

A Study of the Impact of Business Process on the ERP System Effectiveness

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Abstract

An ERP implementation takes many years to complete and requires a large amount of IT investment and their effectiveness is hard to evaluate. Companies implement ERP systems to integrate the business processes of a company, and help organizations obtain a competitive advantage. In each ERP implementation stage, Business Process Reengineering (BPR) plays different important roles. This study examined the process problems (system process / business process), BPR and performance of ERP systems by using the questionnaire survey and AVOVA analysis. We also examined the relationship between degree of BPR and ERP system performance using regression analysis.

Keywords: Enterprise Resource Planning (ERP), Business Process Reengineering (BPR), Information System Success Model

1. Introduction

In response to intensified global competition, numerous companies have implemented new information systems (IS), known as enterprise resource planning (ERP) systems. ERP systems are packaged business software systems, capable of sharing common data, and accessing information in a real time. ERP applications include supply chain management (SCM), customer relationship management (CRM), product lifecycle management (PLM), E-procurement, and financial management (FM) (Barthorpe, Chien, & Shih, 2004; Tsai, Fan, Hung, and Liu, 2006; Cheng, Tsao, Tsai, and Tu, 2007). ERP systems can integrate the business processes of a company, and help organizations obtain a competitive advantage (Lee, Moon, and Lee, 2006; Ip and Chen, 2004). Companies which implement ERP systems gain many advantages, including improving productivity, gaining competitive advantage, satisfying customer demand, and increasing their rapid response capabilities. Tsai, Lin, Chen, and Hung (2007) also indicated that implementing ERP systems can bring benefits for companies, for example reducing cycle time, improving flow efficiency, and rapidly generating financial information. ERP systems enable managers to control the whole business and accelerate decision making. Companies implement

ERP system to become efficient as well as integrate and modernize the business (O'Mahony and Doran, 2008).

ERP implementation takes many years to complete (Mabert, Soni, and Venkataramanan, 2000). Unfortunately, a significant proportion of ERP implementation projects fail. Al-Mashari, Zairi, and Okazawa (2006) and Tsai, Chien, Hsu, and Leu, (2005) indicated that some enterprises underestimate or misunderstand the risks involved in ERP projects, which require. An unsuccessful ERP project can bankrupt a firm, as happened to FoxMeyer Drug Company (Volkoff and Sawyer, 2001; Dong, 2001). Many companies have problems in ERP implementation including Dell computers, Hershi Foods, Apple computers, Whirlpool (Shahin, Sadri, and Gazor, 2010). Scott (1999) argued that 65% of managers believe ERP project failure will damage a firm. The complexity of ERP, high costs and implementation problems force numerous organizations to reconsider their new plans in relation to this enterprise system (Kumar and Hillegersberg, 2000). The effectiveness of IT investment is hard to evaluate (Wagel, 1998). Davenport and James (1990) examined the relationship between information technology capabilities and business process redesign, and concluded that IT represents a useful tool in business process redesign, and moreover that business process redesign should be transformed using IT. In ERP implementation, systems are developed to support business processes such as manufacturing, purchasing, or distribution, thus ERP implementation and business process should be closely connected. Elbertsen and Reekum (2008) indicated that in business process, ERP system is significantly explained by competitive pressure and systems compatibility. Business Process Reengineering (BPR) involves the adoption of process perspectives on a business (Gunasekaran and Ichimura, 1997), and represents a fundamental rethinking of organizations. Somers and Nelson (2004) also indicated that BPR should play different important roles in each stage of ERP implementation.

Following the previous literature, this investigation examined the process problems (system process / business process), BPR and performance of ERP systems by using the questionnaire survey and AVOVA analysis. This study also examined the relationship between degree of BPR and ERP system performance using regression analysis. Subsequently, this study investigated the influences on degree of BPR in ERP implantation. This investigation applied regression analysis to examine the relationship between ERP implementation strategy (big bang or phased) / ERP systems package (international or domestic) and ERP implementation performance (Figure 1).

(Insert Figure 1 about here)

We organize the remainder of the paper as follows. In the next section we review the relevant literature. We describe research methodology and develop hypotheses in Section 3, and we report the results in section 4. In section 5, we offer conclusion remarks. Section 6 was discussion. In section 7 and 8, we report the study limitations and recommendations.

2. Literature review

2.1 BPR and ERP systems implementation

Companies can adopt BPR to pursue multiple improvement goals including quality, cost, flexibility, speed and accuracy. BPR supports the re-thinking of business processes and is necessary to software applications such as ERP systems. Grover, Jeong, Kettinger, and Teng (1995) identified BPR as a key success factor in implementing IT projects, such as ERP systems. Bingi, Sharma, and Godla (1999), Nah, Zuekweller, and Lau (2003), and Somers and Nelson (2004) also argued that BPR should be involved in the ERP implementation.

Huq and Martin (2006) argued that BPR is a one management strategy that creates change via process performance improvements. They analyzed hospital cases to compare ERP approaches towards BPR implementation, and attempted to identify which approach offers a larger probability of ERP success. Huq and Martin found the ERP-driven BPR can more easily design process change, and obtain a preview of project outcomes. Subramoniam, Tounsi, and Krishnankutty (2009) examined the role of BPR in implementing ERP systems and found that all organizations which implement ERP systems should select their own approach based on organizational needs and constraints. Furthermore, Sumner (1999) examined the relationship between critical success factors (CSFs) and ERP system performance, and identified the CSFs as management support, re-design of business processes, training and re-skilling, re-design of business processes, external consultants, management structure, discipline and standardization, effective communications, maintaining excellent staffing, and avoiding attempts at software modification. Competitive pressure and systems compatibility in business process significantly explain the success of ERP system (Elbertsen and Reekum, 2008).

3. Methodology and Hypotheses

3.1 Sample collection and data analysis

To investigate the relationship between ERP system and BPR, this investigation examines the ERP implementation experience of the 5,000 largest corporations in Taiwan during 2009. The questionnaire survey includes ERP system selection factors, and the status of BPR and system process. This study distributed 4336 questionnaires by mail and received 578 usable responses, for a 12.08% response rate. The 578 usable responses included 242 firms that had implemented ERP package software, and these 242 firms comprised the sample for analysis. Four hypotheses were developed to examine the relationships between system, business process, BPR and ERP system performance. Additionally, the relationships between ERP implementation strategy (big bang or phased) / ERP systems package (international or domestic) and ERP implementation performance were also examined.

3.2 Hypotheses development

Travis (1999) indicated that companies that make greater efforts in ERP selection will achieve greater overall success. Furthermore, Somers and Nelson (2004) indicated that correct package selection significantly impacts budgets and goal achievement in ERP implementation. Moreover, Karsak and Ozogul (2009) argued that inappropriate ERP system selection is a major cause of ERP implementation failure. Wei, Chien, and Wang (2005) also demonstrated that a successful ERP project involves business process change management and ERP software system selection. During the initiation phase of ERP implementation, companies should first review existing business processes and identify company demands. Based on previous investigations, this study infers that companies should consider process problems in ERP system selection. The relationship between system and business process should be close in ERP implementation. Based on this perspective, this investigation presents hypotheses 1 and 2, as follows.

Hypothesis 1: Performance in ERP system implementation varies according to whether firms consider the consistency between system and business process in ERP package selection.

Hypothesis 2: The gap between system and business processes significantly affects the performance of ERP system implementation.

Furthermore, Minahan (1998) argued that companies should examine internal business process and modify the business process. BPR can help companies change business processes, and plays different important roles in each of the ERP implementation stages. Cardarelli, Ritu, and Mohan (1998) argued that companies should adopt BPR in ERP implementation. Davenport (1998) also identified BPR as the reason companies implement ERP systems. Based on previous investigations, this investigation infers that companies should consider BPR in ERP implementation and examine the relationship between the degree of BPR and ERP implementation performance. For this viewpoint, this study develops hypothesis 3 and hypothesis 4, as follows.

Hypothesis 3: ERP implementation performance will vary according to whether firms consider BPR.

Hypothesis 4: Companies that achieve higher degree of BPR in ERP implementation will achieve better system performance.

3.3 DeLone and McLean information system success model

This study used DeLone and McLean's (1992) information system success measurement category to measure ERP performance. The performance improvement levels include six dimensions: System Quality, Information Quality, System Use, User satisfaction, Individual impact and Organizational Impact. Table 1 gives the schema.

(Insert Table 1 about here)

The composite performance improvement and performance improvement level of the j^{th} dimension for the i^{th} respondent's company:

$$P_{ij} = \sum_{k=1}^{lj} P_{ijk} \times \frac{\overline{W}_{jk}}{\sum_{k=1}^{lj} \overline{W}_{jk}}, \quad i=1 \text{ to } N, \text{ and } j=1 \text{ to } 6 \quad (1)$$

$$\overline{W}_{jk} = \left(\sum_{i=1}^N W_{ijk} \right) / N \quad (2)$$

$$P_i = \sum_{j=1}^6 \left(P_{ij} \times \sum_{k=1}^{lj} \overline{W}_{jk} / \sum_{j=1}^6 \sum_{k=1}^{lj} \overline{W}_{jk} \right), \quad i=1 \text{ to } N \quad (3)$$

P_{ij} is the performance improvement level of the j^{th} dimension for the i^{th} respondent's company. In Equation (1), \bar{W}_{jk} is the average importance level score of the k^{th} measure of the j^{th} dimension as perceived by N respondents, P_{ijk} is the performance improvement level score (1 to 7) of the k^{th} measure of the j^{th} dimension for the i^{th} respondent's company, and l^{th} is the number of chosen measures for the j^{th} dimension.

P_i is the composite performance improvement level for the i^{th} respondent's company, whose equation is shown in Equation (3). In Equation (3), P_{ij} , \bar{W}_{jk} , and l^{th} are defined as above.

4. Results of the questionnaire survey

This section comprises five parts. Part one examines hypothesis 1 and describes the consistency between the system and business processes in ERP package selection. Part two examines hypothesis 2 and presents the gap between system process / business process and the improvement in the performance of ERP project implementation. Part three then examines hypothesis 3 and presents the consideration for BPR and ERP implementation performance. Next, part four examines hypothesis 4 and details the relationship between BPR degree and ERP implementation performance. Finally, the last part examines which factors will influence the degree of BPR in ERP implantation.

4.1 Consistency between system and business process in ERP package selection

During ERP project implementation, ERP system selection plays an important role. This section uses ANOVA analysis to explore the performance of companies that do or do not consider system and business process in ERP package selection. Companies that consider the consistency between system and business process in ERP package selection are 1 (variable=1), and companies that do not consider the consistency between system and business process in ERP package selection are 0 (variable=0). This section also uses the information system success model of DeLone and McLean (1992) as the dependent variable to construct a measure of ERP effectiveness.

The ANOVA analysis supports hypothesis 1 and indicates that companies considering the consistency between system and business process in ERP package selection perform differently to other firms (See Table 2 and Figure 2), especially in "User Satisfaction" and "Organizational Impact". During initial ERP implementation, companies should examine existing business process and understand employee needs. Numerous investigations have indicated that an appropriate ERP system is helpful to system implementation performance. Karsak and Ozogul (2009) also indicated that a suitable ERP system can radically improve firm competitiveness and performance. Companies should select the appropriate an ERP system that maximizes firm performance. Mabert, Soni, and Venkataramanan (2001) also argued that companies should select the ERP solution with the best potential to provide an excellent decision support tool and which provide competitive advantage. This study finds that companies should consider system and business process in ERP package selection.

(Insert Table 2 about here)

(Insert Figure 2 about here)

4.2 The gap between System process / business process and ERP performance improvement

The questionnaire survey identified 184 companies (82%) with no gap between system and business processes, and 58 companies (26%) with such a gap. This study examines whether the gap between system and business process affects implementation performance of ERP systems. Furthermore, this study applies ANOVA analysis to examine the relationship between ERP performance and the gap between system and business process. Companies with no gap between system and business process are denoted by 1 (variable=1), and companies with a gap between system and business process are denoted by 0 (variable=0).

The ANOVA analysis supports hypothesis 2 and indicates that companies that do not have gap between system and business process perform differently to other companies (See Table 3 and Figure 3), especially in "System Quality", "Information Quality", "User Satisfaction", and "Organizational Impact". An ERP project is usually costly and time consuming to implement (Mabert et al., 2000). Kumar, V., Maheshwari, and Kumar, U. (2002) surveyed 19 Canadian firms and listed critical issues during the adoption stage of ERP system, including project justifications, risks, and ERP-process fit (Law and Ngai, 2007). In ERP system implementation, system and business process should be concordant and complementary.

(Insert Table 3 about here)

(Insert Figure 3 about here)

When business and system process do not match, companies should try to modify business process. ERP system adoption is positively associated with process change (Gattiker and Goodhue, 2002). However, process change is extremely costly. Many studies have considered the impact of business process redesign (Kremers and Dissel, 2000). Some ERP projects fail due to cost and problems associated with organizational change (Holland and Light, 1999; Davenport, 1998). This study infers that companies which with no gap between system and business process will have better ERP implementation performance. Moreover, Irani and Love (2001) argued that the fit between ERP systems and business strategies is critical to organizational performance.

4.3 The consideration in BPR and ERP implementation performance

The questionnaire survey identified 211 companies (87%) that did not consider BPR in ERP implementation, and 31 companies (13%) that did consider BPR. This study examines whether companies that consider BPR in ERP system implementation exhibit different implementation performance to companies that do not consider BPR, and uses ANOVA analysis to explore the relationship between ERP performance and BPR. Companies that do not consider BPR are denoted by 0 (variable=0), and companies that do consider BPR are denoted by 1 (variable=1).

The ANOVA analysis supports hypothesis 3 (See Table 4 and Figure 4). Implementation performance differs between companies that do and do not consider BPR in ERP system implementation, especially in "Information Quality", "User Satisfaction", and "Individual Impact". BPR is a management strategy that creates change through process performance improvement (Huq and Martin, 2006). Morrow and Hazell (1992) argued that business process change is important in evaluating and analyzing business performance. Companies adopt BPR to improve customer service and quality, and to reduce cycle time and production/service cost (Carr and Johansson, 1995). The relationship between business process change and successful ERP implementation is significant. Martin (1998) also indicated that the benefit of ERP adoption results in business change. In this section, companies that consider BPR have better implementation performance. This finding is consistent with the findings of Law and Ngai (2007) that the business process change in successful ERP adoption needs to be empirically investigated.

(Insert Table 4 about here)

(Insert Figure 4 about here)

4.4 The relationship between BPR degree and ERP implementation performance

This section describes the regression analysis undertaken to examine whether companies that achieve more BPR in ERP system implementation achieve better system performance. Regression analysis is used to predict the value of individual variables on the basis of other variables. The dependent variables are denoted by y , and the related variables are called independent variables and denoted by $x_1, x_2, x_3, \dots, x_n$. The independent variable is the degree of BPR in ERP implementation. For the dependent variables, this study uses the information success measurement category of DeLone and McLean (1992) to develop measures of ERP performance.

The analysis supports hypothesis 4 and indicates that companies that are more successful in achieving BPR have better ERP implementation performance (See Table 5), especially in "Organizational Impact". Companies implement ERP systems to achieve business vision and goals. Importantly, any software package must fit organizational goals. To solve the problem of discordance between software package and organizational needs, companies can customize the software or implement BPR. Sumner (1999) indicated that organizations should implement BPR to fit the software, and BPR should instead of the customization. This study finds that companies should increase more degree of BPR to obtain better ERP system performance, consistent with the findings of Hong and Kim (2002), i.e., adequate fit between the organization and the ERP package is critical to successful implementation.

(Insert Table 5 about here)

4.5 The influence factors and degree of BPR

This section examines the relationship between ERP implementation strategy (big bang or phased) / ERP systems package (international or domestic) and ERP implementation performance. Degree of BPR in ERP implementation is the dependent variable in regression analysis, while ERP implementation strategy and ERP systems package are the independent variables. This study uses dummy variables to define ERP implementation strategy and ERP systems package. The model is represented by the following equation: $y_i = \alpha_i + \beta D x_i + \varepsilon_i$; Companies adopting phased implementation strategy are denoted by 1 (Dphased=1), and companies adopting big bang implementation strategy are denoted by 0 (Dphased=0). Besides, companies implement domestic package are denoted by 1 (Ddomestic=1), and companies implement international package are denoted by 0

(Ddomestic=0).

4.5.1 ERP implementation strategy

ERP systems are complex pieces of software. Due to the constraints of budget and time, some companies may only implement the partial ERP modules and some companies implement more ERP modules. From Table 6, no significant effect was found between phased implementation strategy and BPR degree, meaning that company adopting of phased implementation strategy does not affect the degree of BPR implementation. The result also found there are positive effect between big bang implementation strategy and BPR degree, meaning that company adopting of big bang implementation strategy does affect the degree of BPR implementation. ERP implementation associated high costs and implementation problems. In big bang implementation approach, several key modules or the entire systems implemented at the same time. We infer that companies should have more training and education to users in big bang implementation approach to achieve ERP successful implementation and performance. Companies also should consider business and work redesign.

(Insert Table 6 about here)

4.5.2 ERP systems package

Furthermore, this study found significant effects between ERP systems package and BPR degree. From Table 7, the positive effect was found between international package and BPR degree, meaning that company which adoption of international package have more degree of BPR. The result also found there is negative effect between domestic package and BPR degree, meaning that company which adoption of domestic package have less degree of BPR. This study infers that domestic ERP system vendors will better understand the industry environment and business culture of domestic companies than international ERP system vendors. Companies using domestic packages will face less BPR implementation.

(Insert Table 7 about here)

5. Discussion

Implementing ERP systems is challenging for companies. ERP implementation also associated with high costs and implementation problems. Wei et al. (2005) demonstrated that a successful ERP project involves business process change management, ERP software system and cooperative vendor's selection, system implementation, and investigation of system practicality. Baki (2005) argued that companies should select the ERP solution that best matches organizational information needs.

In this study, we know that companies should adopt BPR to improve firm performance (Huq and Martin, 2006), a result consistent with the finding of Davenport and Short (1990) that companies should adjust organizational structure and business culture after new system' implementation. Furthermore, when system and business process are consistent, companies do not need to customize the software to match business process. In this study, we also know that companies with no gap between system and business process will achieve better ERP system performances. The result of this study is corresponds to the finding of Grover et al. (1995) that BPR is the key success factor in implementing major IT projects, such as ERP systems.

6. Conclusion

ERP projects require considerable investment. Unfortunately, the large sums involved mean that poor ERP investments can create a crisis for a firm. In ERP implementation, it is important for companies to change the business process. BPR is a tool that supports re-thinking of business processes (Van der Aalst, 1999). Some companies adopt BPR to boost performance. Grover et al. (1995) identified BPR as one of the key success factors in ERP implementation. Based on previous studies on BPR, this study infers that companies should consider BPR during ERP system initiation.

First, this study examines system and business process are related. Analysis results demonstrate that companies should consider consistency between system and business process in ERP package selection. Siriginidi (2000) argued that the criteria to be used in ERP package selection include: (1) Stability and history of the company; (2) Last 12-month track record of sales; (3) Implementation support; (4) Availability of third party product with the package; and (5) Improvement in ERP packages. Somers and Nelson (2001) also stressed that package selection involves budgets, timeframes, goals, and deliverables. Besides, companies should attempt to reduce the gap between system and business process. Our results further demonstrate that companies with no gap between system and business process will achieve better ERP system performances. In this study, "User Satisfaction" and "Organizational Impact" are affected by the relationship between system and business process.

Second, this study considers the influence of BPR in ERP implementation. Analysis results demonstrate that

companies that consider BPR in ERP system will have better implementation performance. Furthermore, this study identifies a positive relationship between BPR degree and ERP implementation performance. This study finds that BPR consideration affects “Information Quality”, “User Satisfaction” and “Individual Impact”. The role of BPR in ERP systems is crucial (Subramoniam et al., 2009). Companies should adopt BPR to adapt to ERP system, and should not modify the package to adapt to business process (Lambert, Jansen, and Splinter, 2000).

Third, this study examined which factors affect BPR degree, and examines the relationship between BPR degree and ERP implementation strategy (big bang or phased) and ERP systems package (international or domestic). This study demonstrates that companies adopting of big bang implementation strategy and international package have more degree of BPR implementation. Then, companies which implement domestic package face weaker BPR.

7. Limitations of the study

This study uses questionnaires to examine the ERP implementation experience of the 5,000 largest corporations. We received 578 usable responses which include 242 firms that had implemented ERP package software. This investigation only uses the limited samples to examine the relationship between ERP system and BPR.

8. Recommendations

In this study, we use usable questionnaire responses to understand the status of BPR implementation. We suggest the future research can develop the measurement items to measure the impact of BPR on ERP system effectiveness. Furthermore, future research also can use case study to detailly understand the impact of BPR on ERP system effectiveness.

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Table 1. Measurement category of ERP systems effectiveness

System Quality	Information Quality	Using ERP Systems
Data accuracy	Reliability	Amount of use/duration of use
Database content	Timeliness	Charge for system use
Data currency	Usableness	Number of reports generated
System accuracy	Understandability	Number of inquiries
Response time	Relevance	Amount of connect time
User Satisfaction		Individual Impact
Information satisfaction		Individual performance
Software satisfaction		Individual productivity
Software interface satisfaction		Individual decision quality
Overall system satisfaction		Problem identification
ERP project satisfaction		Accurate interpretation
Organizational Impact		
Financial perspective		Internal-business-process perspective
Inventory cost		Inter-departments data transmission
Purchasing cost		Inter-department interaction
Inventory turnover ratio		Response time to environment change
Customer perspective		Learning and growth perspective
On-time delivery of products/service		Understanding of workflows
Response time to customer complains		Employee satisfaction
On-time delivery of invoice		New product development

Table 2. ANOVA analysis of consistency between system and business process in ERP package selection

	Group 1	Group 2	p-value
System Quality	5.9794	5.8914	.344
Information Quality	5.8619	5.7828	.386
System Use	5.6857	5.5397	.123
User Satisfaction	5.3889	5.1621	.044**
Individual Impact	5.3429	5.3052	.699
Organizational Impact	5.4270	5.2741	.095*
Composite	5.5814	5.4566	.027**

Note. Companies that consider system and business process were group 1; Companies that don't consider system and business process were group 2.

*** $p < .01$; ** $p < .05$; * $p < .1$.

Table 3. ANOVA analysis of gap between system and business process

	Group 1	Group 2	p-value
System Quality	5.9804	5.8000	.096*
Information Quality	5.8848	5.6310	.017**
System Use	5.6413	5.5345	.336
User Satisfaction	5.3739	4.9828	.003***
Individual Impact	5.3609	5.2103	.186
Organizational Impact	5.4016	5.2017	.062*
Composite	5.5724	5.3605	.026**

Note. Companies that don't have gap between system and business process were group 1; Companies that have gap between system and business process were group 2.

*** $p < .01$; ** $p < .05$; * $p < .1$.

Table 4. ANOVA analysis of the consideration for BPR

	Group 1	Group 2	p-value
System Quality	5.9602	5.7806	.196
Information Quality	5.8635	5.5548	.023**
System Use	5.6332	5.4968	.336
User Satisfaction	5.3185	5.0194	.076*
Individual Impact	5.3924	4.8645	.000***
Organizational Impact	5.3665	5.1855	.208
Composite	5.5543	5.2994	.036**

Note. Companies that consider BPR in ERP implementation were group 1; Companies that don't consider BPR in ERP implementation were group 2.

*** $p < .01$; ** $p < .05$; * $p < .1$.

Table 5. The relationship between degree of BPR and ERP implementation performance

	p-value	Beta
System Quality	0.836	-.004
Information Quality	0.579	.011
System Use	0.353	.019
User Satisfaction	0.896	-.003
Individual Impact	0.636	.010
Organizational Impact	0.045**	.039
Composite	0.036**	.255

Note. The independent variable is the degree of BPR; the dependent variables are companies' performance improvement constructs in ERP implementation.

*** $p < .01$; ** $p < .05$; * $p < .1$.

Table 6. The relationship between ERP implementation strategy and degree of BPR

	Standard Error	Beta	p-value
Intercept	0.2312	4.8118	.000***
Dphase	0.2983	-0.2987	.317

Note. The independent variables is ERP systems package; the dependent variable is degree of BPR in ERP implementation.

*** p < .01; ** p < .05; * p < .1.

Table 7. The relationship between ERP implementation strategy and degree of BPR

	Standard Error	Beta	p-value
Intercept	0.2744	5.2571	.000***
Ddomestic	0.3226	-0.8637	.007***

Note. The independent variable is ERP implementation strategy; the dependent variable is degree of BPR in ERP implementation.

*** p < .01; ** p < .05; * p < .1.

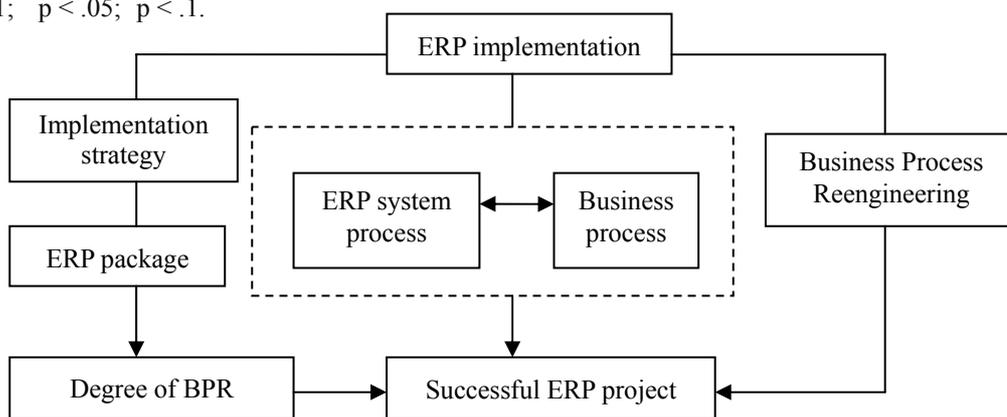


Figure 1. Research framework

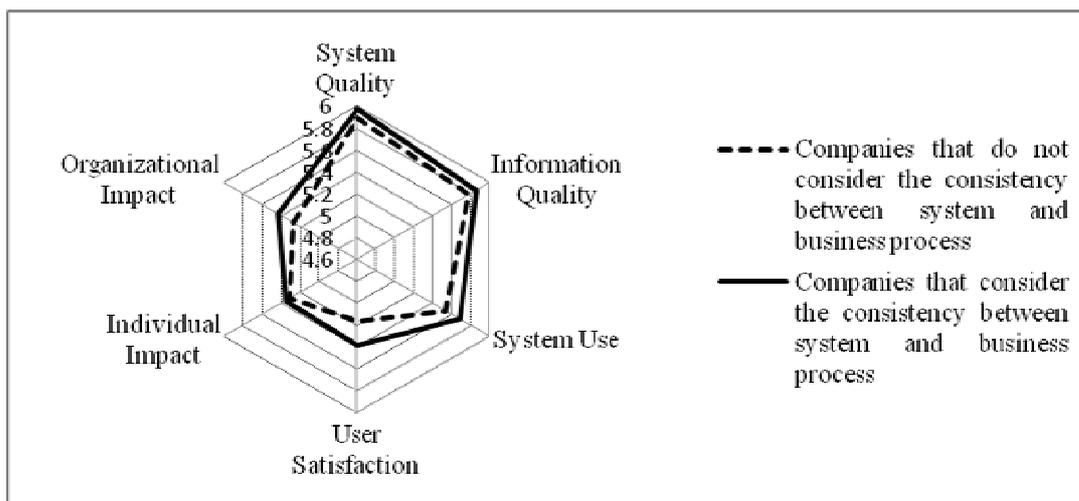


Figure 2. The performance of consistency between system and business process

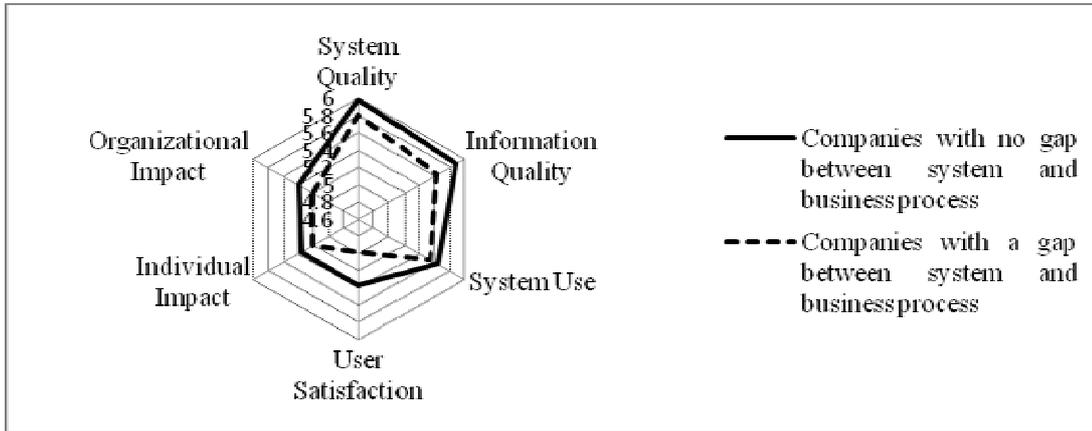


Figure 3. The performance of gap between system and business process

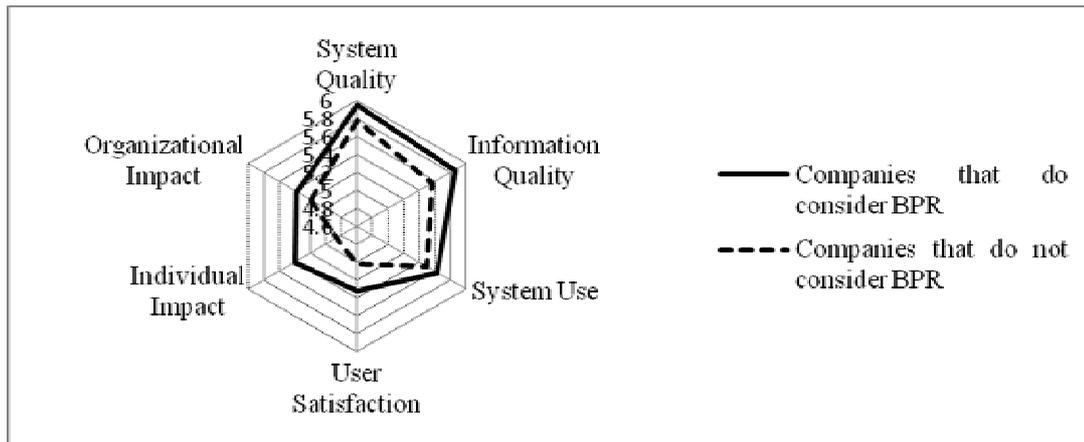


Figure 4. The performance of BPR implementation