BPR performance objectives. This detailed characterization of the respondents' efforts associated with reengineering provided a high level of assurance that the projects attempted are indeed BPR initiatives. Of the 219 firms that have indicated BPR experience, all answered at least one of the descriptive questions concerning current BPR practice.

An important issue in survey research is the possibility of response bias. In the case of the current study, one critical concern is that companies that have attempted BPR and (succeeded) were more likely to respond to the survey than those that had not attempted BPR (or had failed). Fortunately, the reported survey is based on a small portion of a large questionnaire that also includes a number of other topics. In fact, questions on BPR do not appear until the middle part of the questionnaire. Thus, it is very unlikely that self-selection (with a bias toward successful reengineering experience) could have occurred among the respondents.

The intended respondent for the survey was the senior IS executive. To ensure that the actual respondents are indeed top IS managers, we asked for the respondent's job title. The results were coded and classified. The results indicate that an overwhelming majority of the respondents (86.3%) hold tittles such as

CIO, V.P. of Information Systems, Director of Information Systems, Manager of IS, and Supervisor of IS, etc. The remaining 13.7% of respondents were CEOs, consultants, project leaders, manager of systems development, etc.

To assess whether the respondents reflect the sample frame of the 900 firms selected, non-response bias was assessed. Early respondents were compared against late respondents across a number of key organizational characteristics — distribution of industry type, number of employees, company annual sales, organization type, etc. [67]. None of the Chi-squares or *t*-tests were significant (at $P < 0.01$), providing support for generalizability to the sample frame.

Three multiple-item measures were used in the study. These measures have been validated in previous studies. In this study, factor analysis was performed on each and yielded just one factor in every case. In addition, reliability was assessed with respect to the internal consistency of each measure. Cronbach's alpha for the three measures were computed: 0.82 for the centralization of decision measure, 0.91 for the interdepartmental integration measure, and 0.91 for the IS-business planning integration measure. These alpha values are all well above the acceptable level [68].

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