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ABSTRACT

The purpose of this study is to examine the effect of alignment between IT and business strategy and IT infrastructure capability on BPR project performance and implementations in organizations. The research model was developed based on an intensive literature review of conceptual and empirical studies of BPR implementation in organizations. Questionnaires were sent out to senior managers and project leaders in 1,000 top organizations in Australia. A total of 287 responses were received. Multiple regressions with interaction terms were used to analyze the data. The analysis shows that the model explains 42.3% variance of problem severity in BPR implementations, and 16.2% variance of BPR performance. The results indicate that in BPR implementation, project leaders' perceptions of pre-conditions have a greater impact on project performance as compared to senior managers' perceptions. The analysis also reveals that the strategic alignment of IT and business has a moderating effect on the relationship between the perceived role of IT and BPR performance. In all, stable long-term IT strategy operates more effectively on performance than sensitive IT strategy. In order to reach the maximum performance, organizations should match IT strategy with different roles of IT.

Keywords

Business process reengineering, strategy, alignment, IT capability, performance

1 INTRODUCTION

Business Process Reengineering (BPR) gained grounded in the early 1990s, as corporations sought to improve business performance, by making fundamental and radical changes to their business process (Grover et al., 1995, Hammer, 1997). The adoption of BPR in corporations reached its peak in the middle 1990's. *Business Week* described BPR as the 'hottest management concept since the quality movement' (Byrne, 1993), and *Financial Times* reported the forecasts of a worldwide market for BPR products growing at 46% per annum to reach $2.2 billion by 1996 (FinTech, 1992).

A large amount of research has since been conducted in this area. Michael Hammer (Hammer, 1990), Thomas Davenport, James Short (Davenport, 1993, Davenport and Short, 1990), and James Champy (Hammer and Champy, 1993) published those very first books and articles that were looked on and continue to be the most popular references. Since then, more articles and books have been published on a variety of related topics, e.g. Information Technology (IT) in BPR, strategy alignment in BPR projects, and BPR implementation.

However, interest in BPR waned in the mid-1990s (Feller and Bently, 2001). Practitioner literature suggested that BPR fell out of favor with business executives in 1995. Computer Sciences Corporation's (CSC) survey of over 600 CIOs revealed that reengineering was no longer their top priority (King, 1995). Other studies indicated that less than 20 percent of BPR projects paid off in terms of profitability by reducing costs, headcount and avoiding costs (Balachandran and Thiagarajan, 1999). What went wrong with BPR projects and initiatives in organizations? Is BPR another popular management practice that would fall by the wayside? According to the research done by Balachandran and Thiagarajan (1999), there were nine most common pitfalls, among which strategy related problems ranked the highest. Unfortunately, there is comparatively little research focusing on the implementation of BPR and alignment of IT strategy with business strategies. This is a gap in our understanding of BPR implementation that we hope to address in this paper.

The objective of this paper is to analyze the direct and moderating effect of the alignment between IT and business strategies on perceived of BPR projects with consideration of IT infrastructure capability in organizations. A unique aspect of this study is that data were collected simultaneously from the perspective of both senior managers and project leaders for each

organization to provide a more comprehensive view. Senior managers and project leaders have different roles in organizations, and thus are likely to have different perspective toward BPR projects.

The paper will first discuss the theoretical research framework, followed by a discussion of the research design and methods. The results and discussion part will present the analysis and its implementation, followed by the conclusion to highlight contributions and limitations of this research as well as possible avenues for future research.

2 THEORETICAL FRAMEWORK

2.1 BPR Performance

In 1990, Rummler and Brache published a three-level framework of performance, offering a systematic, comprehensive approach design for business reengineering (Rummler and Brache, 1990), in complementary to the emphasis of IT from Hammer and Davenport (Harmon, 2003). This methodology provided a foundation of comprehensive process development and became the most widely used, systematic business process methodology in the mid-1990s (Harmon, 2003). According to the Rummler-Brache methodology, the highest level of performance by executing a software application, e.g. BPR, includes a measure of activity success in design and management. In our research, as shown in figure 1, the conceptualization of BPR performance is developed in two aspects: first, the problem severity of reengineering implementation, based on the result of research done by Grover (Grover et al., 1995), and second, the improvement of organization performance, compared before and after the implementation of BPR projects.

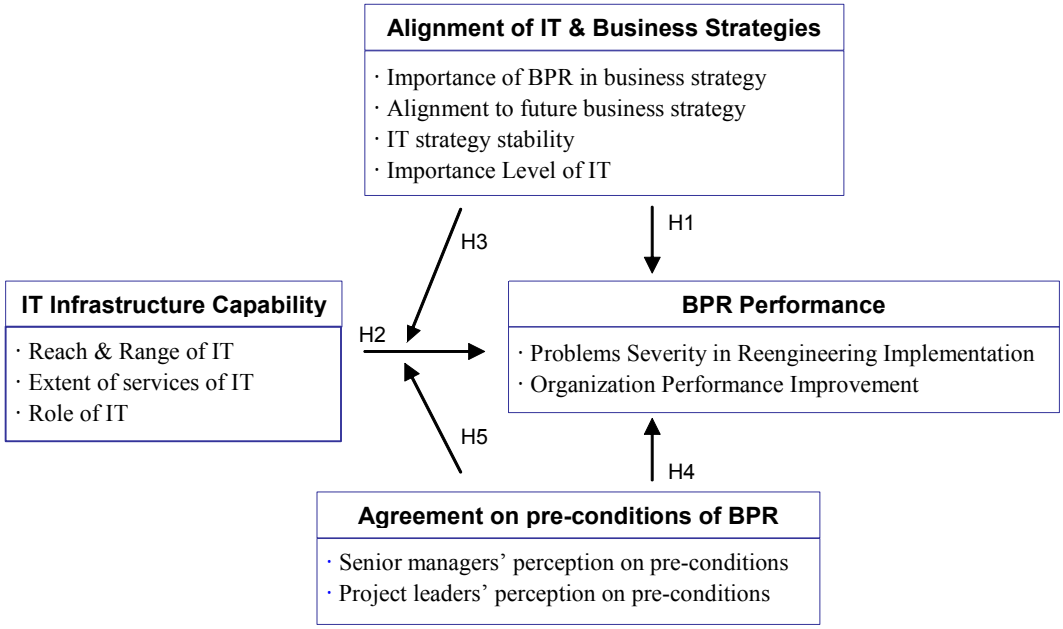

Figure 1. Research Model

2.2 Alignment of IT strategy to business strategy

In our model, the alignment of IT strategy to business strategy is presented by four elements, as shown in figure 1. The famous strategic alignment model is based on two underlying building blocks: strategic fit and functional integration (Luftman, 1996, Henderson et al., 1996). It presents four dominant alignment perspectives: business strategy, IT strategy, organizational infrastructure & process, and IT infrastructure & processes. In this model, IT is viewed as not only a means of functional integration but as an opportunity to enhance the competitive capability of the firm (Henderson et al., 1996). In comparison to the traditional model of organizations, IT aligned strategy would create more opportunities and provide more support for interactions among a wide rage of suppliers, customers, and competitors, leading to an enhanced performance. Therefore, we here generate the following hypothesis:

Hypothesis 1: Alignment of IT strategy with business strategy will have a positive direct effect on BPR performance.

2.3 IT Infrastructure Capability

IT infrastructure is the base foundation of the IT portfolio (including both technical and human assets), shared throughout the firm in the form of reliable services, and usually coordinated by the IS group. The IT infrastructure capability includes both the technical and managerial expertise required to provide reliable services (Broadbent et al., 1999). IT-enabled reengineering of business processes is also highly emphasized in the widely adopted five steps in BPR (Davenport and Short, 1990). It can be assessed using three measures: the reach & range of IT, the extent of the firm's infrastructure services, and roles or functions if IT in organizations (Broadbent et al., 1999, Weill et al., 1996).

The "reach of IT" is conceptualized according to whom can we easily connect by using IT, and is measured from within a business unit to anyone, anywhere. The range of IT can be interpreted as what services can we share automatically and seamlessly in form of sending message, or performing transactions (Broadbent et al., 1999, Henderson et al., 1996, Keen, 1996). With stronger IT infrastructure capability, the organization is more capable to perform reengineering, and better its chances of success. Therefore, hypothesis 2 is generated as:

Hypothesis 2: IT infrastructure capability will have a positive direct effect on BPR performance.

In addition, there is a well-accepted interactive relationship between the strategic context of the firm, the nature of business processes, and the significance of IT investments in infrastructures. While IT is a potential enabler of change, it is also a potential constraint or inhibitor, particularly when the firm's IT infrastructure is inappropriate or inflexible (Broadbent et al., 1999).

Hypothesis 3: The positive direct effect of IT infrastructure capability on BPR performance will enhance with increased alignment of IT strategy and business strategy.

2.4 Agreement on pre-conditions to BPR of senior managers and project leaders

The analysis of organization readiness before the implementation of BPR projects was first brought up by Hammer & Stanton, who raised the importance of the analysis of feasibility of BPR project before the implementation. This process evaluates the feasibility of BPR, and determines the company's strength and weakness at reengineering to see if the organization is positioned for successful reengineering (Hammer and Stanton, 1995).

Senior manager and project leader are two typical types of managers involved in business process reengineering. During the process of evaluation of pre-conditions, senior managers usually take the best interest for one department on a strategic level. By contrast, project leaders have to focus on tractions cutting through each of the departments involved in the process of reengineering. Therefore, senior managers and project leaders would have different opinions toward the feasibility of reengineering. The more discrepancy they have, the more difficulty they would confront in the implementation.

Hypothesis 4: Agreement on pre-conditions to BPR of senior managers and project leaders will have a positive direct effect on BPR performance.

Senior managers are often reluctant in promoting the strategic role of IT (Wu, 2003). Therefore, disagreement on the pre-conditions of BPR projects would impair the performance on a certain level of IT capability, while a high degree of concurrence of senior managers and project leaders would improve the performance.

Hypothesis 5: The positive direct effect of IT infrastructure capability on BPR performance will enhance with increased agreement on pre-conditions of BPR of senior managers and project leaders.

3 RESEARCH METHODOLOGY

3.1 Data collection

Questionnaire packages were generated with two separate questionnaires, one for senior manager and the other for project leader. These packages were mailed to 1000 organizations in Australia. These organizations were chosen on the basis of revenue in the private or public sectors via a mailing list purchased from Drake List Management Services (Murphy et al., 2000). Senior managers in each organization were asked to fill out one of the questionnaires and pass the other questionnaire to project leaders. Senior managers and project leaders returned questionnaires separately. To increase the response rate, a reminder letter was sent to senior managers of non-responding organizations about three weeks after the mailing of the questionnaire package.

Questionnaires were returned from 287 organizations (28.7% response rate). There were 272 questionnaires returned from senior managers, of which 135 indicated that they had not experienced BPR before, while the other 137 were returned with

valid data. One hundred and five project leaders responded, all with valid data. Out of all the questionnaires, there were 91-paired records of both senior managers and project leaders from the same organizations. Reliability of those 91-paired records was 94.54%, which did not differ significantly from the reliability of all 242 records (94.11%). Therefore, 91-paired records were used for the analysis.

3.2 Methods of Analysis

3.2.1 Alignment of IT strategy to business strategy

The "Importance of BPR in business strategy", "alignment of future business strategy" and "importance level of IT" were all measured by one questionnaire item, where higher score means more positive (better, more important, etc.). IT strategy stability was measure by one questionnaire item with dichotic options. The choices were recoded by using stable (Long-term IT strategy tends to be stable in accordance to business strategy) and sensitive (Long-term IT strategy tends to be sensitive in accordance to business strategy).

3.2.2 IT Infrastructure Capability

The value of reach & range of IT and extent of services of IT were calculated on weighed-matrices where different levels have different impact on the whole meaning of the variables. Each level was assigned a weight, and the final scores were the summations of the multiplications of the weights of row and column and the raw data. The score of role of IT was measured by one questionnaire item.

3.2.3 Agreement on pre-conditions to BPR of senior managers and project leaders

Based on 31 questionnaire items, five factors were generated by using primary component analysis (appendix). Averages of factor scores generated by SPSS were used as the scores for senior managers and project leaders.

3.2.4 BPR Performance

There were 64 questionnaire items measuring implementation problems severity. The calculation used five factors generated and tested by Grover (1995). We took the average of these corresponding factors' scores as the value of this variable. Organization performance improvement was measured by one questionnaire item where a higher value represents a greater improvement.

3.2.5 Descriptive Statistics

The analysis of these 91 paired records reached the power of 0.96 with medium effect size at 0.05 level (Cohen, 1992). The descriptive statistics of data collected are shown in table 1.

Variables		N	Mean	Std. Dev.
Alignment of IT & Business Strategies				
X1_1	Importance of BPR in business strategy	90	4.500	.675
X1_2	Alignment to future business strategy	90	4.400	.776
X1_3	IT strategy stability	87	.390	.491
X1_4	Importance Level of IT	91	3.311	1.561
IT Infrastructure Capability				
X2_1	Reach & range of IT	91	3.101	.430
X2_2	Extent of services of IT	91	2.415	.757
X2_3	Role of IT	90	3.530	.782
Agreement on pre-conditions of BPR				
X3_1	Senior managers' perception on pre-conditions	91	3.290	.652
X3_2	Project leaders' perception pre-conditions	91	3.480	.595
BPR performance				
Y_1	Problems severity in Reengineering implementation	91	2.489	.630
Y_2	Organization performance improvement	91	2.388	1.053

Table 1. Descriptive Statistics of Variables

The preliminary analysis above shows some patterns of BPR implementation. First, the alignment of IT and business strategies is very satisfying. The importance of BPR in business strategy and its alignment to future business strategy are both close to the highest score (5.00), while the importance of IT was ranked in the middle range with a large variance. Second, project leaders have higher concern on pre-condition of BPR than senior managers (two-tailed paired samples T-test shows support of evidence of significant difference, p-value = .009). Third, the problem severity of implementation is considerably higher than organization performance improvement. The difference between them is not significant (p = .483), but the higher average score of problem severity means that the total performance of BPR would be below zero even though there exits improvement in organization performance. It is interesting that the strategic alignment and IT infrastructure capability are satisfying but at the same time the BPR performance is below what we expected. This paradox leads to the following step of analysis, where the variance of BPR performance is explained.

4 RESULTS & DISCUSSION

Two multiple regressions were used to analyze the relationships between variables and the variance of performance. In the first model, problems severity of reengineering implementation was used as dependent variable; and in the second model, the improvement of organization performance was included to reach the full picture of BPR performance. The results of analysis are shown in table 2.

	Model 1		Model 2	
	Problem Severity in Reengineering Implementation		BPR Performance	
Independent Variables	β	Sig.	β	Sig.
(Constant)	7.679	.053	-18.253	.088
X1_1 Importance of BPR in business strategy	-.675	.568	3.797	.236
X1_2 Alignment to future business strategy	.172	.889	-1.081	.747
X1_3 IT strategy stability	-.433	.718	1.293	.689
X1_4 Importance Level of IT	-.078	.846	.430	.693
X2_1 Reach & range of IT	1.145	.386	-4.409	.218
X2_2 Extent of services of IT	-.546	.592	3.362	.225
X2_3 Role of IT	-.912	.285	.713	.756
X3_1 Senior managers' perception on pre-conditions	-.100	.409	.341	.299
X3_2 Project leaders' perception on pre-conditions	-.424	.001	1.193	.000
X1_1 * X2_1	-.274	.399	.191	.827
X1_1 * X2_2	.298	.160	.371	.514
X1_1 * X2_3	-.127	.497	.631	.213
X1_2 * X2_1	.069	.863	.249	.817
X1_2 * X2_2	-.059	.737	-.199	.678
X1_2 * X2_3	.094	.506	-.364	.340
X1_3 * X2_1	.548	.133	-1.778	.072
X1_3 * X2_2	.083	.683	.362	.511
X1_3 * X2_3	-.404	.013	.985	.024
X1_4 * X2_1	.071	.553	-.271	.401
X1_4 * X2_2	.014	.840	.168	.378
X1_4 * X2_3	-.018	.765	-.034	.832
X3 * X2_1	-.300	.260	1.120	.121
X3 * X2_2	-.015	.950	-.904	.170
X3 * X2_3	.256	.141	-.368	.431
R Square	.586		.399	
Adjusted R Square	.423		.162	

Table 2. Regression Estimates of Models

The results of the above two multiple regressions models show some support to hypothesis 3 and 4. They also raise some important and interesting analysis below.

Result 1: Project leaders' perception matters

Project leaders' conception on pre-conditions of BPR has a significant negative effect on problem severity ($\beta = .424$, p-value $< .01$). When the concern of project leaders on pre-conditions goes up, the problem severity during implementation goes down. In addition, project leaders' concern on pre-conditions has a very significant positive effect on BPR performance ($\beta = 1.193$, p-value $< .001$). As we all know, senior managers and project leaders work on different levels in organization. Senior managers tend to focus on a single department with many vertical transactions going from the top to the bottom of management. Project leaders focus more on processes cutting through different departments horizontally in the organization. Our research shows that in BPR implementations, project managers' perception on pre-conditions is closely and positively related to BPR performance, while senior managers' is not. One of the reasons for this would be that project leaders get closer to the actual processes of reengineering, and they are more likely participating in the implementation of BPR, while senior managers usually perform from a strategic point of view. Often, senior managers' opinions are weighed more because it is assumed that decision-making should be on the strategic level. However, the result of our analysis provides a complementary point of view. Therefore, when make decisions of BPR implementations based on the pre-condition readiness, practioners should give project leaders the opportunity to speak up, and value their opinion together with those of senior managers', for a unified view of assessment.

Result 2: Strategic alignment has strong moderating effects

Our research revealed that strategic alignment has very strong moderating effects on the relationships between IT infrastructure capability and BPR performance. As shown in figure 2, when long-term IT strategy is stable in accordance to business strategies, the role of IT affects more on BPR performance than sensitive long-term IT strategy. In reference to the problem severity in implementation, sensitive IT strategy is associated with more severe problems. This severity increases when role of IT moves from automation in individual business units to firm-wide cost-saving, and it goes down when the role of IT passes firm-wide cost-saving and goes to investment on organizational strategy level. By contrast, stable strategy is related with much less severity, and this severity becomes the lowest when IT is used to mainly reduce cost than for automation or investment on the level of organizational strategy.

In reference to BPR performance, after consideration of problem severity and the improvement of organization performance, the pattern shows support to what we have concluded above. In the consideration of executing different roles of IT, stable long-term IT strategy is associated with better BPR performance than sensitive long-term IT strategy. However, with regard to the role of IT, these two types of IT strategies present opposite effects. If stable long-term IT strategies are chosen, using IT on automation has a more positive effect on BPR performance than using IT on cost-saving or investments on strategic level. When sensible long-term IT strategies are preferred, using IT on the level of organizational strategy creates the greatest positive effect on BPR performance than using IT on cost saving or automation.

In summary, stable long-term IT strategy creates more performance improvement than sensitive long-term IT strategy. One possible explanation is that in the long run, in order to get along with business strategies, sensitive IT strategy would generate considerably more change and therefore more challenge and confliction, in comparison to stable IT strategy. Therefore, in a certain period of time, stable IT strategy shows more positive effect on BPR performance.

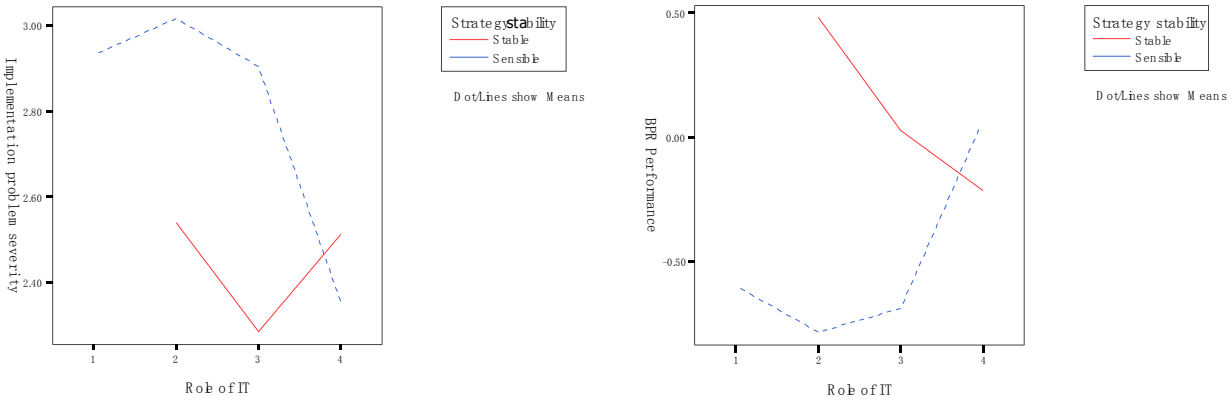

Figure 2. Type of IT strategy as moderator on the effect of role of IT on performance

Table 3 summaries the results from the above and make suggestions of choice of IT when considered with different types of long-term IT strategies. The sequence of choice to reach the maximum of performance should be valued in caution, in that there is no such absolute best choice. It is also important to point out for practitioners that in order to reach a better performance, it is critical to match IT strategy with the right function of IT.

	Choice of "Role of IT" to reach maximum performance			
Stable Long-term IT Strategy	Strategic support	Investment	Cost saving	Automation
Sensitive Long-term IT Strategy	Cost saving	Investment	Automation	Strategic support
	——————→	——————→	——————→	
	Low performance	Medium performance	High performance	

Table 3. Choice of Role of IT in accordance to Long-term IT Strategy in implementations

5 CONCLUSION

This paper analyzes the effects of the "alignment of IT & business strategies" and the "IT infrastructure capability" on BPR performance in implementations in organizations. Our research shows that in consideration of BPR implementation, project leaders' perception on pre-conditions contributes more than senior managers'. The other fundamental result is that the alignment of IT & business strategies plays a moderating effect on the relationship of role of IT and the BPR performance. In general, stable long-term IT strategy performs better than sensitive IT strategy. In order to reach a high performance, organizations should match IT strategy with the right role of IT.

Nonetheless, the paper also has some limitations. First, the sample size could be larger. Data collection is undoubtedly the "headache" for most researchers and PhD students. For our research, one thousand questionnaires were sent out through regular and follow up mails, but they were only ninety-one eligible paired data records. Therefore, other possible methods, e.g. online surveys, should be used to make this process more effective and efficient. Second, only cross-section data were collected for the analysis. This is helpful when looking for relationships among variables but not for determining causality. Longitudinal data are necessary and critical to spot cause and effect. If that had been available, the research would have provided more insights as to why and how BPR performance is improved. However, the collecting of longitudinal data would be even more challenging with limit time and money.

To make comments about future research directions, we would recommend the current trend of business process change (BPC). BPC reflects "the importance of process instead of radicalness" (Grover, 2000). This process view would help

organizations conceptualize new ways to improve operations, satisfy customers, and make the best use of the latest IT. The same research method used here can be performed on BPC projects and compared with what we have discussed in this paper.

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APPENDIX

Component factor analysis of these 31items was conducted with Varimax rotation. Five new factors were generated according to the items ranked with highest loadings under each of them in the rotated component matrix, together explaining 59.4% of total variance. Table here shows the 5 factors with accordingly measures in the questionnaire and the loading to each measure.

	Perception on pre-condition of BPR	Loading
(a)	**Factor 1: Reengineering Leadership (14 items)**	
1	The reengineering leader possessed the title and authority necessary to institute fundamental change	.568
7	The organization believed that the reengineering leader was truly committed to reengineering	.664
10	The reengineering leader had a vision of the kind of organization he or she wished to create	.712
13	The organization believed that the reengineering leaders commitment would be long-lasting	.534
14	The reengineering leader truly understood the nature of reengineering	.625
17	The reengineering leader was able to express the vision he or she had for the organization clearly and simply in operational terms	.760
20	The reengineering leader was ready and able to exercise leadership - through communications, personal behavior, and systems of measurement and reward - in order to make reengineering succeed	.790
22	Measurement systems and performance goals were established to chart the progress of reengineering	.507
25	The reengineering leader was prepared to commit the organizational resources that reengineering required	.732
27	The members of reengineering teams felt empowered to 'break the rules' and to challenge long-standing assumptions	.641
28	The reengineering leader was prepared to commit the personal attention that reengineering required	.827
29	The reengineering leader understood the magnitude of the change reengineering entailed	.716
30	Managers were given end-to-end responsibility for the processes to be reengineered	.647
31	The leader of reengineering was a senior executive who was strongly committed to reengineering	.718
	Factor 2: Organizational Attitude (6 items)	
3	The organizations experience with total quality management (TQM) had created an environment that was receptive to reengineering	.575
4	Managers were motivated to assure that the processes were successfully reengineered	.687
5	The organization believed that the commitment of the senior management team would be long-lasting	.664
6	Key staff organizations – human resources, finance, and information systems - were positive about the prospect of reengineering	.670
9	The organization believed that the senior management team were truly committed to reengineering	.637
11	The organization understood the nature of reengineering, including the fact that it results in multidimensional change that impacts processes, jobs, organizational structure, management responsibilities, etc	.477
	Factor 3: Organizational Support (6 items)	
8	The organization had none of the complacency and arrogance that often follow a sustained period of success	.527
16	The organization had the human resources needed to implement reengineering	.629
21	The entire senior management team shared the leaders enthusiasm for reengineering	.432
23	Key staff organizations – human resources, finance, and information systems - were capable of innovative responses to reengineering demands	.558
24	The organization was free of the skepticism, mistrust, and ambivalence that often follows a period	.641

	of downsizing or restructuring	
26	The organization had the financial resources needed to implement reengineering	.537
	Factor 4: Process Concentration (3 items)	
2	The organization placed a high value on serving customers	.633
12	The reengineering effort was directed at key business processes rather than organizational units	.705
15	The organization had a solid understanding of customer needs	.505
	Factor 5: Conceptual Readiness (2 items)	
18	The organization as a whole recognized the need for reengineering and fundamental change	.642
19	The organization was comfortable with the way in which reengineering proceeds, through risk taking, learning, and ambiguity	.532
(a) Questionnaire item number Instrumentation developed after (Hammer et al. 1995)		