A Study on the Measurement of ERP Implementation Performance by BSC Model : Focused on the Causal Relationships among Performance Indicators

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Abstract

The main propose of this research is to examine the performances in ERP introduced enterprises by utilizing BSC model proposed by Kaplan and Norton [1992], to realize this goals, a theoretical review on ERP, BSC, and other related issues is performed in advance, accordingly, research model was generated. In conceptual model analysis, we focused on casual relationships among four performance measurement indicators after introduction of ERP proposed by Kaplan and Norton [2000].

To test the model, structural equation modeling is employed to analyze data collected from 164 enterprises which have introduced ERP for more than 1 year. Survey respondents were confined within the representatives of each enterprise's ERP.

Hypotheses proposed in our research are tested by covariance structure model, results are listed as follow :

First, learning and growth performance is significant factors for improving both internal process performance and customer performance; second, process performance has a positive impact on customer performance third, despite that customer performance is positively related to financial performance, no direct relationship is found between internal process performance and financial performance, an indirect relationship is built through intermediate medium of customer performance.

Based upon these results, we discuss implications at the latter part of paper. Meanwhile, we also provide research limitations, and future research in the final section.

Keywords : ERP, BSC, Causal Relationship, Performance Indicators

1. Introduction

To be competitive in the world market, enterprises should not only assure their competitive advantages for survival, but also take advantage of information technology strategically so as to enhance their task efficiency and business performances as well as international competitiveness. To do this, a variety of innovative management techniques which utilize information technology and information systems are implemented, among them, the most typical information system is called ERP.

Since the 1990s, more and more enterprises have introduced ERP for the purpose of more efficient utilization of its resource and acquisition of competitive advantages. However, the existing empirical studies concerning performance measurement in ERP introduced enterprises have been conducted on the issues such as : perspectives on improving the effectiveness of individuals and organizations, information system success model concerning user satisfaction, level of system utilizing [Fethi and Ferah, 2004; Sharma and Yetton, 2003; Holsapple et al., 2005] and perspective on financial performance concerning cost saving, ROI improving etc. [Hong and Kim, 2002; Hitt et al., 2002]. In addition, although the effects of implementing ERP would appear immediately, there is a general trend to review and evaluate the system in long-term from a wide-range investment perspective

ERP don't merely mean the process of adopting integrated information system in enterprises, it consists of transformation processes within ERP package, including the overall manage-ment processes and the formation of a new organization structure. Therefore, in order to systematically identify the performance of ERP, it's more effective to hold an overall view on performance improvement when compared to holding a narrow-minded view that merely focuses on the specific sections.

Under this background, BSC model is employed by our research so as to present a systematic performance measurement of the ERP, four perspectives, namely : learning and growth performance, internal process performance, customer performance and financial performance are adopted as measurement variables in our study. In addition, for the purpose of utilizing BSC model as a strategic tool to fulfill corporate strategy, empirical study of mutual causal relationships among the four performance indicators has been performed according to Kaplan and Norton [2000]'s research in which they highlighted the importance of understanding the relationships between performance indicators. By grasping these inherent correlations existing between ERP performance measurement indicators, it's clear that we should concentrate on the overall effects on enterprises rather than focus on specific performance measurement value, meanwhile, implication of our research is discussed from administrative aspects.

2. Theoretical Background

2.1 Enterprise Resource Planning (ERP)

Due to the rapid developments in information and communication technology, globalization of world market, diversification of customer needs,

high uncertainties and rapidly changing business environment and other factors, enterprises have introduced a variety of techniques and management innovations so as to survive and ensure their competitive advantages. Among them, ERP attract extensive interests from industry since it acts as a management innovation tool throughout the whole enterprises. Recently, ERP which has been actively discussed in IT sector have been recognized as a strategic tool for enterprises, meanwhile, research on successful ERP implementation and performance improvement solutions has become a important issue in both industry and academic community.

ERP is a process or approach which attempts to consolidate all of a company's tasks and functions into a single system that services each section's specific needs. It is, in a sense, a convergence of procurement, efficient production, accounting, human resource, marketing, delivery and inventory management system that creates profit for the company. Introduction of ERP does not merely mean the installation of packaged software ERP, possessing the characteristics of innovation management tools, which also surpasses the role of information systems, embodies a process of pursuing innovative management throughout the whole organization processes [Kronbichler et al., 2010].

ERP is utilized to efficiently manage electronic resources in the enterprise, rather than target a specific section, but be applicable to all sections across the enterprise in the form of integrated information system. In addition, by minimizing the weakness of existing MRP and MRPⅡ in flexibility aspect, ERP evolves in the direction of open system that integrates new techniques such as object-orient technology, distributed data processing, open structure, right sizing etc.

By implementing ERP, enterprises can benefit from improved lead time, assert efficiency, customer services, cost saving, information sharing and a wide range of financial or non-financial effects [Asghari et al., 2011]. Therefore, it's necessary to understand the overall performances throughout the whole organization.

2.2 Balanced Scorecard (BSC)

Performance measurement is an important management control step for company's long-term survival and development. Existing traditional performance measurement system is too dependent on financial indicators such as ROI, net profit, return on capital which neglects changes in business environment. As a matter of fact, beside the final result, financial indicators show no other information of management process and causation. Since existing performance measurement relies too much on financial indicators, it pays over much attention to decision-making or instance took place in the past rather than predict future instance which is the real purpose of performance measurement [Choe, 2013]. After recognizing these problems, in order to provide managers with information concerning existing financial performance and acquired information during the accumulation process so as to set policy for supporting growth in future, performance measurement methodology-balanced scorecard (BSC),

proposed by Kaplan and Norton [1992], is adopted.

BSC is an integrated performance measurement system used to achieve company's strategic goals and key success factors, it evenly reflects the financial performance measurement indicators as well as the non-financial performance measurement indicator, and it could also be served as a useful framework for company's strategic goals and competitive needs. Be different from traditional means of measuring performance by financial indicator, BSC can not only evaluate current management performance but also measure the potential capabilities which could enhance performance in the future by using both financial and non-financial indicators, namely : learning and growth, internal process, customer. BSC is deemed as a systematically strategic performance measurement system which evenly takes performance into account from a variety of perspectives, for instance, taking internal innovation process as company's internal performance variable, taking customer as external variable, taking financial performance as resultant variable, taking learning and growth as long-term performance variable.

When compared to traditional corporate management measurement system, BSC possesses the following two significant features. First, BSC investigates corporate performances from four perspectives instead of concentrating on some specific aspects. Second, financial performance measurement indicators as well as non-financial measurement indicators are referred in forms of leading indicators and lagging indicators. It's the trend that many studies are interested in analyzing the effects of mediating

non-financial measurement indicators on financial performance.

Kaplan and Norton [2000] proposed a strategy map to logically describe BSC. Strategy map visually displays about how to achieve corporate final strategy and goals by explaining casual relationships from the four perspectives proposed in BSC, it could also manipulate the way of communication among organization's members as well as the transfer all of company's resources into desired performance [Lee et al., 2009]. Examining mutual causal relationships from BSC model's four perspectives, first, capabilities of employees can be improved and the productivity of information systems can be enhanced from learning and growth perspective, efficiency of organization's business process can be enhanced from internal process perspective, that is, by improving the ability of employees and efficiency of information system, the process of handing big customer's order will be efficient and instant delivery will also be ensured. Similarly, from internal process perspective, customer satisfaction will be enhanced from improvement in production level. It becomes easier to acquire new customers and retain existing customers when customer satisfaction is achieved. Through these means, improved customer satisfaction will ultimately improve corporate financial performances.

As an overall strategic tool, it's essential to understand the causal relationships among corporate BSC performance indicators [Kaplan and Norton, 2000]. The importance of understanding the causal relationships resides in : first, enterprises can provide all organization's members

with concrete measures for achieving strategic goals, second, measurement indicators used now can be adopted to determine whether its effect exists in achieving a real strategic goal. Third, causal relationships among measurement indicators show relevance with other indicators. Thus, without understanding the causal relationships between BSC measurement indicators, insisting on short-term profits or specific sections, from organization aspects, will make it impossible to recognize the performances that can be effective in create performances in the future. Conversely, insisting on performance incentives excessively from organization aspect or customer aspect will make it impossible to recognize practical performances. Consequently, management performance and performance incentives should be interconnected and evenly considered, only by this way, can a long-term improvement in performance measurement be maintained.

2.3 Literature Review

According to BSC, the possibility of enterprises' growth and development is not simply determined by financial status in the past or present, which is determined by a variety of factors such as : customer relationship ability, business processing performance, and organization innovation ability etc. All performance indicators from these four perspectives are related to corporate strategy. Kaplan and Norton [1996] emphasized the essentiality in holding the balance position between long-term goals and short-term goals, financial indicators and

non-financial indicators, leading indicators and lagging indicators, external perspectives and internal perspectives, based on the suggestions proposed by Kaplan and Norton [2000], some existing studies concerning relationships among performance indicators are organized as follows :

Sim and Koh [2001] conducted a survey collected data from 83 electronics companies located within the USA, results from the study provide support for the balanced scorecard. Specifically, findings show that education and training is significantly related to customer performance as well as cost saving performance. In addition, innovative management method is significantly related to low-cost manufacturing, high-revenue and market share, shorter product development time is significant related to manufacturing cost, revenue and market share

Ittmer and Larcker [1998] investigated the relationship between customer satisfaction and financial performance at present or in future. This research conducted analysis to arrive at its conclusion where data are collected from customer-level, business-unit and firm-level. Customer satisfaction indicators exert substantial effects on customer's purchasing behaviors and financial performance from customer-level and business-unit.

It's important to recognize casual relationships among performance perspectives when measuring the performances in ERP introduced enterprises. In order to fulfill corporate version and strategy, balanced performances from long-term or short-term perspectives as well as from financial or non-financial perspectives should be achieved through the implementation of ERP

[Shin et al., 2012]. By introducing ERP, attained performances such as enhanced employee capacity, process efficiency, and customer satisfaction will ultimately improve financial performance. Literatures concerning issues on essentiality of adopting BSC perspective when measuring performances in ERP system introduced enterprises are reviewed and organized as follows:

Ferreira and Malanga [2011] and Chand et al. [2005] suggest that we can take advantage of BSC approach in measuring performances of ERP implementation. According to their study, the essence of BSC approach resides in that it can measure organizational performance in a balanced wide range, from existing limited financial indicators to an integration of indicators from customer perspective, internal process perspective, and learning and growth perspective.

Fang and Lin [2006] indicated the essentiality of employing BSC perspectives in measuring performances of ERP implementation. Meanwhile, they developed performance measurement criterions in view of operation cost savings and revenue improvement from financial perspective, reduction of transaction time and customer satisfaction from customer perspective, integration of work flow from under layer and breakthrough of operational bottleneck.

Overall, although some studies have been performed to highlight the essentiality in employing BSC systematically to measure the performances after introducing ERP, there is a lack of empirical study on the casual relationships among performance indicators. Herein, we employed the four performance indicators proposed in BSC as a method to evaluate corporate performance after introducing ERP and conducted an empirical study on the casual relationships among the four of them.

3. Research Design

3.1 Establishment of Research Model

ERP system do not merely mean the introduction of an integrated information system in enterprises, it comprises the absorption of management process inherent in ERP package as well as the formation of a new organization structure through transformation process. Therefore, in order to systematically identify performances of introduction and implementation of ERP, various situations either inside or outside organization should be reflected in the measurement process rather than hold a narrow-minded view on it, meanwhile it's necessary to bear an overall view on improvement in performances instead of merely focusing on the specific sections [Shin et al., 2012].

Our research employed the four perspectives proposed in BSC by Kaplan and Norton [1992], which are widely utilized as an integrated performance measurement system by a variety of enterprises recently. In addition, based on the opinions proposed by Chand et al. [2005], Sim and Koh [2001], and Rossenmann and Wiese [1999] that understanding of casual relationships among performance indictors should be further carried systematically when compared to organizational performances itself, here, the research model is shown in <Figure 1> as follows.

Causal relationships described in our research model among performance measurement indicators are based on strategy map proposed by Kaplan and Norton [2000] in which learning and growth is set as antecedent indicator and internal process performance, customer performance and financial performance are set as subsequent indicators. In strategy map, direct relationship between learning and growth performance and customer performance is not taken into account. Improvement in employee's satisfaction and professional ability, according to the findings presented by Sim and Koh [2001], will ultimately result in the seamless processing of big customer's order. Moreover, being major performance indicator for employee's capability and organizational culture, learning and growth performance is not directly related to financial performance, which indirectly contribute to financial performance through intermediate mediums of internal process performance and customer performance. Kaplan and Norton [2000], Sim and Koh [2001], and Lee and Huh [2004] all support this opinion, they also raise the proposal that research makes little sense in verifying direct relationship between learning and growth performance and financial

〈Figure 1〉 Research Model

performance, this point is also presented in our research model.

3.2 Research Hypotheses

3.2.1 Relationship between Learning and Growth and Internal Process

In the fast changing business environment, enterprises should show overall and sustainable improvements in organization structure so as to achieve high performances and competitiveness. Accordingly, internal process improvement can benefit from employee's creative ideas and capabilities. This means that in order to achieve high efficiency in organization's processes, employees who are in charge of real task should be exploited with their abilities and potentials.

Accompanied with improved degree of strategic awareness of product in many enterprises, the relationship between learning and growth performance and internal process performance is highlighted than ever. From organization perspective, improvements in business process efficiency, decision-making speed and other achievements only could be obtained by the implementation of methods used to enhance employee's IT mind, utilization rate of information system, customer satisfaction and other performances.

Kim et al. [2012] verified the fact in their study that training on employees exerts positive effect on efficiency of business process. Kwon and Kwon [2004] also confirmed the importance of employee's satisfaction in improving performance from internal business process perspective.

In view of the findings presented in previous literatures, organizational learning and growth
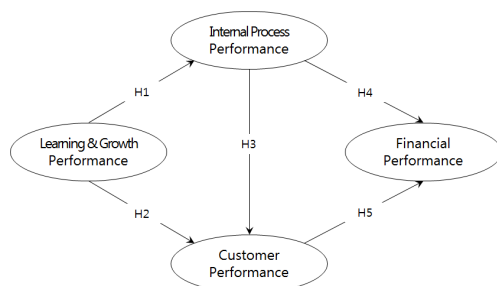
is anticipated to be significantly related to internal process performance. Consequently, we hypothesize that, as one of organizational performances by introducing ERP system, learning and growth performance positively influence internal process performance.

Hypothesis 1 : Learning and growth performance is positively associated with internal process performance in ERP introduced enterprises

3.2.2 Relationship between Learning and Growth Performance and Customer Performance

Act as the most fundamental assets of enterprises, human resources can positively create high customer satisfaction if their learning capabilities and potentials can be put into full play. In particular, learning and growth performance, acting as the most future-oriented performance measurement indicator among the four perspectives included in BSC, is a driving force to generate performance from other ones. If employee's capabilities and satisfactions could be improved, products and service qualities could be ensured through ERP implementation, customer satisfaction will be enhanced ultimately.

Service provided by enterprises is considerably determined by employee's attitudes and behaviors, a reduction in employee's satisfaction with work will lead to service quality degradation and can be perceived by customers Bitner et al. [1999]. As revealed in Sim and Koh [2001]'s research, reinforcement in education and training for employees presents a notable effect on delivery and customer performance. Kwon and Kwon [2004] clarified the direct rela-

tionship between internal employee's satisfaction level and customer satisfactions.

Based on the review of previous literatures, it's estimated that learning and growth performance is positively associated to customer performance, thus, hypothesis is set in our research as follows:

Hypothesis 2 : Learning and growth performance is positively associated with customer performance in ERP introduced enterprises

3.2.3 Relationship between Internal Process Performance and Customer Performance

The execution of various strategies used to improve corporate internal process has positive effect on customer satisfaction, which will contribute to financial performance ultimately. That is to say, strategies which are adopted as measures to increase the efficiency of internal process are anticipated to enhance customer satisfactions in short term, if this effort continues, it's favorable for enterprises to recognize customer, and result will appear as a form of improvements in corporate financial indicators [Schonberger, 1990]. Kaplan and Norton [2000] argued that an attainable, sustainable, and satisfied customer performance can be induced by efforts in process improvement such as : pursuit of innovation in internal business process, improvement in customer management process, superior achievement in operation and logistics process, foundation of friendly relationship with external environment.

Lee and Huh [2004] empirically proved that the customer performance improved accompanied

with an improvement in corporate internal process. Kwon and Kwon [2004] confirmed that, in casual relationship analysis among non-financial performance indicators, internal business process performance such as innovation process, operation process, after-sale service, is positively associated with product and service attributes, customer relationship, image and reputation, and other customer satisfaction performances.

Therefore, corporate internal performance is proposed to exert positive effect on customer performance, accordingly, based on these findings presented in previous literatures, hypothesis is generated regarding the relationship between internal process performance and customer performance in our study as follows :

Hypothesis 3 : Internal process performance is positively associated with customer performance in ERP introduced enterprises

3.2.4 Relationship between Internal Process Performance and Financial Performance

Generally, it has been known that the performance of organization's internal process influences financial performance in long-term through the improvement in customer performance rather than affect financial performance directly [Choi and Eboch, 1998]. But refer to the results of studies concerning casual relationship between BSC measurement indicators, duo to the shrinkage in cycle of corporate activity as well as the changing market environment, a conclusion has been drawn that internal process performance directly improves financial performance in short-term in some cases instead of across the intermediate

medium of customer performance [Lee and Huh, 2004]. According to Sim and Koh [2001]'s research, by introducing innovative management techniques, shortened product development period is examined to be significantly connected to low cost as well as increase in sales. Lee and Huh [2004] confirmed the direct casual relationship between corporate internal process performance and financial performance.

Based upon these literature reviews, it can be expected that internal process performance is positively related to financial performance in ERP introduced enterprises. Accordingly, hypothesis on relationship between internal process performance and financial performance is developed as follows.

Hypothesis 4 : Internal process performance is positively associated with financial performance in ERP introduced enterprises

3.2.5 Relationship between Customer Performance and Financial Performance

A direct casual relationship between customer satisfaction and financial performance has been verified by a number of scholars [Reichheld and Schefter, 2000; Devaraj et al., 2002], it explains that customers who are satisfied with specific corporate product or service will continue to purchase such product or service in the long term ultimately, corporate financial performance will benefit from those customers' continued purchase behaviors.

In addition, customer performance will contribute to the improvement in financial performance in various aspects. As mentioned above,

although customer performance has direct influence on financial performance, it could also affect financial performance by indirect means such as reducing customer defection, boosting customer loyalty, establishing barriers for competitors to entry and other methods [Reichheld and Sasser, 1990; Fornell, 1992].

Banker et al. [2000] clarified that non-financial indicators in associated with customer satisfaction in service enterprises have significant relevance to financial performance in future. In Ittner and Larker [1998]'s research, customer satisfaction, which is regarded as the representative ness of non-financial performance, is analyzed in together with financial performance at present and in future, based on the results presented in their research, customer satisfaction indicator is tested on the significance it shows on corporate financial performance.

According to the findings and suggestions raised by previous literatures, hypothesis is generated concerning casual relationship between customer performance and financial performance in ERP system introduced enterprises as follows.

Hypothesis 5 : Customer performance is positively associated with financial performance in ERP introduced enterprises

3.3 Definition of Research Variables

In order to evaluate performance in ERP system introduced enterprises, four-dimension perspectives proposed in BSC model are employed, namely, they are leaning and growth performance, internal process performance, customer performance, financial performance. Each questionnaire item used to evaluate performance in ERP system introduced enterprises is scored on a seven-point Likert scale (1 = strongly disagree; 4 = neutral; and 7 = strongly agree). Beyond that, in order to understand the characteristics of ERP system and obtain general information of enterprises which response to our survey, survey items such as kind of business, scale, project duration, operation period of the implementation of ERP system etc. are considered in questionnaire.

Operational definition and related literatures concerning the four performance measurement indicators of ERP system implementation are briefly summarized in <Table 1>. According to these operational definitions and references, detailed items of measurement are presented in <Appendix> for lack of space.

<Table 1> Operational Definition and References on Research Variables

Performance Indicators	Operational Definitions	References
Learning and Growth Performance	Performance from people, system and process perspectives which can be helpful in building the enterprise's ability	Kaplan and Norton [1992] Lee and Huh [2004]
Internal Process Performance	Performance which is made to improve enterprise'score processes and core capabilities	Kaplan and Norton [1992] Fang and Lin [2006]
Customer Performance	Performance about how much value enterprise exhibits in target market and subdivision market	Kaplan and Norton [1996] Ittner and Larker [1998]
Financial Performance	Performance from monetary perspective such as revenue and productivity which is regarded as the final step of enterprise's performance	Banker et al. [2000] Brewer and Speh [2000]

4. Hypotheses Testing and Data Analysis

4.1 General Information of Samples

In order to systematically investigate organizational performance, structure equation modeling is employed to analyze data collected from enterprises located in Korea which has introduced ERP for more than 1 year. Prior to conducting the formal survey, a pilot-test was carried out to test content validity of the initial version of survey questionnaire. It was carried out on a sample of 25 people, all of whom were officers in ERP introduced enterprises. The results from the pilot test led to the final version of the survey questionnaire with changes in wording and a few minor changes in the survey items.

A structured formal survey was conducted in order to evaluate the proposed model and to validate the proposed sets of interrelationships associated with enterprise's performance with the implementation of ERP. The survey was conducted with enterprises on a large scale. A total of 900 questionnaires were distributed in various forms of mail, e-mail, online surveys etc. The questionnaires were distributed to enterprises in various kinds of business, including electrical and electronics, machinery and metals, chemical and fiber, distribution and service, food and beverage etc. Finally, 176 questionnaires were collected (a response rate of 19.6%), 12 questionnaires were eliminated due to invalid answers or central tendency, leaving 164 questionnaires for our empirical analysis. <Table 2> presents the general information of respondent samples.

4.2 Analysis of Research Model

Proposed by Anderson and Gerbing (1988), measurement model and structure model are sequentially employed by a two-stage analysis to test hypotheses that are set to evaluate organizational performance of enterprises after introducing ERP. AMOS ver. 5.0 is utilized as a tool to examine the relationships among variables through

〈Table 2〉 General Information of Samples

Divisions		Freq.	Per.(%)	Divisions		Freq.	Per.(%)
Kind of Business	Electrical and electronic	54	32.9	Project Duration	Less than 6 months	20	12.2
	Machinery and metals	38	23.2		6 months~1 year	83	50.6
	Chemical and fiber	28	17.1		1~1.5 year	42	25.6
	Distribution Service	15	9.1		1.5~2 years	11	6.7
	Food, beverage	12	7.3		More than 2 years	8	4.9
	Others	8	4.9	Operation Period	Less than 1 year	0	0.0
Scale	Less than 50	10	6.1		1~2 years	20	12.2
	51~100	24	14.6		2~3 years	29	17.7
	101~500	83	50.6		3~4 years	62	37.8
	501~1000	17	10.4		More than 4 years	53	32.3
	1001~5000	20	12.2	Overall		164	100.0
	More than 5000	10	6.1				

⟨Table 3⟩ Results of Confirmatory Factor Analysis with Each Variable Separately

Divisions	Items	χ^2	d.f.	p	GFI	AGFI	RMR	NFI	CFI
Learning and Growth	5	10.605	5	.031	.974	.904	.030	.983	.990
Internal Process	5	5.561	5	.351	.987	.960	.021	.989	.997
Customer	5	10.589	5	.014	.976	.879	.023	.983	.988
Financial	5	12.328	5	.031	.973	.918	.031	.983	.990

covariance structure model analysis.

Usually, confirmatory factor analysis is conducted with a division of two steps in social science field. In first step, in order to examine uni-dimensionality of individual variable included in proposed model, confirmatory factor analysis of each variable is performed separately, here, feasible goodness of fit index will appear when at least 4 or more measurement items exist in each variable. Following this, a comprehensive confirmatory factor analysis integrating all variables and measurement items is performed. Some researchers carry on confirmatory factor analysis by the first step and then the second step in sequential order, while others optionally use only one step in their study. Aimed at providing a precise analysis of proposed research model, our research sequentially conducted first step which individually employs the four variables of organization performance as research object and second step which put these four variables into research simultaneously.

As suggested in the previous literatures, the model's goodness of fit is assessed by these indices as GFI (the Goodness of Fit Index, at a desirable level of more than 0.90), AGFI (the Adjusted Goodness Fit Index, at a desirable level of more than 0.85), NFI (the Normed Fit Index, at a desirable level of more than 0.90),

CFI (the Comparative Fit Index, at a desirable level of more than 0.90), RMR (Root Mean Square Residual, at a desirable level of less than 0.05), χ^2 (with no special criteria, as small as possible), P-value of χ^2 (at a desirable level of less than 0.05). ⟨Table 3⟩ summarizes the results of confirmatory factor analysis which are individually performed with the four configuration variables of organizational performance. As we can see from the table, all of the four variables of enterprise's performance have attained a suitable figure with more than four measurement items that put off the doubts on problems.

As shown in ⟨Table 3⟩, in order to provide the best configuration of each concept, χ^2, GFI, AGFI, RMR, NFI, and other values are checked to evaluate good of fit index. All good of fit values of configuration concepts have attained satisfactory level. Based on the result of confirmatory factor analysis of each configuration variable, we can conclude that all of the four variables including learning and growth performance, internal process performance, customer performance and financial performance are integrated and put into the second confirmatory factor analysis to evaluate organizational performance in ERP introduced enterprises. Results of the second confirmatory factor analysis are showed in ⟨Table 4⟩ as follows.

<Table 4> Second Confirmatory Factor Analysis of Performance Variables

Divisions	Items	Factor Loading	Standard Error	t-Value	p-Value	Construct Reliability	AVE
Learning and Growth Performance	learn1	.853	–	–	–	0.899	0.757
	learn2	.789	.065	13.947	.000		
	learn3	.825	.075	12.104	.000		
	learn4	.851	.068	13.197	.000		
	learn5	.853	.070	13.766	.000		
Internal Process Performance	proc1	.853	–	–	–	0.881	0.540
	proc2	.723	.082	13.566	.000		
	proc3	.850	.087	10.962	.000		
	proc4	.872	.076	13.669	.000		
	proc5	.812	.072	14.055	.000		
Customer Performance	cust1	.853	–	–	–	0.913	0.582
	cust2	.818	.061	16.233	.000		
	cust3	.727	.071	12.385	.000		
	cust4	.871	.053	13.852	.000		
	cust5	.899	.054	16.951	.000		
Financial Performance	fncl1	.970	–	–	–	0.912	0.679
	fncl2	.946	.050	20.312	.000		
	fncl3	.746	.057	19.180	.000		
	fncl4	.648	.068	11.822	.000		
	fncl5	.867	.071	10.857	.000		
Goodness of Fit Index	χ^2 = 188.338, df = 137, χ^2/df = 1.375, p = 0.002, RMR = 0.078, GFI = 0.908, AGFI = 0.859, NFI = 0.941, CFI = 0.983						

According to the results of confirmatory factor analysis concerning organizational performance of ERP system introduced enterprises, p-value of χ^2 is not satisfied well with the recommended criteria, RMR = 0.078, GFI = 0.908, AGFI = 0.859, NFI = 0.941, CFI = 0.983 and most of these indicator values surpass the recommended criteria for acceptance that have attained satisfactory level. Most especially, the value of χ^2/df (1.375) is within the optimum range of 1 to 2.

All of the standardized factor loadings of configuration concepts have achieved at a statistically significant level of t ≥ 2, p ≤ 0.05 which ensure the convergence validity and discriminant validity among configuration concepts. In addition, based on the results of AVE (average variance extracted) which is calculated to determine whether criteria for each configuration concept represents its research unit, all construct reliability values of research units in our research model are confirmed to be higher than standard value of 0.7 and AVE value is also confirmed to be higher than standard value of 0.5, these facts represent the appropriateness of measurement model in our research [Hair et al., 1998; Bagozzi and Yi, 1988].

Then, Correlation analysis which adopts Pearson's correlation coefficient is performed to investigate discriminant validity of research units

and approximate degree of performances in ERP introduced enterprises, results are shown in <Table 5>. Although correlation analysis of all variables was performed as the antecedent step of hypotheses testing on ERP success factors, in order to measure more specific discriminant validity of the four organizational performance configuration variables, correlation analysis in associated with the four performance variables, namely leaning and growth performance, internal process performance, customer performance and financial performance, is re-performed. Here, discriminant validity can be evaluated by the following three ways : first, the method determines whether square root of the AVE ($\sqrt{AVE}$) is above the value of correlation coefficient between configuration concepts [Fornell and Larcker, 1981]. Second, the method determines whether the same hypotheses on configuration concepts should be dismissed [Anderson and Gerbing, 1988]. Third, after selecting the pairs of theoretically similar concepts, one model is raised where correlation coefficient between the two concepts is fixed at 1 and another free model is built which has free correlation between the two concepts, next to this, χ^2 variance analysis is performed to determine whether significant difference exists between these two

models [Steenkamp and Trijp, 1991].

Among the three methods discussed above, AVE value, the most rigorous analysis method to determine the discriminant validity, is adopted as evaluation method in our research [Chin, 1998]. Results of correlation analysis are shown in <Table 5>, the $\sqrt{AVE}$ of each research unit is larger than the correlation coefficient between other concepts which ensures the discriminant validity.

Moreover, in view of average value of the four organizational performance variables in ERP introduced enterprises, overall, 4 points in a 7-point standard for evaluation has been attained which is above the common level. When looking at organizational performance more specifically, learning and growth performance shows the highest value whereas financial performance show the lowest value among the four organizational performance measurement variables. Judging by these figures, a relatively higher effect in terms of non-financial performance is obtained when compared to financial performance.

4.3 Structure Model Analysis

4.3.1 Goodness of Fit Test on Research Model

Based on the findings presented in previous

<Table 5> Correlation Analysis Results of Performance Configuration Concepts

Configuration Concepts	Average	Standard Error	learn	proc	cust	fncl
learn	4.774	.994	.870			
proc	4.761	.998	.682**	.734		
cust	4.543	.934	.633**	.631**	.763	
fncl	4.187	.932	.503**	.442**	.539**	.824

Note) 1. The diagonal values represent the $\sqrt{AVE}$.
    2. *p < 0.05, **p < 0.01.

analysis of measurement model, goodness of fit is analyzed before conducting covariance structure model analysis concerning relationships among configuration variables of the four organizational performances in ERP introduced enterprises.

Representative goodness of fit index utilized to evaluate the goodness of fit of research model can be roughly divided into three kinds: absolute goodness of fit index which can evaluate the overall goodness of fit of model, incremental goodness of fit index which can compare the proposed model to base model, and parsimonious goodness of fit index concerning parsimoniousness of model etc. Test results of the entire structure model's goodness of fit are shown in <Table 6>.

According to the test result of goodness of fit of our proposed research model, the value of RMR (0.082) doesn't meet the recommended accepting standard very much. The value of χ^2/df (1.252) is located in the range from 1 to 2, other goodness of fit indexes such as GFI = 0.912, RMSEA = 0.039, AGFI = 0.863, NFI = 0.947, CFI = 0.989, PGFI = 0.642, PNFI = 0.673 etc. well satisfy the recommended accepting criteria thus validating an overall convincing research model as well as a generally good fit of structure model [Fornell and Larcker, 1981].

4.3.2 Hypothesized Path Testing by Structure Model Analysis

Based on the assumption that proposed research model is suitable for study, a model analysis concerning casual relationships among the four organizational performances and configuration variables in ERP system introduced enterprises is carried by employing structure equation modeling analysis, results are shown in <Figure 2>. T value is utilized to test statistical significance of path coefficients, coefficient value is higher than 1.965 and p-value is lower than significance level of 0.05 thus dismissing the null hypothesis.

Structure model analysis concerning casual relationships among variables of performance is performed and the result is described as follows: first, in view of hypothesis (H1) which assumes that learning and growth performance is positively associated with internal process performance in ERP introduced enterprises, the effects of learning and growth performance on internal process are statistically significant (standardized path coefficient = 0.725, t = 9.421, p < 0.05), hence, hypothesis 1 (H1) is strongly supported by the results.

Second, in view of hypothesis (H2) which assumes that learning and growth performance is positively related to customer performance in

<Table 6> Research Model's Goodness of Fit Test

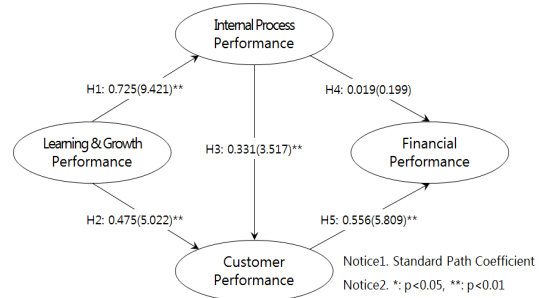| Goodness of Fit Index	Absolute Goodness of Fit Index					Incremental Goodness of Fit Index			Parsimonious Goodness of Fit Index	
	χ^2(p, df)	χ^2/df	GFI	RMR	RMSEA	AGFI	NFI	CFI	PGFI	PNFI
Recommended Acceptance Criteria	–	≤ 3.0	≥ 0.9	≤ 0.08	≤ 0.08	≥ 0.8	≥ 0.9	≥ 0.9	≥ 0.6	≥ 0.6
Analysis Results	169.071 (0.025, 135)	1.252	0.912	0.082	0.039	0.863	0.947	0.989	0.642	0.673

ERP introduced enterprises, our results indicate that learning and growth performance is strongly associated with customer performance (standardized path coefficient = 0.475, t = 5.022, p < 0.05). Thus, hypothesis 2 (H2) is supported.

Third, in view of hypothesis (H3) which assumes that internal process performance is positively associated with customer performance in ERP introduced enterprises, our results also show that internal process performance exerts a substantial effect on customer performance (standardized path coefficient = 0.331, t = 3.517, p < 0.05), thus validating hypothesis 3 (H3).

Forth, the effect of internal process performance on financial performance in ERP introduced enterprises is not significant (standardized path coefficient = 0.019, t = 0.199, p < 0.05), showing that internal process performance do not act as an antecedent of financial performance. Hence, hypothesis 4 (H4) is not supported.

Finally, in view of hypothesis (H5) which assumes that customer performance is positively associated with financial performance in ERP introduced enterprises, our results show that the impact of customer performance is positively related to financial performance (standardized path coefficient = 0.556, t = 5.809, p < 0.05), thereby indicating support for hypothesis 5 (H5).

Hypotheses on casual relationships among the four performance measurement indicators are tested so as to systematically analyze the performances in ERP introduced enterprises. However, in order to compare the strength of mutual relations between configuration variables of the four organizational performances, besides those direct relationships, both indirect

<Figure 2> Path Diagram of the Research Model

effects through intermediate variables and the overall effects should also be taken into consideration in our research. That is to say, focusing on direct relationships between variables may overlook the indirect effects between them and consequently distort their impacts on the final results. Thus, in order to avoid this error, an overall effects investigation which integrates direct effects and indirect effects together is desired. Accordingly, an analysis of all direct, indirect and overall effects among configuration concepts included in our research model is performed and the research results are shown in <Table 7>, degree of influence is displayed by the value of standardized path coefficients.

As shown in <Table 7>, in view of the degree of overall effects that put direct and indirect effects into consideration at the same time, these effects sorted by degree from strong to weak are summarized respectively in sequences as follows : effect of learning and growth performance on customer performance, effect of customer performance on financial performance, effect of learning and growth performance on financial performance, effect of internal process performance on customer performance, effect of internal process performance on financial performance etc.

〈Table 7〉 Overall Effects Analysis of Research Model

Configuration Concepts	Customer Performance			Financial Performance		
	Direct	Indirect	Overall	Direct	Indirect	Overall
Learning and Growth Performance	0.475	0.240	0.715	–	0.411	0.411
Internal Process Performance	0.331	–	0.331	0.019	0.184	0.203
Customer Performance	–	–	–	0.556	–	0.556

Note) The value in the cell is standardized path coefficient.

4.4 Discussions on Hypotheses Testing Results

ERP system is utilized as an innovative technique in enterprises. Rather than target a specific section, but can be applicable to all sectors across the enterprise in the form of integrated information system. Therefore, it's necessary to form a viewpoint on performances in ERP introduced enterprises from an integrated perspective instead of financial, information system or other limited perspectives. Thus, in order to systematically investigate organizational performance, organizational performances are divided into four configuration variables according to BSC, namely : learning and growth performance, internal process performance, customer performance and financial performance,

following that, structure equation modeling is employed to examine casual relationships among indicators by survey data collected from enterprises located in Korea which has introduced ERP for more than 1 year.

Hypotheses on casual relationships among configuration variables are empirically tested and results are shown in 〈Table 8〉.

As shown in 〈Table 8〉, among the five research hypotheses proposed on casual relationships among four indicators which are used to evaluate performances in ERP introduced enterprises, except for the hypothesis on relationship between internal process performance and financial performance, all other ones have been validated to possess positively (+) significant effect relationships. In view of the hypotheses

〈Table 8〉 Results of Hypothesis Testing on Casual Relationships

Hypothesized Paths	Direction	Standard Path Coefficient	Standard Error	t-Value	Support or Not
Growth and Learning Performance → Internal Process Performance	+	0.725	0.077	9.421**	H1(supported)
Growth and Learning Performance → Customer Performance	+	0.475	0.091	5.022**	H2(supported)
Internal Process Performance → Customer Performance	+	0.331	0.090	3.517**	H3(supported)
Internal Process Performance → Financial Performance	+	0.019	0.092	0.199	H4(dismissed)
Customer Performance → Financial Performance	+	0.556	0.095	5.809**	H5(supported)

Note) *p < 0.05, **p < 0.01.

testing results, discussions on relationships among variables are provided individually as follows :

First, learning and growth performance is verified to exert a substantially positive effect on internal process performance. That is to say, business process efficiency and decision-making promptness can be improved by training employees' ability in using information systems, building their informal minds and enhancing their satisfaction. The results are consistent with the findings of previous studies conducted by Kaplan and Norton [2000], Kim et al. [2012] and Kwon and Kwon [2004] etc. In other words, when employees' business capabilities are enhanced, accuracy of business processing and production capacity will be prompted correspondingly, moreover, the better satisfaction with company and business is sustained, the improved degree of internal structure and business innovation can be achieved.

Second, learning and growth performance is positively associated with customer performance. The quality of product is fairly affected by the ability of employees who are responsible for production. Especially, service provided by enterprises is considerably determined by employee's attitudes and behaviors, a reduction in employee's satisfaction with work will result in service quality degradation which can be perceived by customers. That is to say, the most fundamental asset of enterprises is people. Act as the most fundamental assets of enterprises, human resources can positively create high customer satisfaction if their learning capabilities and potentials can be put into full play. This results

are consistent with the findings presented in Sim and Koh [2001], Lee and Huh [2004] and other researches.

Third, the positive effects of internal process performance on customer performance are significant. By introducing ERP in enterprises, business processing accuracy, business automation, decision-making promptness, and other internal process efficiency can be improved, accordingly, higher accuracy of transaction processing, faster customer order processing and response, lower rate of defective products and other performance also can be benefited from, these performances will contribute to improvement in customer satisfaction finally. This result is consistent with the findings of Kaplan and Norton [2000], Lee and Huh [2004] who argue that customer's satisfaction is determined by internal process efficiency.

Forth, our study finds no evidence of a statistically significant relationship between internal process performance and financial performance. This result is somewhat not consistent with the results of previous studies conducted by Kaplan and Norton [2000], Sim and Koh [2001], and Lee and Huh [2004]. According to the results, by introducing ERP to enterprises and improving internal process simultaneously, improvements in efficiency and productivity fail to exert direct effects in financial performance, however, as we can see from <Table 7>, results of analysis which gives comprehensive consideration to overall results instead of considering direct effect or indirect effect separately are presented as follows, although internal process performance is not directly associated with financial

performance, which can indirectly contribute to financial performance through the intermediate medium of customer performance. That is, relating to the better efficiency that results from improvement in corporate internal process, improved customer satisfaction will ultimately contribute to financial performance.

Finally, the impact of customer performance is positively associated with financial performance. This result is in accordance with a variety of previous literatures [Kaplan and Norton, 2000; Reichheld and Schefter, 2000; Devaraj et al., 2002]. In case that customers are satisfied with specific products or service, they will continue to purchase such products or service in the long term, in addition, they may recommend their favorable purchasing experiences for the people around them, corporate financial performance such as sales amount, market share, revenue will benefit from those customers'continued purchase behaviors. Meanwhile, taking advantage of improved customer performance that results from customer satisfaction, decreased customer defection, boosted customer loyalty, established barriers for competitor'-sentry and other additional effects will contribute to improvement in financial performance.

5. Conclusion

5.1 Summary and Implications

In order to measure organizational performance in ERP introduced enterprises, our research employed the four perspectives proposed in BSC by Kaplan and Norton [1992]. These perspectives are widely adopted as an integrated

performance measurement by a variety of companies recently, namely : learning and growth perspective, internal process perspective, customer perspective and financial perspective. According to the research of Kaplan and Norton [2000], they argue that analysis of casual relationships among performance indictors should be further carried systematically when compared to organizational performance itself, hence, hypotheses on casual relationships among the four organizational performance variables are generated and empirically tested.

Hypotheses, proposed in our research, aimed at measuring casual relationships among the four measurement indicators of organizational performances, are tested by covariance structure model. Results are listed in brief as follow:

First, learning and growth performance is empirically verified to be positively related to internal process performance as well as customer performance. Internal process performance is significant factors for improving customer performance. However, we find no evidence of statistically significant relationship between internal process performance and financial performance. Moreover, customer performance also has a positive impact on financial performance.

Second, although internal process performance is not directly associated with financial performance, which can indirectly contribute to financial performance through the intermediate medium of customer performance. That is, relating to the better efficiency that results from improvement in enterprise's internal process, an indirect relationship is built through the inter-

medium of improved customer satisfaction.

Focusing on relationships among the four performance perspectives presented in BSC model, casual relationship analysis is conducted with the target of ERP system introduced enterprises, implications of analysis results are discussed as follows.

First, casual relationships among BSC's four performance indicators proposed by Kaplan and Norton [2000] are empirically tested. BSC's four perspectives are employed by Kaplan and Norton [2000], Fang and Lin [2006] and other similar literatures to measure organizational performance. Although the necessity of casual relationship analysis between performance indicators is highlighted by these studies, there is a lack of empirical study to verify these hypotheses. Our research attempts to empirically test the corporate performances in ERP introduced enterprises based on a casual relationship analysis of BSC's four perspectives.

Moreover, a significant portion of hypotheses developed in previous studies concerning casual relationships among the four perspectives are empirically reconfirmed in our research which could be served as the significant implication of our research.

Second, based on the four performance indicators in BSC, reconstruction are performed so as to fit the situation of ERP, then, casual model are built and empirically tested. Among these studies concerning ERP's success factors and other issues, although some have employed the four perspectives proposed in BSC as performance indicators [Brewer and Speh, 2000; Rosenmann and Wiese, 1999; Fang and Lin, 2006], they haven't taken relationships into account among performance variables in their researches. Performances of ERP implementation should consider the entire organization as a whole. When compared to the measurements measuring performances synthetically or separately, a performance measurement methodology possessing desirable validity is proposed in our research which provides a comprehensive view of correlations among indicators of the structure model.

Third, performance measurement model in ERP introduced enterprises and principal success factor models are considered step-by-step in our study, for the purpose of maximizing organizational performance, a strategic methodology is proposed, that is, by measuring the casual relationships among corporate performance variables, results presented in analysis concerning performance measurement in ERP introduced enterprises, and results presented in analysis of research model concerning affecting variables, are synthesized together, then, corporate performance can be systematically measured. Through the performance measurements mentioned above, it could be able to identify the attributes where management should be focused on so as to improve the relative weak performance after comparing degrees of sections' performances. By these measures, performance of every section in ERP introduced enterprises can be improved averagely.

5.2 Limitations and Future Research

This research empirically examines performances in ERP introduced enterprises with a

concentration of casual relationship among four perspectives. This study is not free from limitations, to overcome these limitations, future researches are proposed as follows.

First, In order to systematically investigate organizational performance, questionnaire survey is conducted to collect data from enterprises which have introduced ERP for more than 1 year, research model is examined based on the survey results. Although it seems reasonable to measure corporate performance just focusing on enterprises which have introduced ERP for more than 1 year, it's hard to reflect changes in research objects as time goes by conducting cross-sectional study being subject to a specific point. Therefore, in order to accurately and reliably measure the degree of performance in ERP introduced enterprises in future, longitudinal research method should be adopted in observing performance before and after the introduction of ERP or on a regular interval of time. Also, in order to increase the level of the generalization of findings, comparative study within the same industry and cross-industrial study should be needed.

Second, by adopting the four performance measurement indicators (learning and growth perspective, internal process perspective, customer perspective, financial perspective) revealed in BSC, organizational performances resulting from ERP implementation can be measured, moreover, casual relationships among these performance variables is also examined. In addition, all survey questionnaire items are derived from measurement items been adopted in related previous literatures. In order to build a strategic performance measurement system so as to effectively achieve corporate strategy and goals, it's necessary to present the deduction process of strategy map configuration which shows relationships among detained items, deduction process of key performance index (KPI) which is derived from performance resulting from ERP and deduction process of measurement items which reflect the characteristics of ERP and enterprises.

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\<Appendix\> Measurement Items of Each Performance Indicator

Performance Indicators	Measurement Items
Learning and Growth Performance	1. The improved level of standardization of business processes 2. The improved level of integration with other systems 3. The improved level of employee's informal mind 4. The improved level of employee's utilization of system 5. The enhanced level of employee's satisfaction
Internal Process Performance	1. The enhanced level of business processing accuracy 2. The decreased level of business volume 3. The improved level of decision-making speed 4. The enhanced level of business automation 5. The increased level of information sharing among internal members
Customer Performance	1. The increased level of transaction processing accuracy 2. The decreased level of order processing time 3. The decreased level of product defectives 4. The decreased level of response time on customer delivery 5. The enhanced level of customer satisfaction
Financial Performance	1. The increased level of revenue 2. The increased level of sales amount 3. The decreased level of total expense 4. The increased level of inventory turnover ratio 5. The increased level of market share

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