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Information technology-enabled change: the risks and rewards of business process redesign and automation

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Information technology-enabled business process redesign is a means of levering the power of information technology to change organizational processes radically resulting in substantial improvements in corporate effectiveness and efficiency. Some of the greatest opportunities for organizational improvement using IT are associated with the support of processes that cross functional boundaries. In this search for improvement, it is important to recognize that there are both process risks associated with business process redesign and structural risks associated with crossing functional boundaries. This paper proposes a model that relates the risks and rewards of IT-enabled change and reports on the experience of 59 organizations. The study found that organizations tend to emphasize either cross-functional business process redesign or intrafunctional automation projects. The results suggest that corporations that wish to take advantage of the rewards available from information technology-enabled change should recognize the risks associated with cross-functional change and process redesign.

Introduction

The old saying that states 'if it is not broken, then don't fix it' is being increasingly replaced with its antithesis, the adage that 'if it is not broken then there is still time' to make the improvements necessary to survive. This transition is symbolic of the pressure that many organizations have experienced to improve their efficiency and effectiveness. Such pressures have caused companies to focus on the potential rewards associated with new projects while all but disregarding the risks related to change. Traditionally, the 'conservative' approach for applying information technology (IT) was through automation of existing processes within the boundaries of a traditional function, such as finance or marketing. While automation of existing processes may increase the speed at which current business practices are carried out, it is based on the assumption that the design of the original process was satisfactory.

The current competitive business climate has forced organizations to consider more drastic change in search of greater gains in organizational effectiveness. As an enthusiastic supporter of radical change, Davenport (1993) wrote

> In the face of intense competition and other business pressures on large organizations in the 1990s, quality initiatives and continuous incremental process improvements, though still essential, will no longer be sufficient. Objectives of 5% or 10% improvement in all business processes each year must give way to efforts to achieve 50%, 100%, or even higher improvements levels in a few key processes. . . . Achievements of order-of-magnitude levels of improvement in these processes means redesigning them from beginning to end, employing whatever innovative technologies and organizational resources are available (p. 1).

Business process redesign

The terms business process redesign (BPR), business process re-engineering, process innovation or re-engineering have been used interchangeably to describe the phenomenon of radically altering business processes to achieve remarkable improvements in performance (Davenport, 1993; Grover *et al.*, 1993).[1] BPR has also been termed as a new form of industrial engineering to contrast with its process-oriented approach to the task decomposition and specialization that formed the basis of classical industrial engineering (Davenport and Short, 1990). While terminology may vary, four common features of BPR can be derived from the relevant literature. BPR can be defined as a radical departure from existing practices (Alter, 1990; Hammer, 1990; Venkatraman, 1991) that is deliberate and planned (Alter, 1990; Davenport and Short, 1990; Hammer, 1990; Senn, 1991; Venkatraman, 1991) to bring about a dramatic improvement in performance (Alter, 1990; Hammer, 1990; Senn, 1991; Venkatraman, 1991), typically enabled by information technology (Alter, 1990; Hammer, 1990, Venkatraman, 1991).

[1] Another widespread phenomenon, the quality movement, represents an incremental and continuous orientation to process change as opposed to the radical reinvention of process espoused by BPR.

Risk and information technology-enabled change

Traditionally, the risk of an action has been defined in terms of the severity and probability of an unfavourable result (Haimes, 1991). This definition may be applied directly to quantify some very simple systems where every outcome and probability can be anticipated and calculated. However, when dealing with organizational change it may be difficult if not impossible to quantify either the severity or the likelihood of a single undesired outcome, much less the myriad of unfavourable outcomes possible (Denenberg *et al.*, 1974; Kaplan and Garrick, 1981). The recognition of the complex interaction of social and technological characteristics associated with IS development and implementation have led to a method of indirect measurement of IS risk that is based on determining factors that are related to the underlying risk of information system failure (Davis *et al.*, 1992; Barki *et al.*, 1993).

The factors associated with IS project risk and failure have been proposed in terms of IS project characteristics, development process and technological expertise (McFarlan, 1981; Lyytinen and Hirschheim, 1987). This research has also led to suggestions on how to reduce IS project risk by securing top management support, involving end-users in the development process and obtaining both user and IS professional expertise (Lucas, 1975; Cerullo, 1980). While there is a wealth of research into the elements contributing to IS success and failure, it is important to recognize that the nature of the risk is defined specifically in terms of the success or failure associated with information systems.

It should be noted that BPR, automation or any change for that matter does not need to be associated with information technology (IT). However, IT can add new opportunities for process redesign through improved coordination, communication and information manipulation. While information technology can enable BPR, the focus is not on the information system (IS), but on business process improvement. In many cases BPR can be instituted with the current IS without committing new IT resources by concentrating on changing how the present system is used to carry out work (Davenport, 1993; Grover *et al.*, 1993).

Even when BPR is made possible by the use of IT, the risks related to IS failure are only a subset of all the risks associated with BPR project failure. In this paper, a broader scope of risk is implied, the risk that after committing the resources and effort to carry out the automation or BPR project, the organization as a whole is not as well off as it had anticipated, whether or not the related information system was a success. This organizational risk may be due to BPR or automation project failure or because the project had an unanticipated or unmeasured negative impact on the organization's operations.

Organizational risk is always present with organizational change, so it is important to carefully weigh the potential risks and rewards before deciding to attempt a project. In this paper, a model will be proposed relating the risk and rewards of IT-enabled process change. This model will be used to generate a series of questions that will then be examined using the responses from a mail survey of senior IS managers. Two specific types of risk will be presented; process risk and structural risk. Finally, some conclusions and implications for future research will be discussed.

The risks and rewards of process redesign

While automation represents technology change with minor or incremental change in the structure of the business process, IT-enabled BPR requires that the technology be levered by fundamentally and radically changing the underlying process. BPR is by definition radical change (Hammer, 1990) and radical change is 'a clear, risky departure from existing practice' (Ettlie *et al.*, 1984, p. 683). Radical change has been traditionally defined in terms of an increase in potential organizational risk and performance gains (Dewar and Dutton, 1986; Damanpour, 1991). The extent of change required by BPR tends to preclude the use of parallel implementation strategies where the old and new systems operated simultaneously and forces organizations to take on the increased risks associated with an all-or-nothing strategy when implementing projects (Davenport, 1993).

Even proponents of BPR admit that 'organizations that can avoid such wrenching change should probably do so' (Davenport, 1993, p. 15). Despite the related risks, companies are being drawn by the anticipation of huge rewards possible through process improvement. It is the contention of this paper, while IT-enabled BPR promises great rewards, it is inherently more difficult than automation and involves increased process risk. Process risk is defined as a broad term to describe the risks inherent in the radical altering of business processes associated with re-engineering. It includes the risks associated with the potentiall irreversibility of the change process, resistance to change, and task ambiguity.

(1) Irreversibility of the change process increases the costs or financial risks associated with project failure. While no company plans on failure, back-up procedures are an important part of any development project. The radical process change associated with re-engineering forces most organizations to take a 'cold turkey' strategy towards project implementation. BPR may so alter the business it can be very costly or impossible to revert to the original process if the new organization fails (Martin *et al.*, 1991; Davenport, 1993).

(2) Resistance to process change lowers acceptance of the new process and increases the risk of failure of the BPR project. People may find it very difficult to accept the radical departure of traditional practices associated with BPR which increases the likelihood that the project will be rejected by employees and ultimately fail. If the new business process is going to succeed, it will have to be accepted by the employees carrying out the business tasks. Overcoming resistance to change and convincing individuals to adapt to new processes can be very complicated (Lawrence, 1954; Hirschheim and Newman, 1988; Nelson, 1990). Davenport (1993) suggests replacing 'resisters and/or individuals who failed to adapt' (pp. 193–4) to BPR. However, this might not always be practical.

(3) Task ambiguity is the uncertainty associated with redefining the nature of an individual's work and increases the risks of suboptimal performance and system failure. BPR often requires employees to become generalists by taking on jobs with broader scopes and greater responsibility (Hammer, 1990; Davenport, 1993). The more radical the departure from traditional practices, the greater the task uncertainty or ambiguity, which has been consistently found to be associated with risks of dysfunctional organizations and employee turnover (Rizzo *et al.*, 1970; Guimaraes and Igbaria, 1992).

To illustrate the concept of process risk, consider a company which has dispersed sales and distribution locations. The company originally had separate manual sales systems at its various corporate locations. When an order was received, it was taken on a paper invoice and then sent to a local credit clerk. The clerk then determined the creditworthiness of the customer before the order was filled. The company integrated IT into its credit checking functions by developing a database that allowed salespersons, in an on-line environment, to evaluate the creditworthiness of customers and authorize shipment. The database was expected to produce faster order fills, increased sales and customer satisfaction. The database also allowed them to re-engineer their sales process and save hundreds of thousands of dollars in personnel, training and hardware costs by establishing a centralized credit-processing facility.

Months after the system was in place, the company found that sales had dropped at several locations and uncollectable billing had risen at many others. Upon examination, they found many of the sites had unique seasonal and cultural factors that made local analysis of creditworthiness necessary. Unfortunately, the expertise of their ex-credit clerks was no longer available to the corporation making the change process irreversible. The lifetime of specialized local credit experience that was stored in these clerks was very costly to replace.

There was also a marked increase in voluntary turnover of many of the organization's sales representatives. Some salespeople expressed a general feeling of increased uncertainty in job requirements, i.e. task ambiguity and others resented the added duties associated with the new sales process. Many of the salespeople resisted the change in the sales process. Some of the company's best salespeople even left the firm and took their client bases with them.

In terms of the anticipated rewards from decreased costs and increased efficiency, the BPR of the company's sales process was a success. However, decreased sales, increased employee turnover and bad debt had an adverse effect on their current revenues. It is important to realize that the firm carried out IT-enabled BPR to achieve radical rewards, but may have failed to recognize the full extent of the related process risks involved. The popular press is full of the testimonies of consultants touting the incredible productivity gains possible with BPR, but there seems to be a quiet void concerning the effects of failed BPR projects.

The risks and rewards of crossing functional barriers

Information technology can support automation and IT-enabled BPR at different levels of the organization. IT-supported organizational change can occur within functional areas (intrafunctional) or between functional areas (cross-functional) (Venkatraman, 1991; Wilkinson, 1991). Cross-functional processes such as new product development, outbound logistics, order processing, etc., many times offer the potential for performance gains through improved information flows and reduced administrative redundancy (Teng *et al.*, 1994). While the most significant gains in performance tend to occur through the use of IT to support processes that cross functional boundaries (Davenport and Short, 1990; Hammer, 1990; Seen, 1991; Grover *et al.*, 1994), it also increases structural risk. Structural risk represents risks associated with crossing traditional functional boundaries and altering existing organizational structures. It includes the risks associated with structural change, increased structural complexity and parochial ownership of the process.

(1) Structural change increases the risks associated with disturbing the institutionalized corporate structures. Crossing functional boundaries may destroy a desired feature of the organization. For example, a cross-functional project might alter the segregation of duties which is used to safeguard assets by holding different individuals responsible for storage and distribution of resources (Meigs *et al.*, 1982).

(2) Structural complexity increases as you involve more than one functional area in the project (e.g. multiple reporting and control structures) which increases the risk of project failure. Higher levels of complexity require increased organizational commitment and coordination and make change more difficult (Ettlie *et al.*, 1984; Damanpour, 1991).
(3) Parochial ownership of parts of the system increase the risk associated with political and functional power struggles. Crossing functional boundaries may require adjustments in the organizational power structure and could incite infighting among groups with parochial ownership of their part of the process (Markus, 1983; Grover *et al.*, 1988).

Structural risk can occur with either re-engineering or automation. For instance, take the case of a company that instituted a cross-functional sales database and experienced an embezzlement. The new system brought about structural change which allowed the same individual to both receive and authorize a sale. The structural risk was compounded by increased structural complexity which contributed to the confusion as to which department was responsible for the authorization of sales payments. One salesperson took advantage of this newly granted authority to ship merchandise to a fictitious vendor for resale. In the old system there was a segregation of duties that forced the sales people in the marketing department to obtain authorization from the finance department.

Another case illustrating structural risk occurred in an organization that developed increased networking and database capacity. This new cross-functional system allowed the production department access to raw accounting data. The production department felt that access to the most current sales information would allow them to plan their production schedule more precisely. At the same time, the accounting manager's parochial ownership caused resentment over his loss of control of the data that resulted from the new system. The accounting manager's lack of assistance contributed to the production manager's misunderstanding of the accounts receivable schedule and a costly inappropriate production run. Eventually, the new production manager worked out his differences with the accounting manager and produced a valuable just-in-time inventory system. Both of these examples illustrate structural risks associated with the initiation of cross-functional IT-enabled change.

Matching risks and rewards

Ideally organizations would like to carry out IT-enabled change to achieve rewards in the form of productivity gains without exposing themselves to increased risk. However, the potential for increased rewards is inevitably related to risk. Based on the prior discussion, cross-functional projects have higher structural risks relative to intrafunctional projects and BPR is associated with increased process risk as compared to automation. Consequently, while IT-enabled cross-functional BPR may have the potential to produce the greatest gains in organizational effectiveness, it would involve both process and structural risks.

The relationships between process redesign and the crossing of functional boundaries can be conceptualized as forming the relationship shown in Table 1. All else being equal, intrafunctional automation appears to be the least risky approach with the smallest potential reward, while cross-functional BPR would be the most risky approach with the greatest potential reward. In the current environment of increased competition and economic pressure, organizations that can accommodate the risk may attempt to maximize their rewards by carrying out cross-functional IT-enabled BPR, while risk-averse organizations or organizations that can avoid these economic pressures (e.g. regulated monopolies), should probably avoid the pain associated with cross-functional BPR (Davenport, 1993).

A widely cited example of cross-functional IT-enabled BPR is that carried out at Mutual Benefit Life (MBL). MBL re-engineered its individual life insurance underwriting process, which originally consisted of 40 steps with 100 people in 12 functional areas to the use of a case manager supported by shared databases, computer

Table 1 Risks and rewards of organizational IS projects

Structural risk	Process risk	
	Low	High
High	Cross-functional automation Moderate reward Moderate risk	Cross-functional BPR High reward High risk
Low	Infrafunctional automation Low reward Low risk	Intrafunctional BPR Moderate reward Moderate risk

networks, expert systems and access to human specialists (Davenport and Short, 1990; Hammer, 1990). Despite its success in IT-enabled BPR, MBL was forced to seek protection from its creditors by declaring bankruptcy. While it is impossible to relate MBL's bankruptcy to its BPR efforts it does point to the need to recognize that there are other ingredients necessary for organizational success and that some businesses may be motivated by extreme pressures to accept the added risks associated with interfunctional BPR.

Depending on the perceived circumstances either mixture of reward and risk may be the 'rational' choice. For example, in times of economic turbulence it is quite rational for a manager who perceives that the organization is 'losing the war' to take on the high risks associated with cross-functional BPR because they perceive their current status as negative, while it would be unreasonable for a manager who is not under this pressure to take on the same risk. The utility function of the standard economic theory of diminishing marginal utility ensures that any decision 'between two negative outcomes is less negative in terms of utility than the corresponding certainty' (Dawes, 1988, p. 41). In other words, it is completely rational to attempt a risky cross-functional BPR project that might save the company instead of just waiting for the near certainty of bankruptcy.

It would appear reasonable that a rational organization, depending on its condition, could concentrate its IT efforts on any of the four approaches. At one extreme, a company would feel economic pressures to attempt to maximize their potential rewards by focusing on cross-functional IT-enabled BPR. At the other extreme, a company would minimize its risk by concentrating on intrafunctional automation. Other organizations in less extreme circumstances might choose to take one of the moderate risk approaches for IT projects. The possibility that organizations might concentrate on certain IT projects that match their need for performance gains with their tolerance for risk is the basis for the following exploratory question regarding the four types of IT projects identified in Table 1.

Question 1: What is the profile of contemporary organizations with regard to the four types of IT project described?

It is assumed that when organizations choose projects, they match the project risks and rewards and set their objectives for project success appropriately. For example, if an intrafunctional project is designed to increase performance by 20% and cost \$200 000, it should be considered equally as successful as a cross-functional BPR project that is designed to increase performance 200% and cost \$2 000 000. The degree that the anticipated gains are obtained should be strongly related to the perception of success (matching of project goals and effort) of the IT project. However, since BPR involves radical change and current organizations may have less experience with the phenomenon, they might have greater difficulty anticipating the amount of effort required and the rewards possible. This leads to an exploratory question concerning the perceived success of BPR.

Question 2: What is the perceived success of cross-functional and intrafunctional BPR projects?

Organizations that are accustomed to the risks associated with cross-functional automation may plan to do more BPR in the future than organizations that concentrate on intrafunctional automation. The lack of experience that organizations have with IT-enabled BPR projects may also contribute to their choice of projects. Companies may start with intrafunctional BPR projects and only after gaining experience increase their cross-functional BPR efforts (Davenport, 1993). The newness of BPR makes it especially important to understand the future intentions of organizations to carry out BPR, as expressed in the following question.

Question 3: What relationship will BPR success and IT project type preference have on the organization's intentions to carry out BPR in the future?

While the phenomena of IT-enabled BPR has only been in existence for a few years it has drawn the attention of both academicians and practitioners. This study is an early descriptive attempt to understand IT-enabled BPR by relating it to prior research in risk and radical innovation. The next section discusses the data gathered in examination of the proposed questions.

Study and results

The survey instrument was developed through an iterative process of review and refinement. This process included a series of interviews and pre-tests with IS executives that focused on issues of instrument clarity, item wording and validity. To ensure that the respondents understood the BPR concept as discussed in this paper, each subject was exposed to the construct in the cover letter and was given a concise definition preceding the individual questions. The subjects were told that business process redesign was the use of information technology to radically overhaul or change business processes, while automation was the computerization of existing business processes with minor if any change to the original process.

A random sample of 300 vice-presidents and directors of IS from *Information Week*'s 500 most progressive users of IT were mailed the survey instrument. It was presumed that these users would be more likely to engage in IT-enabled BPR. After accounting for invalid addresses, 59 were received for an effective response rate of 20%. Early and late respondents were compared on all six variables listed in Table 2 to test for non-response bias and no significant difference was detected.

The survey seeks to identify organizational IS projects by asking IS managers to allocate their total intraorganizational IS automation and BPR projects for the last 12 months between those that occur within functional areas and between functional areas. As shown in Table 2, the instrument also measured IT-enabled BPR success using a two-item, seven-point scale that measured satisfaction and goal achievement of IT-enabled BPR projects. This scale had an acceptable α coefficient of 0.70 (Nunnally, 1978). Intention to increase BPR effort was measured by a single item with a seven-point scaled response.

Forty-four percent of the respondents were employed in the manufacturing industry, while 21% were involved in the service industry. An equal number of respondents (12%) were in the commercial utilities and financial insurance industries. The other subjects of the study were employed in the banking (9%) and the transportation industries (3%). The diverse nature of the respondent firms allows insight into the research questions across different industries.

In response to question 1 the study found that the moderate risk and reward approaches of cross-functional automation and intrafunctional IT-enabled BPR made up, on average, 23% and 15% of all organizational IS projects (shown in Table 3). The predominant form of IT-enabled BPR carried out by responding organizations was the high-risk and reward strategy of cross-functional IT-enabled BPR, which averaged 26% of the total organizational IS projects. Intrafunctional automation was the most popular form of organizational IS projects averaging 36%. In other words over one-third of the IS projects of surveyed companies were involved in an automating process within functional areas. The most prevalent approaches were those that promised the greatest rewards (cross-functional BPR, 26%) or allowed for the lowest exposure to structural and process risks (intrafunctional automation, 36%).

As shown in Table 4, the nature of organizational IS project profiles was further examined using Pearson's correlation to explore the relationship between intrafunctional automation (low risk, low reward), intrafunctional BPR, cross-functional automation and cross-functional BPR (high risk, high reward). While the various IS project types do not represent purely mutually exclusive approaches, there was a strong negative correlation between cross-functional BPR and intrafunctional automation ($-0.58, p = 0.000$) and cross-functional automation (-0.40, $p = 0.01$). Table 4 also shows that intrafunctional BPR had a negative relationship with intrafunctional automation (-0.38, $p = 0.001$) and cross-functional automation (-0.40, $p = 0.001$). The negative correlation suggests that organizations tended to emphasize either automation or BPR projects. In addition, intrafunctional and cross-functional automation had a positive correlation (0.30, $p = 0.01$); however intrafunctional and cross-functional BPR were not significantly correlated. In summary the IS

Table 2 Variable operationalization

Variable	Measure
Intention to increase BPR effort	A single item: we will expand our re-engineering efforts
BPR success	A two-item scale: 1, we are satisfied with our re-engineering efforts; 2, we have achieved (or anticipate achieving) our re-engineering goals (α = 0.70)
Intrafunctional BPR	The percentage of total IS projects for last 12 months that were intra-functional BPR
Cross-functional BPR	The percentage of total IS projects for last 12 months that were cross-functional BPR
Intrafunctional automation	The percentage of total IS projects for last 12 months that were intra-functional automation
Cross-functional automation	The percentage of total IS projects for last 12 months that were cross-functional automation

Table 3 Descriptions of organizational IS projects

Structural risk	Process risk	
	Low	High
High	Cross-functional automation 23.33%	Cross-functional BPR 25.99%
Low	Intrafunctional automation 36.00%	Intrafunctional BPR 14.68%

Table 4 Correlational matrix of business process redesign and automation

	Intention to increase BPR efforts	BPR satisfaction	Intrafunctional		Cross-functional	
			BPR	Automation	BPR	Automation
Intention to increase BPR efforts	1.00	0.20[a]	0.12	−0.30[b]	0.21[a]	−0.15
BPR satisfaction	–	1.00	0.08	Not applicable	0.38[c]	Not applicable
BPR intrafunctional	–	–	1.00	−0.38[c]	× 0.03	−0.40[c]
Automation intrafunctional	–	–	–	1.00	−0.58[c]	0.30[b]
BPR cross-functional	–	–	–	–	1.00	−0.40[c]
Automation cross-functional	–	–	–	–	–	1.00

[a] $p<0.1$, [b] $p<0.05$, [c] $p<0.005$.

project profile of the surveyed organizations indicates the following.

(1) The most prevalent IS projects recorded were the high-risk/reward portfolio (cross-functional BPR) and the low-risk/reward portfolio (intrafunctional automation). This suggests that organizations may tend to be aggressive or conservative by emphasizing either a high-risk/reward portfolio (cross-functional BPR) or a low-risk/reward portfolio (intrafunctional automation).
(2) While the relationships between different types of automation efforts and between different types of BPR efforts is either positive (cross-functional automation correlated significantly with intrafunctional automation at 0.30) or insignificant (cross-functional BPR was not correlated with intrafunctional BPR), the relationship between any type of automation effort and any type of BPR effort is always negative. This indicates that an organization is oriented towards either automation or BPR.

Question 2 was explored by using Pearson's correlation technique to compare perceived BPR satisfaction and IT-enabled BPR (shown in Table 4). The results showed that there is a significant positive correlation between the extent of cross-functional BPR and satisfaction (0.38, $p = 0.002$) and no significant corresponding relationship with intrafunctional BPR. It is possible that the lower potential impact (reward) of intrafunctional IT-enabled BPR might reflect this lack of a significant correlation.

It is important to note that these patterns could also be the result of the newness of the BPR phenomena and as more organizations gain experience with IT-enabled BPR, these relationships may change. Further insight into the appropriateness of the model may be gained by examining the future intentions of organizations to carry out BPR as proposed in question 3.

An organization's intention to increase its BPR effort had a positive and marginally significant correlation to BPR satisfaction (0.20, $p = 0.063$) and cross-functional BPR (0.21, $p = 0.059$). It was negatively correlated to intrafunctional automation (−0.30, $p = 0.010$) and not significantly correlated to intrafunctional BPR or cross-functional automation. It appears that organizations that are carrying out cross-functional BPR (high risk and reward) are planning to increase their BPR efforts, while those that are pursuing intrafunctional automation (low risk and reward) do not plan to institute BPR. These results suggest that those organizations that are carrying out either a high-risk and high reward approach or a low-risk and low reward approach do not plan on changing their IS project emphasis.

Discussion and implications

This study presented a model relating the risks and rewards of cross-functional and intrafunctional IT-enabled BPR and automation and explored a number of related questions. Through a survey of top IS managers, these questions were examined. The managers were asked to answer questions concerning their IS projects for the last year, BPR satisfaction and intentions to increase BPR efforts in the future. Their responses suggest that organizations tend to emphasize either BPR or automation projects. The study also found that organizations that carry out IT-enabled BPR are more likely to initiate cross-functional IT-enabled BPR and to be more satisfied with their efforts than those organizations that carry out intrafunctional IT-enabled BPR. In addition, organizations that carry out cross-functional BPR (high reward and risk) plan to increase their BPR efforts, while organizations that concentrate on intrafunctional automation (low risk and reward) do not plan to increase their BPR efforts.

While it appears that the greatest opportunities for organizational improvement using IT are associated with the redesign of processes that cross functional boundaries, there are also risks. It is important to recognize that there are both process risks associated with IT-enabled BPR and structural risks associated with crossing functional boundaries. The results suggest that corporations that wish to take advantage of these opportunities need to identify and plan for the risks associated with cross-functional IT-enabled BPR.

The structural risk associated with cross-functional change (structural change, increased structural complexity and parochial ownership) may be somewhat mitigated through careful planning and top management support. Before structural change occurs, it is important that there is a thorough understanding of the current system and the effect that the change process is going to have on the system. In this way, those parts of the old system that are desirable can either be maintained or new structures can be planned for and put in place to overcome any new shortcomings. The increased structural complexity associated with cross-functional change requires increased planning and support to overcome the intense coordination needed to implement the new system successfully (Grover *et al.*, 1994). The counter-productive infighting that may result from parochial ownership of cross-functional systems must be dampened by the direct intervention and support of top management.

The process risks (irreversibility of the change process, resistance to change and task ambiguity) associated with IT-enabled BPR may also be reduced through careful planning and the establishment of an innovative and supportive organizational environment (Teng *et al.*, 1994). With radical change like that associated with IT-enabled BPR, it may be impossible to go back to pre-BPR processes, so organizations must make contingency plans for back-up systems before attempting IT-enabled BPR of critical organizational processes. Resistance to change and the adverse effects of task ambiguity can be mitigated by an innovative and supportive environment. This environment is only possible if the employee has trust, understanding and a feeling of ownership in the success of the project.

This study is one of the first empirical explorations of a new and important phenomenon which needs further research. In the future, some organizations may need to learn how to prepare for perpetual BPR, by establishing a corporate environment that has the ability to recognize new IT and associated opportunities to redesign their business processes on an ongoing basis. It is vital that organizations learn to deal with constant change and productive chaos. Future studies will need to examine these questions in terms of the integration of IS planning, corporate strategic planning and human resource management.

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