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How business process reengineering affects information technology investment and employee performance under different performance measurement

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Abstract Business Process Reengineering (BPR) is an approach for business process transformation and unconstrained reshaping of all business processes. This study examines the impact of BPR on information technology (IT) investment and employee performance. In this study, it is considered to be likely that employee performance will be improved by performance measurement, and thus, we intend to set up a performance measurement process which is similar to the employee's goal setting. To this end, this study examines the relationship existed between performance measurement and performance. The obtained results show a positive relation existing between IT and BPR implementation, and employee performance and BPR implementation. Moreover, the empirical result supports that performance measurement associated with cost reduction and lead time shortening in the internal processes and quality improvement in the external processes can improve the performance.

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1 Introduction

In the 1990s, many US companies embraced reengineering as an effective tool to implement changes to make the organization more efficient and competitive (Attaran 2004). Business Process Reengineering (BPR) is an approach for business process transformation and unconstrained reshaping of all business processes, involved technologies, and related management systems, as well as the accompanied organizational structure and values, to achieve considerable advances in performance throughout the business (Goll 1992). BPR aims at making these processes more competitive by improving quality, reducing costs, and shortening the product development cycle (Guimaraes and Bond 1996; Hammer and Champy 1993). In addition, BPR can be used to bridge business operations and engineering of systems (Jain et al. 2009). The primary objectives of BPR are to make the business organization more competitive by improving quality, reducing costs, and reducing product development cycles (Guimaraes and Bond 1996). Firms have been reengineering various business functions for years, and it ranges from customer relationship management to order fulfillment, and from assembly lines to logistics (Ozcelik 2010a,b). Many organizations gained substantial benefits from the implementation of BPR projects (Ozcelik 2010a,b).

Today, firms face a rapidly changing business environment and higher consumer expectations. In such an environment, the design and implementation of sound business processes are important in achieving necessary business performance

and flexibility. With an effective use of IT, BPR can significantly improve companies' performance because IT can save time and improve the accuracy of the exchange of information about company goals and strategies (Gunasekaran and Nath 1997). Ly et al. (2012) analyze that IT can foster and ease the implementation, execution, monitoring, and adaptation of business process. The role of IT is a key enabler of BPR reemergence (Ahadi 2004; Mary 2008). Continued innovation in IT may imply that the role of IT in process redesign is not likely to be diminished in the future (Ramirez et al. 2010).

BPR involves large investments in personnel costs. Companies implementing BPR need to increase their hiring cost and training budget by around 30–50 % (Al-Mashari and Zairi 1999). Using a well-designed business process will increase managers' or line workers' productivity and consequently improve employees' performance. However, companies implementing BPR may face some challenges (Guimaraes and Bond 1996). For example, managers and/or line workers may not be willing to accept the new business processes created by BPR. Companies implementing BPR may also try to change too much so forget employee working habits, which in turn has the potential to create an unfriendly working environment that will cause employees to be anxious and resistant to changes. Companies may also lay off employees for achieving the cost-saving purposes after BPR implementation, which may harm employee morale for those who remain with the company. In addition, poor communication is also an important factor affecting BPR implementation. For these aforementioned problems, a case can be made that companies should encourage managers or line workers to utilize the well-designed business process by setting up adequate performance measurements.

Companies that set up the performance measurements linked to BPR will encourage managers or line workers to use the new business processes. Managers' or line workers' performance can be measured by conducting performance measurements. If managers want to motivate their employees to accomplish the company's objectives, employees must be rewarded timely based on evaluated and achieved performance levels. For this reason, performance measurement plays a critical role in BPR implementation. Unfortunately, the number of studies on the impact of BPR on employee performance and performance measurement is rather limited.

BPR entails major changes in business processes that may lead to organizational instability. Therefore, it is expected that BPR has a significant effect onto the company performance. During the implementation of BPR, the use of IT can contribute to higher revenue. The main purpose of this paper is to contribute a better understanding of relationships existed between IT, BPR, performance measurement, and employee performance

2 Literature reviews and hypotheses development

2.1 BPR and IT

Enterprises must dynamically reengineer and improve the business processes to cope with the new constraints, and further it must be responsive adequately to address the emerging challenges (Xu et al. 2008). BPR concerns the fundamental rethinking and redesign of business processes to gain a dramatic and sustaining improvement of performance in such areas as costs, quality, service, and speed (Hammer and Champy 1993). A business process can be identified as a commodity that flows through the system (Gunasekaran and Nath 1997). A process-focus approach provides the opportunity to formally reengineer or radically reduce the number of activities it takes to carry out a process, often with the help of IT (Hammer and Champy 1993). IT has played such a vital role in the success of the overall reengineering initiative. The smooth flow of information can be thus eased by adopting IT to improve the integration in various functional areas (Gunasekaran and Nath 1997).

Senior managers often face a number of problems during the implementation of BPR. Effective decision making often needs timely, accurate, and relevant information. Informing lower level managers and line workers of the decisions and operating strategies is one of the important elements of a successful implementation of BPR. To this end, IT can help to break down communication barriers occurred between corporate functions, empower line workers, and hence fuel process reengineering. Senior managers always consider IT as one of potential sources of/for competitive advantage (Attaran 2004). Enterprise Resource Planning (ERP) systems are designed to support the business process improvements of this nature, thereby enhancing information quality, decision making, and the resulting company's performance (Ghosh and Skibniewski 2010). The implementation of ERP systems and the accompanying changes in the business operations may bring the long lasting organizational benefits (Roztocki and Weistroffer 2013). Companies implementing BPR supported by IT can indeed reduce costs. For example, companies can improve the sales order entry process by using electronic data interchange (EDI) to link directly with their customers. By doing so, retailers can send the orders directly to the company's sales order system in a format and style that can be used to remove the need for another round of data entry (Romney and Steinbart 2006). As a result, companies can remove or cut down the time, paper, and people involved in/with every transaction. Companies can also maintain and/or increase their customer service by reducing the potential mistakes caused by possible human errors. From the above discussion, IT is truly a key factor in this enrichment process. In other words, during the BPR implementation, companies tend

to increase the IT investment in the area of customer relationship management (CRM).

Implementing process redesign may result in doing the same work with fewer people and less number of supervisors, and thus reorganizing the workloads in a lower, overall cost structure. If a company is interested in reducing its costs or enhancing it productivity, it may focus on BPR projects with an aim at the improvement of operational efficiency (Ramirez et al. 2010). To this end, BPR's potential benefits can be fully realized by integrating IT. A field study suggests the need for a strong integration of IT and business process redesign can be employed to improve the company-wide productivity (Johansson et al. 1993).

IT application has been used to improve the communication efficiency between corporate departments, shorten business processes, and thus, reduce the costs of products. IT can not only be utilized to automate the business processes but may also change the way business is conducting. From the aforementioned discussions, improvements in BPR can be achieved by investing in IT. For this reason, companies may have a tendency to invest in IT for implementing BPR and this leads to the following hypothesis.

H1: IT investment and BPR implementation are positive related.

2.2 BPR and employee performance

Petrozzo and Stepper (1994) believe that BPR involves with the concurrent redesign of processes and the supporting information systems to achieve a radical improvement in the company's products and services. Companies implementing BPR wish to restructure and simplify the business process and have to force the managers or line workers to use a well-designed business process, which is created by BPR. Companies implementing BPR can improve employee morale and productivity (Guimaraes and Bond 1996). In other words, companies will educate employees to make the right decisions and respond effectively to unexpected situations. Managers or line workers with continuous education will certainly improve their capability and productivity. Using this well-designed business process will not only increase the productivity but also improve the performance. As a result, BPR implementation can not only improve a company's performance, but it also can improve managers' or line workers' productivity. Hammer and Champy (1993) have promoted the fundamental rethinking and radical redesign of business processes to achieve the dramatic improvements in critical, contemporary measures of performance. From the above discussion, the 2nd hypothesis is proposed below.

H2: Employee performance will be improved by BPR implementation.

2.3 Employee performance measurement and employee performance

Goal-setting theory (Locke and Latham 1990, 2002) was developed inductively over a 25-year period, based on some 400 laboratory and field studies. These prior studies show that specific and hard goals lead to a higher level of task performance compared with easy or vague ones. As long as a person is committed to the goal, has the requisite capability of attaining it, and does not have conflicting goals, there is a positive, linear relationship existed between goal difficulty and task performance. (Locke and Latham 2006)

The theory of goal setting deals with the relationship between conscious goals or intents and task performance. In this theory, an individual's intents regulate his/her actions. A goal is simply defined as what the individual is consciously trying to do (Latham and Yukl 1975). According to this theory, harder goals result in a higher performance than do easy goals while specific goals may result in a higher performance than do no goals or a generalized goal of "do your best." For this reason, employees were more productive in goal setting conditions. Soft drink salesmen and servicemen checked more vending machines when specific hard goals were assigned than when no goals were assigned. However, assignment of easy goals did not result in better performance than no goals.

Companies seeking for higher performance can set higher performance levels by benchmarking leading companies or competitors. Benchmarking is a process of investigation and learning for improving and changing an organization based on the performance of the best practice of other companies, industry best practices, competitors' best practices, and/or internal best practices. Previous research has argued that benchmarking can make a significant improvement to performance (Lock 2001). It has shown that vast differences in the performance between leading companies and average companies in the performance of dealing with particular activities (Gattorna and Berger 2001). By benchmarking leading companies, firms have experienced a significant success in upgrading their organizational capabilities.

Companies can set up performance measurements for BPR using the same concept of setting goals and benchmarking for their managers or line workers. By doing so, it can encourage them to achieve companies' goals in a positive way. The performance measurements also can help quantifying how much managers and line workers produce using the new BPR processes. For example, companies can assess employees' performance by comparing expected outcomes and actual outcomes. Employees' rewards will be based on each

one's performance level achieved. The more they reach their goals, the more reward they will receive; and this is a basic tenet of pay for performance.

Sharecropping, in which the worker shares in the output created on the landowner's property, may be the oldest form of pay for performance. Pay for performance is an artifact of the widely held belief that the company must reward their managers or line workers based on the performance level they achieve if a company wants to motivate them to follow organization objectives. The scholars classified two types of rewards that people value and they are intrinsic and extrinsic (Kaplan and Atkinson 1998). Intrinsic rewards come from within the individual, such as job satisfaction or organizational loyalty based on inner values or beliefs. Companies can create the potentials for people to experience intrinsic rewards through job design, organization culture, and management style. Extrinsic rewards, on the other hand, are valued outcomes that one person gives to another and they may include recognition, plaques, prizes, awards, and pay for performance. For this reason, it is a widely accepted practice in the companies to establish the extrinsic rewards to motivate their managers or line workers. Managers or line workers will work hard, and their performance will increase because of the possibility to receive the higher rewards.

The extent to which BPR goals are accomplished is strongly related to the benefits the organization derives from the BPR project, and also the extent the BPR project has an impact onto the company performance. The extent to which benefits are derived is also positively related to company performance (Guimaraes and Bond 1996). The primary benefit of BPR is to make businesses more competitive by improving quality, reducing costs, and shortening lead time (Hammer and Champy 1993; Hale and Cragg 1996; Guimaraes and Bond 1996). Therefore, companies should set up the needed performance measurements to measure their managers' or line workers' performance in the following three areas including quality improvement, cost reduction, and lead-time shortening. In this current study, the business processes will be classified into internal and external ones. The research and development and production processes are internal, while after-sale support to customers is an external process. Companies have to provide customer services and after-sale support to customers as part of their management strategy which focuses on meeting customer expectations to reach its goals effectively and efficiently through the customer satisfaction (Wagenheim and Reurink 1991). Further, companies must set up a different approach to performance measurements for both internal and external processes. For internal processes, companies will focus on the quality of products and the costs or time spent to produce them. As to external processes, companies will focus on satisfying customers by providing what they want such as on-time, reliable, and consistent service delivery and quick & accurate responses to customers' problems. Therefore, hypotheses 3 are established as follows:

H3: Employee performance will be motivated by performance measurement.

H3a: Employee performance will be motivated by performance measurement of costs reduction in internal processes.
H3b: Employee performance will be motivated by performance measurement of costs reduction in external processes.
H3c: Employee performance will be motivated by performance measurement of quality improvement in internal processes.
H3d: Employee performance will be motivated by performance measurement of quality improvement in external processes.
H3e: Employee performance will be motivated by performance measurement of lead time shortening in internal processes.
H3f: Employee performance will be motivated by performance measurement of lead time shortening in external processes.

3 Methodology

3.1 Variables definition

3.1.1 Information Technologies (IT)

From the above discussion (Gunasekaran and Nath 1997; Attaran 2004), it should be clear that companies would benefit from implementing BPR with the use of IT. The following questionnaire items were used to assess whether or not the subject companies have made IT investments in improving CRM, product development and cost reduction during their BPR implementation in the past 5 years. The measurements of IT investment for CRM and product development include "Improving the development of new products and/or services," "Exploring the relationship with other companies," "Increasing customers' satisfaction," "Preparation for entering a new business," and "Pollution reduction." The measurements of IT investment for costs reduction include "Carrying costs reduction in inventory," "Costs reduction in materials and human assignment," and "Costs reduction in payroll." The questions are measured by the answer of either "Yes" or "No."

3.1.2 Business Process Reengineering (BPR)

It is noted that companies may implement BPR in any process or activity. Following the study of Hammer and Champy

(1993), the questionnaire items were used to assess whether or not the companies that implemented BPR in the past 5 years. The items examined include improving the whole process, improving partial process, adjusting the process, and without improving the process. The measurements of BPR implementation include "Materials transformation," "Production," "Assembly," "Warehouse management," "Distribution," "Customer service," "Administration department," "Cooperation with overseas companies," and "Product reprocesses and rework." The questions are measured by the answers of "Change completely," "Partial change," "Little change," and "No change."

3.1.3 Performance measurements

As discussed earlier (Guimaraes and Bond 1996), the main objectives of BPR implementation are to achieve the goal of costs reduction, quality improvement, and lead time shortening. This study examined the relationship existed between the performance of internal processes and external processes, respectively, and also employee performance measurements associated with costs reduction, quality improvement, and lead time shortening. The measurements of costs reduction in internal processes include "Materials transformation," "Production," "Storehouse management," and "Distribution." The measurements of costs reduction in external processes include "Customer service," "Administration department," "Cooperation with overseas companies," and "Product reprocesses." The measurements of quality improvement in internal processes include "Materials transformation", "Production", "Storehouse management," and "Distribution." The measurements of quality improvement in external processes include "Customer service," "Administration department," "Cooperation with overseas companies," and "Product reprocesses." Finally, the measurements of lead time shortening in internal processes include "Materials transformation," "Production," "Storehouse management," and "Distribution;" while the measurements of lead time shortening in external processes include "Customer service," "Administration department," "Cooperation with overseas companies" and "Product reprocesses." The questions are measured again by the answer of either "Yes" or "No."

3.1.4 Employee performance

This research explores how BPR affects employee performance through the establishment of performance measurements. The following questionnaire items asked to measure whether or not the performance measurements have reflected their managers' and line workers' performance. The measurements of employee performance include "Managers' performance can be influenced by performance measurements," "Line workers' performance can be influenced by performance measurements," and "Managers' compensation is linked to performance." The questions are measured by the answer of either "High influence" or "Low influence."

3.2 Data analysis method

The PLS procedure has been gaining great interest and widely used among information system researchers in recent years (Compeau and Higgins 1995; Chin and Gopal 1995) because of its ability to model latent constructs under conditions of non-normality and for small to medium sample sizes. PLS comprises a measurement model and a structural model. The measurement model specifies relations between observed items and latent variables while the structural model specifies relations between latent constructs. PLS is preferable to other techniques such as regression which assume error free measurement (Lohmoller 1989; Wold 1985). PLS estimates parameters for both the links between measures and constructs (i.e., loadings) and the links between different constructs (i.e., path coefficients) at the same time. Further, PLS model is usually analyzed and interpreted sequentially in two stages: (1) the assessment of the reliability and validity of the measurement model, followed by (2) the assessment of the structural model (Chin 1998). This sequence ensures that the researcher has reliable and valid measures of constructs before attempting to draw conclusions about the nature of the construct relationships. PLS is particularly suitable to this study because it makes minimal data assumptions and requires relatively small sample sizes (Wold 1985).

3.3 Data collection and questionnaire design

The sample firms were restricted to companies listed on the Taiwan Stock Exchange in 2006. Data was collected through a specially designed survey instrument sent to sample firms first to conduct a pilot study. After incorporating the necessary adjustment and improvement, there was a total of 800 questionnaires sent out and 145 out of 800 were returned. The response rate is 18.13 %. The questionnaires is listed in Appendix. However, 13 of returned questionnaires were invalid and dropped from further analysis because too many values were missing or incomplete. Therefore, 132 of returned questionnaires were used for analysis and the effective response rate is 16.5 %. The questionnaires were filled out by senior managers since they had needed knowledge, skill, and experience to answer the questions.

4 Data analysis

4.1 Demographic statistic

The demographics of the respondent companies are shown in Tables 1, 2, and 3, respectively. The respondent companies

Table 1 Industry type

Industry type	Frequency	Percentage
Foodstuff industry	6	4.55 %
Textile industry	9	6.82 %
Electrical machinery industry	26	19.7 %
Electrical equipment industry	7	5.3 %
Chemical industry	6	4.55 %
Iron and steel industry	6	4.55 %
Electronic industry	43	32.58 %
Other	29	21.95 %
Total	132	100 %

can be classified into eight different industries, of which the largest is the electronics industry (32.58 %), with the second largest as the electronic machinery industry (19.7 %). The "number of employees" information is provided in Table 2. The measure of "employee number" is used to represent the companies' size. For the respondent companies, 67.42 % of them have more than 200 employees. This means that more than half of respondent companies are a middle or large size company. In terms of "age of years," there were only five companies operating less than 5 years, while 52.27 % of the companies were in operation for more than 20 years old.

4.2 Reliability and validity

The KMO measures the sampling adequacy with which should be greater than 0.6 for a satisfactory factor analysis to proceed (Kaiser 1974). Another indicator of the strength of the relationship among variables is Bartlett's test of sphericity. Bartlett's test of sphericity is used to test the hypothesis if the correlation matrix is an identity matrix. The observed significance level is .0000 and it is small enough to reject the hypothesis. It is thus concluded that the strength of the relationship among variables is strong. In addition, it may prove to be a good idea to precede a factor analysis for the data to complete this study.

Table 2 Employee number

Employee number	Frequency	Percentage
Under 100	14	10.61 %
100~200	29	21.97 %
200~1,000	64	48.48 %
1,000~5,000	18	13.64 %
Over 5,000	7	5.3 %
Total	132	100 %

Table 3 Company age

Age in years	Frequency	Percentage
Under 5 years	5	3.79 %
5~10 years	24	18.18 %
10~20 years	34	25.76 %
20~30 years	38	27.79 %
Over 30 years	31	24.48 %
Total	132	100 %

Consequently, factor analysis is employed to test the validity of the questionnaire. Factors with eigenvalues greater than 1 are extracted. Construct validity is evaluated using principal components factor analysis. All the factors loading need to be higher than 0.5 (Hair et al. 2009). The results are summarized in Table 4. Bagozzi and Yi (1988) argue that variance

Table 4 Factor analysis

Factor name	Question No.	Factor loading	Eigenvalue	Variance (%)	Cronbach's α
BPR implementation	2.1	0.814	5.874	65.265	0.9325
	2.2	0.757			
	2.3	0.861			
	2.4	0.873			
	2.5	0.841			
	2.6	0.811			
	2.7	0.790			
	2.8	0.761			
Costs reduction in internal process	3.1	0.769	2.180	54.502	0.7183
	3.3.	0.771			
	3.4.	0.753			
Costs reduction in external process	3.5.	0.750	2.283	57.074	0.7402
	3.6.	0.645			
	3.7.	0.818			
	3.8.	0.798			
Quality improvement in internal process	3.1	0.711	2.275	56.874	0.7350
	3.3	0.837			
	3.4	0.803			
Quality improvement in external process	3.5	0.542	1.961	49.035	0.6352
	3.6				
	3.7	0.762			
	3.8	0.752			
Lead-time shortening in internal process	3.1	0.760	2.216	55.405	0.7314
	3.3	0.709			
	3.4	0.775			
Lead-time shortening in external process	3.5	0.621	2.164	54.1	0.7014
	3.6	0.764			
	3.7	0.796			
	3.8	0.749			

Table 5 PLS analysis

Factor name	Question No.	Loading	Composite reliability	AVE
BPR implementation.	2.1	0.820300	0.931	0.63
	2.2	0.735900		
	2.3	0.854000		
	2.4	0.860500		
	2.5	0.839100		
	2.6	0.773500		
	2.7	0.717100		
	2.8	0.720800		
Costs reduction in internal process	3.1	0.881500	0.82	0.61
	3.3.1	0.751300		
	3.4.1	0.702400		
Costs reduction in external process	3.5.1	0.796800	0.86	0.61
	3.6.1	0.815500		
	3.7.1	0.708900		
	3.8.1	0.807000		
Quality improvement in internal process	3.1.2	0.747100	084	0.63
	3.3.2	0.821100		
	3.4.2	0.811600		
Quality improvement in external process	3.5.2	0.748400	0.81	0.52
	3.6.2	0.590100		
	3.7.2	0.771500		
	3.8.2	0.755800		
Lead-time shortening in internal process	3.1.3	0.818200	0.83	0.61
	3.3.3	0.765800		
	3.4.3	0.762900		
Lead-time shortening in external process	3.5.3	0.766200	0.84	0.57
	3.6.3	0.725900		
	3.7.3	0.771800		
	3.8.3	0.768200		

extracted (VE) over 0.5 for average shows the measuring items are representative. Lastly, Cronbach's α was used here to test the reliability of the questionnaire. Nunnally (1978) states that it is necessary to change or rework the questionnaire if the reliability level is lower than 0.7. The Cronbach's α in this research are all greater than 0.7, which means the scales used in this study are all reliable. In short, measuring the consistency and stability of the questionnaire is the main purpose of a reliability test.

4.3 PLS analysis

Chin and Newsted (1999) suggest that composite reliability should be>0.7 to examine the internal consistency. Average variances extracted (AVE) are all above the recommended 0.5 level, supporting the convergent validity of measurement scales (Fornell and Larcker 1981) or the loadings of the items in every factor are above 0.5 (Nunnally 1978). The result shows that the research meets the convergent validity. Finally, Chin and Newsted (1999) advice that the square root of AVE of each factor should larger than the correlation coefficient with other factors, supporting the discriminant validity of scale items. The corresponding results are listed in Table 5. Table 6 is the correlation analysis.

4.4 Hypothesis examining

The results of path coefficients of PLS structural model are listed in Table 7 and Figs. 1 and 2 accordingly. During the BPR implementation, companies can utilize information technology to speed the process and also reduce the need for additional papers or human resources while dealing with the order processing task. This research has proposed that companies make IT investment in the areas of customer relations maintenance, product development, and costs reduction during the BPR implementation. The obtained empirical results did support the proposed hypotheses 1.

The coefficient of BPR is 0.205*** which is positively related to the employee performance. The relationship existed between BPR and employee performance is an important consideration in this research. In general, companies

Table 6 Correlation analysis

Factor	Means	Std	IT	BPR	PP	CRIN	CREX	QIIN	QIEX	TIIN	TIEX
IT investment (IT)	0.658	0.462	0.590								
BPR Implementation (BPR)	0.514	0.449	0.338	0.794							
Performance (PP)	0.409	0.478	0.220	0.296	0.821						
Costs Reduction in Internal Process (CRIN)	0.568	0.495	0.228	0.209	0.448	0.781					
Costs Reduction in External Process (CREX)	0.684	0.461	0.213	0.184	0.395	0.598	0.781				
Quality Improvement in Internal Process (QIIN)	0.672	0.463	0.300	0.158	0.340	0.544	0.548	0.794			
Quality Improvement in External Process (QIEX)	0.676	0.458	0.311	0.095	0.453	0.463	0.541	0.656	0.721		
Lead-Time Shortening in Internal process(TIIN)	0.601	0.490	0.061	0.133	0.413	0.393	0.435	0.538	0.508	0.784	
Lead-time shortening in external process	0.655	0.475	0.066	0.130	0.369	0.380	0.474	0.589	0.529	0.671	0.755

Table 7 PLS structural model: path coefficients, t-statistics

	Path coefficients	t-statistics
BPR → IT investment	0.338	5.290***
BPR → Performance	0.205	2. 624***
Costs Reduction in Internal Process → Performance	0.247	2.509**
Costs Reduction in External Process → Performance	0.041	0.669
Quality improvement in Internal Process → Performance	−0.164	−1.500
Quality improvement in External Process → Performance	0.285	2.796***
Time shortening in Internal Process → Performance	0.176	2.137**
Time shortening in External Process → Performance	0.058	0.741

* Indicates significant at the $p<0.1$ level, ** Indicates significant at the $p<0.05$ level,*** Indicates $p<0.001$ level

implement BPR to mainly restructure and simplify business processes. Thus, by using the newly developed business processes, it would be expected that the managers and/or line workers will increase their productivity and in turn, improve their resulting performance. The empirical results obtained from this study also support hypothesis 2.

In Table 7, the coefficient of performance measurements of cost reduction in the internal process is 0.247** which is positively related to the employee performance. However, the regression outcome doesn't support the relationship existed between performance measurements for costs reduction in the external processes and also the resulting employee performance, and consequently hypothesis 3b is rejected. The coefficient of performance of quality improvement in the internal processes is −0.164 which does not support hypothesis 3c either. The coefficient of performance of quality improvement in the external processes is actually 0.285*** which is positively related to the employee performance. The coefficient of performance measurement of lead time shortening in the internal processes is 0.176** which is positively related to the employee performance. As a result, the relationship between performance measurement of lead time shortening in terms of the external processes and employee performance is not supported.

The establishment of employee performance measurements is the same as setting a goal traditionally for employees to accomplish it. According to the theory of goal setting, employees' performance will be higher in the goal setting conditions than these conditions wherein they are given no goal. Thus, companies are likely to see a better performance by setting the performance measurement standards using/adopting benchmarking against leading companies. The obtained outcomes have shown that the establishment of the performance measurements will indeed improve employee performance.

The respondent companies of this research are mainly middle-sized, with 64 companies (48.48 %) having a size of employees between 200 and 1,000. Most of the companies in Taiwan are original equipment manufacturers (OEM), and this study suggests they will probably increase their competitiveness by paying more attention to such internal processes as reducing the product costs and shortening the production cycle time. Further, they will also need to pay more attention to developing employee performance measurements for internal processes rather than external processes. A possible reason may be that companies might establish/develop inappropriate performance measurements internally. Moreover, the employees' performance will not be able to be measured by applying inappropriate performance measurements.

Next, we divide all samples into three groups and they include traditional industry, information technology (IT) industry and other industries. Traditional industry may include the foodstuff industry, textile industry, chemical industry and iron and steel industry while IT industry may include electronic industry, electrical machinery industry and electrical equipment industry. The reasons to divide the entire samples into to three groups are presented as follows.

First, IT industry in Taiwan has played such an important role in the worldwide IT market for over a decade and it actually accounts for about one third of Taiwan's GDP. Many companies in the IT industry have been established

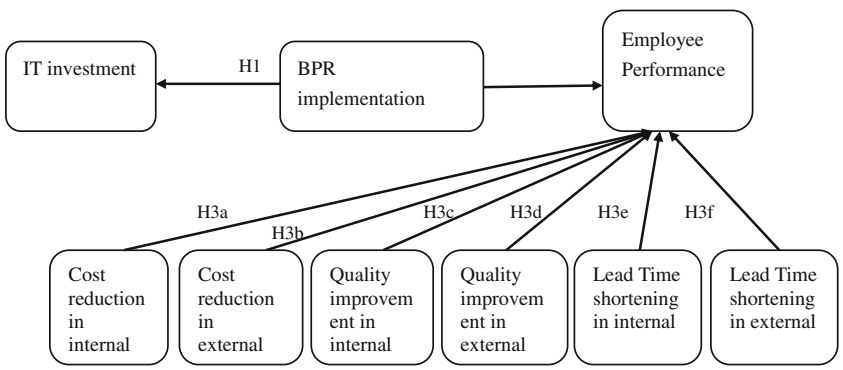

Fig. 1 The research model

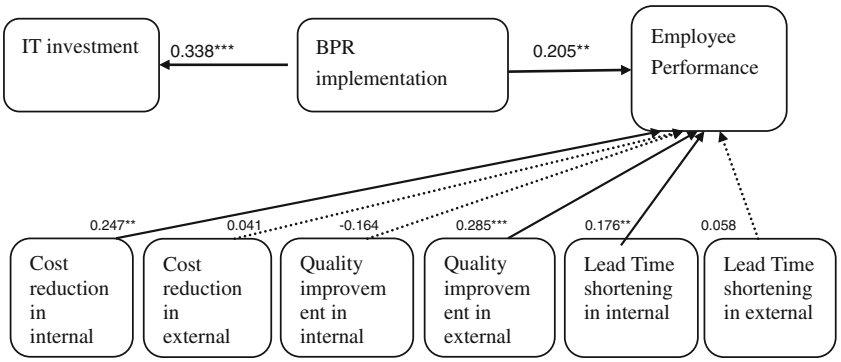

Fig. 2 PLS structural model with significant path coefficients

for less than 15 years while those in traditional industry were generally developed in more than 40 years ago. Therefore, the three groups can be deemed as a representative sample of Taiwan's industry. Secondly, the topic of this paper is to discuss how BPR implementation affects IT investment and the resulting corporate performance. For this reason, the IT industry was particularly chosen, since it invests a lot in IT, to see whether the effect of BPR implementation onto IT investment is still significant. The obtained results in Table 8 show there is no significant variation among the different industry groups. The significant positive relations still exist between BPR implementation and IT investment, and between BPR implementation and employee performance even after we control the industry differences.

Table 8 PLS structural model (Control the industry differences): path coefficients, t-statistics

	Path coefficients	t-statistics
BPR → IT investment	0.344	3.611***
BPR → Performance	0.202	2.430*
Costs Reduction in Internal Process → Performance	0.259	2.743**
Costs Reduction in External Process → Performance	0.042	0.764
Quality improvement in Internal Process → Performance	−0.165	−1.625
Quality improvement in External Process → Performance	0.285	2.912***
Time shortening in Internal → Process Performance	0.168	2.064**
Time shortening in External Process → Performance	0.059	0.796
Dummy 1 → IT investment	0.098	0.905
Dummy 1 → Performance	0.018	0.265
Dummy 2 → IT investment	0.072	0.497
Dummy 2 → Performance	0.056	0.762

* Indicates significant at the $p<0.1$ level, ** Indicates significant at the $p<0.05$ level,*** Indicates $p<0.001$ level; Dummy 1: IT industry is 1; others are 0; Dummy 2: Traditional industry is 1; others are 0

5 Conclusions and future implications

This paper discusses the relationship existed between IT, BPR, performance measurement, and employee performance. The empirical result shows that a positive relation existed between IT investment and BPR implementation. With IT, companies can more effectively gather information on customer needs and better meet the changing market demands. This reduces the possibility of producing unpopular products, and also raises the opportunity for companies to discover the potential market. By producing the right product, companies can satisfy their customers and thus, increase their market share. IT investment can also reduce transaction time and paperwork and use human resources in a more efficient manner. IT also plays a key role in setting up the performance measurement mechanism during the BRP implementation. This study proves that not only before but also during the BPR implementation, companies need to invest lots of IT expenses to ensure and facilitate the success of BPR implementation. In many cases, IT is regarded as the biggest barrier to rapid and radical changes since radical change may require IS redesign. From the above discussion, it is notable that IT is clearly an enabler of reengineering.

The empirical result supports the hypothesis that BPR implementation improves employee performance, creates a new working environment, and support the need for building new and better employee work habits. Through BPR implementation, companies can always reevaluate the process again and this practice enables individuals and groups to effectively assess where they stand in comparison with the current status and progress of their competitors. By reviewing the involved business process, companies will be able to redesign the working flows to further improve the performance. This fact confirms the relationship existed between IT, BPR and employee performance can assist management level make the right decision about the implementation and adoption of BPR.

This study examines the hypothesis that employee performance is motivated by the performance measurement in BPR implementation. Companies can increase

their competitiveness by implementing BPR. However, implementing BPR sometimes will associate with a need to redesign the original business process. It is not easy for employees to get used to the new process. Therefore, the performance measurement establishment is expected to be a contributing factor to encourage employees to use/adopt the new process. The obtained results also justify the suggestions that clear and specific goal setting can inspire employees to work harder to meet the requirements and improve the performance. The performance measurement established by the companies can also be viewed as a tool to communicate companies' objectives to employees. Achievement of the employees with the expected performance is helpful for the achievement of a company's goals. Employees using the well-designed process will no doubt improve their performance by becoming more competitive. BPR implementation can enhance employee performance but only when the organizations adopt a reasonable performance measurement system. To know if their performance has been improved, employees need to be consistently monitored by the adequate performance measurements standard and system. It is essential to stick to the principle that employees' rewards are paid based on their measured performance.

This study links employee performance measurement to internal and external processes which can encourage employees to use the newly designed processes. The empirical result supports that performance measurement associated with costs reduction and lead time shortening in internal processes and quality improvement in external processes can improve the relative performance. Most companies in Taiwan are original equipment manufacturers (OEM), which increase their competitiveness by reducing product costs and production cycle time. According to the marketing perspective that organizations achieve their goals may mean that they perform better than their competitors by satisfying their customers with greater operational efficiency and effectiveness.. Additionally, business can utilize the performance measurement of quality improvement in external processes to enhance the customers' satisfaction.

There are however, some limitations in this paper. First, the results of questionnaires may be affected by the respondents' personalities or preferences. Secondly, this study only surveys companies listed on the Taiwan Stock Exchange. Companies not listed on Taiwan Stock Exchange may have different outcomes. Thirdly, this study only examines the relationship among IT investment, BPR implementation, performance measurement, and employee performance. It is suggested that more variables could be included for further research. Finally, this paper only conducts the research for eight industries. Different industry types can be compared and analyzed for further research.

Appendix 1

Table 9 The questionnaire

1. What kind of problems that your company will need to solve by making Information Technology investment in the past 5 years?

	Past 5 years
1.1 Improving the development of new products and services.	( )
1.2 Exploring the relationship with other companies.	( )
1.3 Increase customers' satisfaction.	( )
1.4 Preparation for entering new business.	( )
1.5 Pollution reduction.	( )
1.6 Carry costs reduction in inventory.	( )
1.7 Costs reduction in materials and human assignment.	( )
1.8 Costs reduction in payroll.	( )

2. Whether your company has made BPR in the past 5 years?

	Change completely	Partial change	Little change	No change
2.1 Process of materials transformation.	1	2	3	4
2.2 Process of production.	1	2	3	4
2.3 Process of assembling.	1	2	3	4
2.4 Process of storehouse management.	1	2	3	4
2.5 Process of distribution	1	2	3	4
2.6 Process of customer service.	1	2	3	4
2.7 Process of administration department.	1	2	3	4
2.8 Process of cooperate with overseas companies.	1	2	3	4

3. Whether your company has established performance evaluations for assessing the business process?

	Cost	Quality	Time
3.1 Process of materials transformation.	1	2	3
3.2 Process of production.	1	2	3
3.3 Process of assembling.	1	2	3
3.4 Process of storehouse management.	1	2	3
3.5 Process of distribution	1	2	3
3.6 Process of customer service.	1	2	3
3.7 Process of administration department.	1	2	3
3.8 Process of cooperate with overseas companies.	1	2	3

Table 9 (continued)

4. Whether the following situations have happened during the business process management.	High reflected	Low reflected
4.1 The performance evaluations can reflect managers' performance.	1	2
4.2 The performance evaluations can reflect line workers' performance.	1	2
4.3 The managers' payments are depending on performance which is measured by performance evaluations.	1	2

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