“Towards an analytical framework of corporate performance measurement in chemical industry: balanced scorecard perspective”

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ARTICLE INFO	Li-Min Chuang, Chi-Ming Ho, Jung-Jeng Shiu and Hsu-Ping Huang (2011). Towards an analytical framework of corporate performance measurement in chemical industry: balanced scorecard perspective. *Problems and Perspectives in Management*, *9*(3)
RELEASED ON	Tuesday, 29 November 2011
JOURNAL	"Problems and Perspectives in Management"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES **0**

NUMBER OF FIGURES **0**

NUMBER OF TABLES **0**

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Towards an analytical framework of corporate performance measurement in chemical industry: balanced scorecard perspective

Abstract

Taiwan is facing a borderless world in terms of economic competition in this age of globalization marked by rapid changes in both domestic and international environments. Its petrochemical industry needs to map out a strategy to boost its competitiveness so that the industry will maintain continued growth. This paper studies three major groups: senior managers in the petrochemical industry and balanced scorecard experts engaged in the industry's daily operations, employees working in the petrochemical industry; and scholars and experts specialized in the use of balanced scorecard methodology. Following in-depth interviews and a survey with questionnaires and an analysis of the hierarchy process, the study reaches the following conclusions: a perfect system for evaluating business performance must include indicators for evaluating traditional performance as well as indicators for evaluating strategic performance; with regard to the use of balanced scorecards, this paper suggests these three steps. First, set up an evaluation structure for implementing business goals and visions. Second, define strategic goals in order to select suitable antecedent units and to select strategic measurements that can serve as performance indicators in the performance evaluation system. Third, draft an implementation plan which will successfully introduce balanced scorecard to a business organization; with the balanced scorecard, a business organization can translate its business goals and visions into concrete strategies. The balanced scorecard can also be used to gauge if a business organization has achieved its business goals and visions after putting its strategies into effect.

Keywords: balanced scorecard, performance appraisal, financial performance measures, nonfinancial performance measures.
JEL Classification: L21, L25, L65.

Introduction

Research background and rationale. The rapid development of information technology and global trade liberalization has led to increasingly intense competition between enterprises. In Taiwan, traditional industries have evolved from labor-oriented businesses to the current knowledge economy, which is based on economies of scale. For corporate sustainability, many enterprises use methods such as corporate relocation, corporate restructuring, business integration, IT outsourcing, and process re-engineering to respond to the pressures of continuous economic growth, which have affected Taiwan's traditional industries.

With the rise of international free trade, many enterprises are facing challenges, such as improvement of performance, reduction of operating costs, high standards of customer needs, the threat of competitors, improvement of the competitiveness of enterprises, and adaptation to a changing situation to achieve business goals, which deeply test the business intelligence of enterprise managers. Porter (1985) has stated that the competitive strategies of enterprises are the offensive or defensive actions they take to obtain a better position in the industry. To have advantages over competitors, enterprises have developed a variety of management methods, which have ranged from total quality management and management by objective in earlier years to the recent supply chain management, customer relationship management, value chain, and business process re-engineering. Even more recently, enterprises have turned to new, popular management methods, such as enterprise resource planning, knowledge value chain, and Six Sigma. The common goal of all of these methods is to create advantages in a highly competitive environment. Indeed, the competitiveness of an enterprise can be increased through the implementation of a set of strategies. However, a proper set of performance evaluation guidelines, is needed for the implementation of strategies. Currently, having tools to effectively evaluate the operating performance of enterprises is the primary issue for enterprise managers.

Traditional corporations generally use financial aspects to measure business performance, such as ROA, ROI, etc. In the past, individuals in charge of enterprises were only concerned about corporate profits because corporations only cared about the financial side of operations. Indeed, accounting measurements were used to evaluate the performance index of each department, and managers did not care about the effectiveness of strategy implementation. Because so much attention was focused on the financial aspects, nonfinancial performance suffered from poor management, and corporations could not adjust to rapid and drastic environmental changes. This eventually led to corporations losing their competitiveness and closing down. Therefore, strategies to enhance performance should include items related to corporate vision, organizing the intelligence of management teams, and excellent

communication channels between organization members, which would allow members at different levels of the corporation to unite in their approach toward strategic goals. Traditional performance management strategies had several flaws. Thus, in 1992, Professor Kaplan, Harvard University, and Dr. Norton, Nolan Norton Institute, introduced an index to implement financial and nonfinancial performance guidelines into corporate performance evaluation (i.e., the balanced scorecard). The balanced scorecard (BSC) originated from the combined practical experiences of service, manufacturing, and high-tech industries to start the development of new research. BSC initially focused on the nonfinancial performance index, but, after ten years of evolution, it now covers four dimensions (i.e., financial, customer, internal business process, and learning and growth). BSC translates corporate strategies into specific action and connects four dimensions with the organization's missions to create a competitive advantage. In addition, BSC helps corporations focus on strategic issues, integrate all resources to pursue the implementation of effective strategies, and accelerate the realization of corporate vision.

The development of BSC can encourage managers to interpret corporate vision and effectively communicate and integrate the standards of strategic objectives and measurement criteria to achieve corporate missions. The present study focused on Taiwan's chemical industry, which should strengthen its competitive advantage internationally to maintain continued growth. We used the viewpoints of BSC to assess the practitioners who actually implement BSC and experts and scholars who perform significant studies on it. The present study was performed using the corporate performance index for the chemical industry. In addition, the present study analyzed the relevant literature and case studies to further integrate theory and practice.

Purpose of the research. Based on the aforementioned research background and motivation, this study used the viewpoints of BSC to perform an empirical analysis of representative cases. The present study had three main objectives:

1. Discussion of the measurement dimension, content, and index of performance management of the chemical industry using BSC.
2. Exploration of the relative importance of four dimensions in BSC through in-depth interviews, focus groups, and an analytic hierarchy process (AHP).
3. Summarization of the study's conclusions to provide relevant suggestions to the chemical industry, scholars, and future researchers.

1. Literature review

1.1. Performance evaluation. *1.1.1. The concept of performance evaluation.* Performance evaluation is the human resource management activity of an organization that determines the extent to which an employee was performing his/her job effectively. Kaufman (1988) believes that performance evaluation is a measurement method to prove and specify that a planned effort achieved the desired result. Although performance evaluation can be viewed from multiple perspectives, the purpose of performance evaluation is to assist in the achievement of a corporation's strategic mission, objective mission, and vision. With an excellent performance evaluation system, a corporation can achieve its goal of organizational performance and find operating problems within the corporation. Therefore, performance evaluation can improve uniformity of operation among employees and promote consistency of objectives to achieve the goal of a project.

For the performance evaluation system, Simon (2000) first proposed the organizational vision or mission, which would form a strategy that could be performed and determine the organization planning and goals. After establishing an excellent performance evaluation system, action must be taken or the organization vision or mission would be difficult to achieve.

1.1.2. Index of performance evaluation. Most of the traditional indices of performance evaluation were primarily focused on quantitative financial indices based on the cost accounting system; however, many past evidences have indicated that overemphasis on the financial indices could damage the competitiveness of enterprises. Therefore, nonfinancial indices are gradually receiving attention.

Most of early research on the balanced scorecard has focused on the "balance" of the scorecard, investigating how managers use scorecard measures to evaluate performance (Lipe and Salterio, 2000, 2002; Ittner et al., 2003; Banker et al., 2004; Libby et al., 2004; Roberts et al., 2004; Dilla and Steinbart, 2005; Helen, 2006; William, 2010). Recent research indicates that a number of organizations begin to actively utilize BSCs to link their strategy and operations (Bartlett and Goshal, 1996; Kaplan and Norton, 1996b; Hope and Fraser, 1997; Silk, 1998; Atkinson and Brander Brown, 2001). The selection of performance measures is a major aspect of the balanced-scorecard implementation process (Niven, 2002). The goals of the firm to develop performance measurement (PM) systems are not only to evaluate performance, but to help align managerial actions. These systems have extensively relied on financial measures which provide incentives for managers to make decisions that

focus on short-run performance (Butler et al., 1997; Kaplan and Norton, 1996; Laurie and Nancy 2010). BSC should enable managers to engage in activities that are consistent with firm goals, ultimately improving the manager's decision-making process (Lipe and Salterio, 2002) and the firm's long-run performance (KN, 1996, 2008). Bungay and Goold said that non-financial performance measures provide short-term targets on the long-term strategic road (1991).

The indicators in BSC have progressive layers in between and are inner-related to each other, which are able to balance between different segments on the value chain, short-term and long-term profits, objective and subjective measurement factors, financial and non-financial indicators, main and secondary indicators, and between the results and the motivating reasons (Xu, 2008; Li Hui, 2010). Kaplan and Norton proposed an alternative PM system, BSC to help mitigate this short-term focus (1992, 1996). Lipe and Salterio said that evaluator involvement in the implementation process could influence scorecard-related judgments (2000).

In recent years, there have been several breakthrough developments in the accounting field, including the concept of strategic performance evaluation. Enterprises turn corporate visions and missions into strategic objectives and introduce strategic objectives into performance evaluation systems. These evaluation systems provide corporate management with an understanding of the competitive environment and a way to assess the achievement of strategic objectives. Before the strategic performance evaluation was proposed, corporate managers could only obtain evaluation results from traditional performance evaluations, and they did not know the key factors responsible for their operational success or failure. Therefore, to achieve the goals and strategic objectives of the enterprise, corporate management should adjust the performance evaluation to make the evaluation information more valuable.

1.2. Balanced scorecard. BSC is an indicator for promoting future performance, and it overcomes the deficits of past financial performance evaluation indices. It is not only an evaluation tool but also a tool for corporate managers to transmit investment results to organization employees and other related parties to achieve corporate strategies. Indeed, a corporation needs to have strategic direction to acquire competitive advantages. These strategies can easily be achieved when they are integrated with strategic themes, objectives, and an evaluation index of the four dimensions of BSC.

Scorecard initiatives are actionable plans intended to affect performance in targeted objectives, but recently scorecard proponents have shifted emphasis from balance to strategy, arguing that the scorecard serves as a tool for defining strategic objectives and communicating them throughout the organization, identifying initiatives to achieve those objectives, and evaluating whether those objectives have been achieved (Kaplan and Norton, 2000, 2001; Niven, 2002; Buytendijk et al., 2004; Kaplan and Norton, 2004a, 2004b, 2006). A study by Bain and Company indicates that 53 percent of firms worldwide use BSC, including 61 percent of large firms and 49 percent of firms in North America (Rigby and Bilodeau, 2009).

BSC includes four dimensions (i.e., financial, customer, internal business process, and learning and growth), which allow corporate organizations to achieve a balance between short-term and long-term goals, expected results and driving factors of these results, and soft-subjective and hard-objective measurements. The contents of the four dimensions of BSC are described below:

1. **Financial dimension.** Kaplan and Norton (1996) have stated that the financial dimension is the intersection of the goals and measurements of each dimension in BSC. Indeed, each measurement within BSC should be an interlocking causal chain with the main purpose of improving traditional financial performance. BSC retains the financial dimension because the financial index can reflect the past performance of the enterprise, which can be used to determine whether the implementation of corporate strategy can contribute to profits.
2. **Customer dimension.** Customer satisfaction is the main source of profit in business operations. Indeed, a corporation cannot sustain its operations in a competitive environment if it does not know the needs of its customers. Enterprises should use the concept of "customer first" as a basic management guideline, and the operating activities of an organization can use customer loyalty as a key indicator that they are meeting customer needs.
3. **Internal business process dimension.** In the internal business process dimension, management must grasp the major internal process to add value for customers and shareholders. In other words, management should focus on improving and measuring these key processes to assist the business unit, improve the attraction and retention of customers in the target market segment, and meet the shareholder's high expectations of financial reward. Kaplan and Norton (1996) said that the internal business process dimension was mainly designed to achieve the goals at the customer and financial levels; therefore, its focused measurements are customer satisfaction and financial objectives of organization.

Learning and growth dimension. Kaplan and Norton (1996) have pointed out that the three principal sources of organizational growth and learning are people, systems, and organizational procedures. The financial, customer, and internal business process dimensions in the balanced scorecard reflect the actual capacity of people, systems, and organizational procedures to achieve goals. To narrow the gap between these three dimensions and organizational objectives, enterprises should invest more money and time on staff training. In addition, enterprises should use information technology to strengthen the organizational system, retain the core values, and create an excellent corporate culture.

2. Study design

2.1. Research framework. The present study focused on the concepts of the balanced scorecard to establish and verify a performance evaluation system in Taiwan's chemical industry. The research framework is shown in Figure 1.

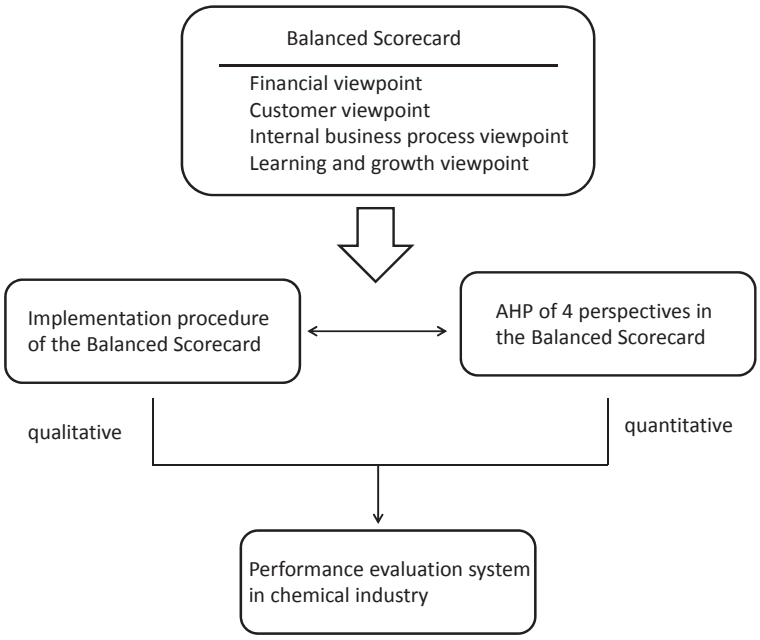

Fig. 1. Research framework

2.2. Research subjects. The present study examined three groups of research subjects:

1. **The first group.** This group included representative chemical industry executives and expert practitioners of BSC. The study was mainly based on in-depth interviews to discuss the difficulties that may be encountered when industries implement BSC and potential solutions to these difficulties. In addition, we hoped to provide suggestions for industries in the establishment of BSC performance evaluation system.
2. **The second group.** This group contained representative members of the enterprises in the chemical industry. This study mainly involved questionnaire-based surveys and used judgment sampling in purposive sampling to select four representative corporations (i.e., Dic Taiwan Ltd., Nitto Denko, Chi Lin Technology, and Chia Lung Chemical Industrial Corp). In addition to the four representative corporations, we also included their business relationships with supply chain partners. In total, there were 200 questionnaires for middle-level managers in accounting, administrative, and financial departments.
3. **The third group.** This group included scholars and experts in the use of BSC and primarily involved AHP expert questionnaire surveys. The surveys were designed to explore the weighted correlation among all dimensions to assist in establishing a corporate performance evaluation system in the chemical industry based on the viewpoints of the BSC.

2.3. Research methods. The research methods in the present study included literature review and collation, personal interviews and the use of case studies, questionnaire surveys, and an analytic hierarchy process (AHP).

2.3.1. Literature review and collation. In addition to collecting literature relevant to the balanced scorecard, this study also analyzed and collated related data using theoretical means, problem solutions, and practical applications. These data were summarized and compared to clarify concepts and select appropriate application methods.

2.3.2. Personal interviews and the use of case studies. The method proposed by Yin (1987) for data and document compilation and interviews was used for the case study collection method:

1. Document and data compilation. The present study initially collected and reviewed relevant published documents (e.g., research reports submitted by experts in books, newspapers, magazines, journals, and internet resources) and all historical documents and files from representative chemical companies (i.e., Dic Taiwan Ltd., Nitto Denko, Chi Lin Technology, and Chia Lung Chemical Industrial Corp). This process provided a preliminary understanding of the subject, which increased the efficiency of the interviews and data analysis.
2. Interviews. The present study also collected data by performing face-to-face interviews with top-level managers in the chemical industry. These interviews supplemented the written documents and provided a better understanding of each company's case, which allowed us to select more appropriate indicators.

2.3.3. Questionnaires. We sent questionnaires to the members of the representative corporations in the chemical industry to obtain data for analysis. The questionnaires were based on relevant literature about BSC, in-depth interviews with top-level managers in representative enterprises in the chemical industry, and experts in the practice of BSC.

The questionnaire was divided into five sections: (1) the financial dimension; (2) the customer dimension; (3) the internal business process dimension; (4) the learning and growth dimension; and (5) basic information about the company. The first four sections of the questionnaire incorporated the 5-point Likert scale (i.e., unimportant, of little importance, moderately important, important, and very important). The fifth section gathered information, such as the name of the respondent's affiliated company, years of company establishment, capital of the company (New Taiwan Dollar), number of employees, and business type. After the implementation of BSC and observations of company improvements, we provided respondents with their answers to the items of the questionnaire.

The operational definition of the four dimensions in the present study was developed according to previous literature relevant to BSC performance, management systems, the actual operational situation, and the purpose of the present study (Kaplan and Norton, 1996).

2.3.4. AHP. In the AHP section of the present study, factor analysis was performed on the four dimensions (i.e., customer, financial, internal business process, and learning and growth) to extract the criteria-referenced assessment of the four dimensions through the discussion of relevant literature and in-depth interviews of the first group.

3. Analysis of questionnaire results

3.1. Questionnaire recovery rate. In the present study, the empirical research of the questionnaire was performed on the more representative chemical industry enterprises (i.e., DIC Taiwan, Nitto Denko, Chi Lin Technology, and Chia Lung Chemical) using paper and internet questionnaires.

A total of 200 questionnaires were issued in this study, and a total of 160 questionnaires were collected. There were 74 paper questionnaires (70 were valid and 4 were invalid) and 86 internet questionnaires (78 were valid and 8 were invalid). The total questionnaire recovery rate was 74.00%, and the invalidity rate was 7.50%.

3.2. Factor analysis. In the present study, principal component factor analysis was performed. Varimax rotation was used to determine the dimension of each questionnaire item and select the factors with an eigenvalue larger than 1. A 0.6 absolute value of factor loading was set as the acceptable level, and the difference between this factor loading and other factor loadings needed to be larger than 0.3 to avoid one variable explaining several factors at the same time. In addition, each factor was given a name based on the factor loading. The present study used the balanced scorecard as the theoretical basis and performed factor analysis according to the four dimensions (i.e., financial, customer, internal business process, and learning and growth dimensions).

3.2.1. Financial dimension. Two factors were extracted, and the detailed data are shown in Table 1. Higher values for each factor were associated with a greater level of importance.

Factor 1: The enterprise profitability (Fina01), which measured the financial success of the enterprise, contained six variables: (1) earnings per share (EPS); (2) return on investment (ROI); (3) return on equity (ROE); (4) return on assets (ROA); (5) revenue growth; and (6) net profit margin (EBIT/Total revenue).

Factor 2: The operating ability of the enterprise (Fina02) contained four variables: (1) fixed assets turnover rate; (2) receivables turnover rate; (3) inventory turnover rate; and (4) operating cash flow ratio.

Table 1. The analysis of financial dimension

Dimension	Factors	Factor loading	Eigenvalue	Cumulative explained variance	Cronbach's α
Financial dimension	Fina01 The enterprise profitability		4.325	0.485	
	Fin01 EPS	0.872			0.872
	Fin07 ROI	0.844			
	Fin03 ROE	0.793			
	Fin02 ROA	0.745			
	Fin04 Revenue growth	0.729			
	Fin09 Net profit margin	0.697			
	Fina02 The operating ability of the enterprise		2.876	0.720	
	Fin05 Fixed assets turnover rate	0.869			0.834
	Fin10 Receivables turnover rate	0.840			
	Fin08 Inventory turnover ratio	0.754			
	Fin06 Operating cash flow ratio	0.735			

3.2.2. Customer dimension. Two factors were extracted, and the detailed data are shown in Table 2. Higher values for each factor were associated with a greater level of importance.

Factor 1: Customer perception (Cust01), which measured the feelings of the customers towards the services provided by the enterprises, contained six variables: (1) customer satisfaction; (2) customer relationship; (3) customer retention rate; (4) customer acquisition rate; (5) customer complaint rate, and (6) customer profitability.

Factor 2: Corporate services (Cust02), which measured the impact of services offered by the enterprise on customer perception, contained four variables: (1) degree of innovation; (2) service quality; (3) image and reputation; and (4) market share rate.

Table 2. The analysis of customer dimension

Dimension	Factors	Factor loading	Eigenvalue	Cumulative explained variance
Customer dimension	Cust01 Customer perception		3.966	0.529
	Cus01 Customer satisfaction	0.864		
	Cus10 Customer relationship	0.842		
	Cus03 Customer retention rate	0.767		
	Cus02 Customer acquisition rate	0.724		
	Cus07 Customer complaint rate	0.699		
	Cus04 Customer profitability	0.640		
	Cust02 Corporate services		2.866	0.683
	Cus09 Degree of innovation	0.795		
	Cus06 Service quality	0.782		
	Cus08 Image and reputation	0.766		
	Cus05 Market share rate	0.732		

3.2.2. Internal business process dimension. Three factors were extracted, and the detailed data are shown in Table 3. Higher values for each factor were associated with a greater level of importance.

Factor 1: Product quality (Proc01), which measured the level of attention that enterprises focused on quality, contained two variables: (1) product defect rate; and (2) product return rate.

Factor 2: New product development (Proc02), which measured the emphasis that enterprises placed on research and development, contained five variables: (1) innovation ability; (2) new product development ability; (3) the number of new products developed; (4) process capability; and (5) productivity.

Factor 3: Product manufacturing (Proc03), which measured the enterprises consistency between progress and production, contained three variables: (1) production plan achievement; (2) duration of production time; and (3) machine failure rate.

Table 3. The analysis of internal business process dimension

Dimension	Factors	Factor loading	Eigenvalue	Cumulative explained variance	Cronbach's α
Internal business process dimension	Proc01 Product quality		1.803	0.307	
	Pro01 Product defect rate	0.833			0.813

Table 3 (cont.). The analysis of internal business process dimension

Dimension	Factors	Factor loading	Eigenvalue	Cumulative explained variance	Cronbach's α
Internal business process dimension	Pro02 Product return rate	0.781			
	Proc02 New product development		3.916	0.614	
	Pro08 Innovation ability	0.891			0.853
	Pro03 New product development ability	0.884			
	Pro05 The number of new products developed	0.836			
	Pro04 Process capability	0.795			
	Pro06 Productivity	0.781			
	Proc03 Product manufacturing		2.043	0.776	
	Pro10 Production plan achievement	0.851			0.831
	Pro07 Duration of production time	0.764			
	Pro09 Machine failure rate	0.736			

3.2.4. Learning and growth dimension. Two factors were extracted, and the detailed data are shown in Table 4. Higher values for each factor were associated with a greater level of importance.

Factor 1: Staff perception (Lear01), which measured how employees perceived the benefits provided by the enterprise, contained five variables: (1) staff education and training; (2) employee empowerment level; (3) employee attendance; (4) employee turnover; and (5) employee loyalty.

Factor 2: Staff job performance (Lear02), which measured the performance evaluation system used by managers to assess employees, contained five variables: (1) number of proposals from staff; (2) staff work time; (3) average staff productivity; (4) staff performance evaluation; and (5) team performance.

Table 4. The analysis of learning and growth dimension

Dimension	Factors	Factor loading	Eigenvalue	Cumulative explained variance	Cronbach's α
Learning and growth dimension	Lear01 Staff perception		3.045	0.469	
	Lea04 Staff education and training	0.785			0.836
	Lea07 Employee empowerment level	0.745			
	Lea02 Employee attendance	0.731			
	Lea01 Employee turnover	0.722			
	Lea03 Employee Loyalty	0.719			
	Lear02 Staff job performance		3.075	0.612	
	Lea08 Number of proposals from staff	0.832			0.926
	Lea09 Staff work time	0.785			
	Lea06 Average staff productivity	0.734			
	Lea05 Staff performance evaluation	0.723			
	Lea10 Team performance	0.711			

3.3. Analytic hierarchy process (AHP). In the present study, we calculated the geometric mean of the scores on the questionnaires answered by experts to construct a pair-wise comparison matrix at all levels. We then evaluated the relative weights of the four dimensions (i.e., financial, customer, internal business process, learning and growth) in BSC through relevant computing operations using the AHP software. In addition, after discussing prior literature and the information obtained from in-depth interviews the first group of the study, the elements of the financial, customer, internal business process, and learning and growth dimensions were extracted to use as items for evaluation through factor analysis.

The "measurement dimension" of the first level in AHP was based on the theory of BSC proposed by Kaplan and Norton, which included the financial dimension, customer dimension, internal business processes dimension, and learning and growth dimension. The "evaluation item" of the second level was obtained through the factor analysis of the first stage, which included nine items. Therefore, the AHP framework of this study was constructed using two levels and nine evaluation items.

The AHP expert questionnaire in the present study was based on the viewpoint of BSC, and ten expert questionnaires were issued to investigate the relative weights of the financial, customer, internal business process, and learning and growth dimensions in a performance evaluation system of the chemical industry. The AHP Expert Choice 2000 decision support software was used to calculate the weights of measurement dimensions and evaluation items in the AHP expert questionnaires. In addition,

this software tested the accuracy of the questionnaire measurements and determined that the results were consistent.

3.3.1. Screening of valid questionnaires. The consistency was calculated using the AHP software, and we used the consistency ratio (*C.R.* = *CI*/*RI*) proposed by Saaty (1980). The ratio of *CI* to *RI* for the same-order matrix is call *R.C.*, which defines the accuracy of the pairwise comparisons. The consistency was considered to be acceptable when $C.R. \leq 0.1$. In the present study, the *C.R.* value was < 0.1, which indicates that the consistency was acceptable.

3.3.2. Results of weights. The expert's responses to the questionnaires provided opinions on the relative importance of all elements in the first-level "measurement dimensions" and the second-level "evaluation items". The weights of the pairwise comparison matrix are summarized in Figure 2.

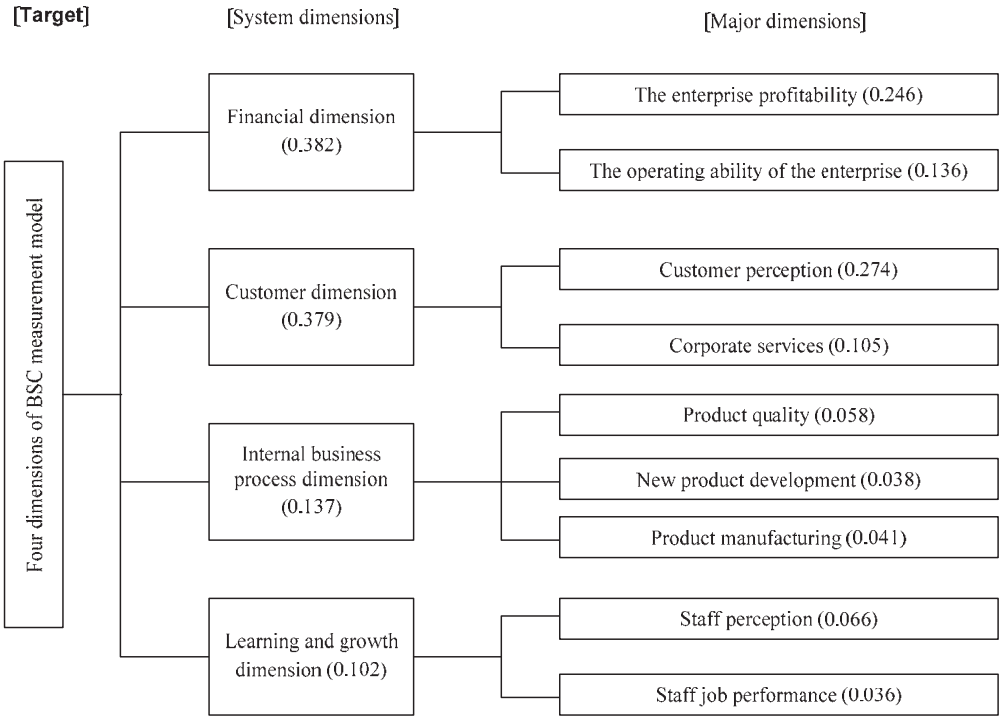

Fig. 2. Hierarchical structure and dimensions being studied

3.3.3. Results and discussion. The most important evaluation criterion in the first-level evaluation indicators was "financial dimension", which had a weight of 0.382. This indicator was important because the chemical industry requires new plants for production work. In the second-level evaluation index, the weight of "enterprise profitability" was 0.246, and the weight of "operating ability of enterprise" was 0.136. Therefore, we know managers of chemical industry pay more attention to the profit level than the management level. These findings also indicate that managers wish that they can obtain higher returns after investment of large resources, including manpower, money, equipment, and technology. Indeed, profit-seeking enterprises pay the most attention to whether the organization can profit, and the amount of profit, during operation.

In the first-level evaluation index, the second most emphasized evaluation criterion was "customer dimension", which had a weight of 0.379. Interestingly, the difference between the financial dimension and the customer dimension was less than 0.004, which indicates that in addition to pursuing maximal profits, chemical industries were still concerned with the perception of the customer. This type of company in Taiwan has transformed from an original equipment manufacturer (OEM) to a customer-oriented original design manufacturer (ODM), which highlights that today's enterprise mangers must pay attention to the changes in the whole market environment and use a customization approach to operate the market.

In the second-level evaluation index, the weight of "customer perception" was 0.274, and the weight of "corporate services" was 0.105. These results suggest that managers in the chemical industry demand commitment to the improvement of products and services to meet customer needs and enhance customer satisfaction. Therefore, enterprises must use high standards to evaluate the products and services that they provide. In addition, enterprises must focus their attention on the customers who significantly contribute to their profits.

In the first-level evaluation index, the "internal business process dimension" had a weight of 0.137.

Because corporations in the chemical industry have professional management teams, research and development teams, perfect product development models, and strict quality control. That is, when establishing the management team, the enterprise has invested considerable resources and spirits, so this dimension, compared to other dimensions, is more stable and more controllable. Hence, the enterprise is more comfortable in the normal management process, and more attention is put on the management of finance and customers. However, it does not mean the enterprise puts less emphasis on the management team.

In the second-level evaluation index, the weights of "product quality", "new product development", and "product manufacturing" were 0.058, 0.038, and 0.041, respectively. The whole operational system of the enterprise transforms from the traditional hierarchical structure into a learning organizational structure and ultimately into a flat structure, which increases product quality, reduces production cost, and shortens delivery time. Therefore, the existence of an information system for an integrated process approach is a critical element for new product development and manufacturing.

In the first-level evaluation index, the least emphasized evaluation criterion was the "learning and growth dimension", which had a weight of 0.102. The learning and growth dimension included people, information systems, and organizational procedures. If corporate managers want to shorten the mismatch between these three elements and corporate objectives, they must invest more money and time on staff education and training. In addition, they must use information technology to strengthen the organizational system, preserve core values, and create an excellent corporate culture.

In the second-level evaluation index, the weight of "staff perception" was 0.066 and the weight of "staff job performance" was 0.036. The internal activities of enterprise organization that are related to staff, such as training, education, and benefits, all belong to support activities. Therefore, in addition to pursuing profit maximization and a high market share, managers in the chemical industry also have significant concerns about enhancing staff capabilities. It is not enough, however, to focus on staff perception. People, information systems, and organizational activities must be integrated to facilitate the pursuit of maximal benefit for the enterprise.

3.3.4. Strategy map. Kaplan and Norton (2001) have stated that a strategy map acts as a common framework to describe strategies that can assist enterprises in fully presenting the outcomes they want and driving the performance of those outcomes in a series of logical, causal steps. Therefore, a strategy map is the best tool for business leaders to present and manage strategies. In the present study, the derivation graph of the strategy map compiled from the weights obtained from AHP is shown in Figure 3.

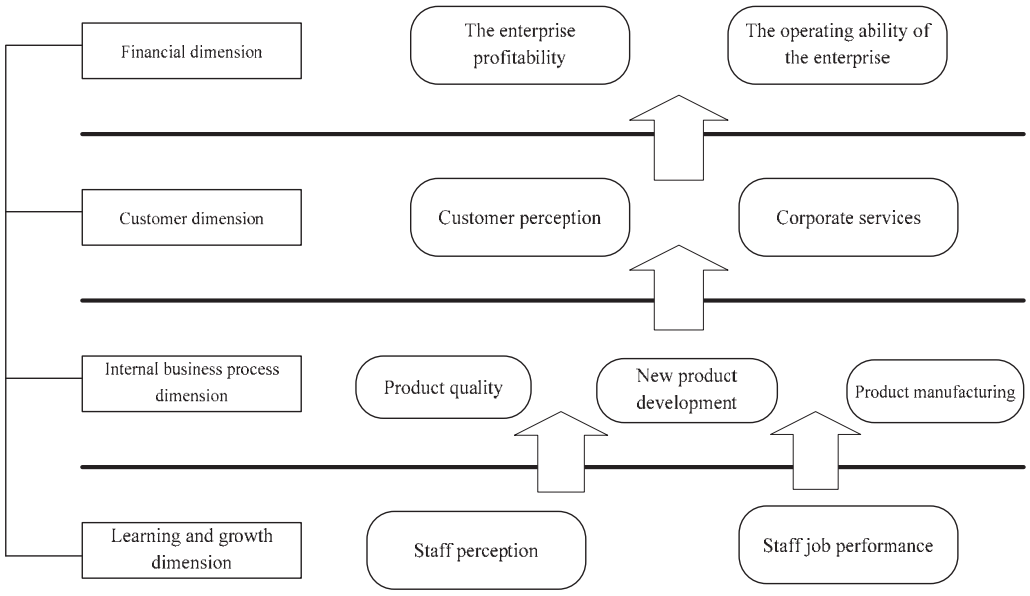

Fig. 3. The derivation of the strategy map

The derivation of the strategy map in the present study is based on BSC proposed by Kaplan and Norton. The relationship between all measurement dimensions and evaluation items can be seen in Figure 3. In the learning and growth dimension, the staff perception and job performance can affect the internal business process dimension; therefore, these variables can be reflected in the product level (e.g., product quality, new product development, and product manufacturing). The procurement of raw materials, production

scheduling, assembly of semi-finished products, product manufacturing, logistics distribution, after-sales service, and other activities of companies in the chemical industry was reflected in the customer dimension, which indicates whether the services provided by enterprises have positive impacts on customer perception and business operations influenced by customer perception. After a series of processes, the final corporate operating performance was reflected in the financial dimension. Corporate managers can evaluate operating performance, goal achievement rates, and cost control through performance evaluation indices. Moreover, performance evaluation indices can reflect the earning power and operating ability of enterprises in the chemical industry.

Conclusions and recommendations

Conclusions. This present study used the viewpoints of BSC to study two main subjects: practitioners who actually implement the balanced scorecard and experts and scholars who have researched the balanced scorecard in studies of performance evaluation indices of enterprises in the chemical industry. In addition, we used relevant literature discussion and case studies to integrate theory and practice.

The present study used BSC as the theoretical basis, and factor analysis, reliability and validity analysis, in-depth interviews, and AHP were used to measure the relative degrees of importance of the four dimensions of BSC. The empirical results of this study were used to describe the strategy map, and the causal relationships between the elements of the four dimensions of BSC were linked through the strategy map. Strategy maps provide corporate managers with a plan to concentrate their resources and obtain efficient teamwork from every unit in the organization, which allows the organizational objectives and vision to be transformed into practical actions and implanted into each member of the organization. The results of the present study are summarized below.

After the questionnaires were collected for this study, the factor analysis was performed to extract key elements.

The following list shows the variables associated with each factor:

1. Financial dimension: enterprise profitability and operating ability of the enterprise.
2. Customer dimension: customer perception and corporate services.
3. Internal business process dimension: product quality, new product development, and product manufacturing.

Learning and growth dimension: staff perception and staff job performance.

After AHP expert questionnaires were collected, we analyzed the relative weights and described the strategic map:

1. In the learning and growth dimension, the staff perception and job performance of the chemical industry enterprises affects the level of internal business processes.
2. In the internal business process dimension, the product quality has the most impact, followed by product manufacturing, and the development of new product has the least impact. The quality of product will be reflected in the level of customer satisfaction.
3. In the customer dimension, real-time response to market demand starts to become the focus of corporate operation because the market orientation is completely driven by consumers.

In the financial dimension, the contribution of strategic implementation to company profit can also be determined because the financial dimension can reflect past performances of the enterprises. Therefore, managers can clearly understand the status of corporate operations through the data presented by a performance evaluation index.

After comprehensive analysis of these three results, we arrived at the following conclusions:

1. The evaluation index of a perfect corporate performance evaluation system should include a traditional performance evaluation index and a strategic performance evaluation index.
2. Through the use of BSC, enterprises can transform corporate objectives and visions into practical strategies and determine whether the corporate objectives and visions can be achieved after strategic implementation.

Recommendations for enterprises. The present study used in-depth interviews to empirically analyze the goals of the study and provide recommendations for enterprises in the chemical industry.

1. Before the implementation of the balanced scorecard, a rigorous and careful analysis of the feasibility should be performed, and a research proposal should be prepared to provide criteria for the implementation of the plan by the executive team. Therefore, the research proposal should clarify the corporate objectives, visions, and strategies.
2. When implementing a new information system in an organization, there will be some resistance and obstacles. Therefore, corporate managers must have the ability to thoroughly understand the performance evaluation system. In addition,

they must affirm and support the implementation of the new performance evaluation system and oversee that the system increases efficiency.

Recommendation for future researchers. Although many documents were collected for the present study and we have a certain degree of understanding of the current status of the chemical industry development within the whole market environment, some questions were not discussed in depth because of limitations in cost, time, and data acquisition. In addition, future studies should focus on the following recommendations.

1. The sample size of interviews can be expanded to make the data more comprehensive.
2. Although we focused on the chemical industry, future studies could examine the key elements and factors in the establishment of performance evaluations systems in other industries.

References

1. Atkinson, A.A., R. Balakrishnan, P. Booth, J.M. Cote, T. Groot, T. Malmi, H. Roberts, E. Uliana, and A. Wu (2001). New directions in management accounting research, *Journal of Management Accounting Research*, 9, pp. 79-108.
2. Banker, R.D., H. Chang, and M.J. Pizzini (2004). The balanced scorecard: Judgmental effects of performance measures linked to strategy, *The Accounting Review*, 79 (1), pp. 1-23.
3. ____, G. Potter, and D. Srinivasan, (2000). An empirical investigation of an incentive plan that includes nonfinancial performance measures, *The Accounting Review*, 75 (1), pp. 65-92.
4. Bartlett, C.A. and Goshal, S. (1996). "Release the entrepreneurial hostages from your corporate hierarchy", *Strategy & Leadership*, Vol. 24, No. 4, pp. 36-42.
5. Bungay, S. and Goold, M. (1991). "Creating strategic control systems", *Long Range Planning*, Vol. 24, No. 3, pp. 32-39.
6. Butler, A., S. Letza, and B. Neale. (1997). "Linking the Balanced Scorecard to Strategy", *Long Range Planning*, 3, pp. 242-253.
7. Buytendijk, F., B. Wood, and L. Geishecker (2004). Drivers and challenges of corporate performance measurement, No. R-22-0730, Stamford, CT: Gartner, Inc.
8. Carmen A. and Javier A. (2010). Consensus and Link Structure in Strategic Performance Measurement Systems: A Field Study, *Journal of Management Accounting Research*, Vol. 22, pp. 271-299.
9. Dilla, W.N., and P.J. Steinbart (2005). Relative weighting of common and unique balanced scorecard measures by knowledgeable decision makers, *Behavioral Research in Accounting*, 17, pp. 43-53.
10. Helen Atkinson (2006). Strategy implementation: a role for the balanced scorecard? *Management Decision*, Vol. 44, Issue 10, London, p. 1441.
11. Hope J. & Hope T. (1997). Competing in the Third Wave: The Ten Key Management Issue of the Information Age, New York: Harvard Business School.
12. Hope, J. and Fraser, R. (1997). "Beyond budgeting ... breaking through the barrier to the third wave", *Management Accounting*, September, pp. 20-33.
13. Ittner, C.D., R.A. Lamber, and M.W. Meyer (2003). Subjectivity and the weighting of performance measures: Evidence from a balanced scorecard, *The Accounting Review*, 78 (3), pp. 725-758.
14. Kaplan, R.S., and D.P. Norton (1992). The balanced scorecard measures that drive performance, *Harvard Business Review*, 70 (1), pp. 71-79.
15. ____ (1996b). Using the balanced scorecard as a strategic management system, *Harvard Business Review*, 74 (1), pp. 75-85.
16. ____ (2000). Having trouble with your strategy? Then map it, *Harvard Business Review*, 78 (5), pp. 167-176.
17. ____ (2001). The Strategy-Focused Organization: How Balanced Scorecard Companies Thrive in the New Business Environment, Boston, MA: Harvard Business School Press.
18. ____ (2004a). Measuring the strategic readiness of intangible assets, *Harvard Business Review*, 82 (2), pp. 52-63.
19. ____ (2004b). Strategy Maps: Converting Intangible Assets into Tangible Outcomes, Boston, MA: Harvard Business School Press.
20. ____ (2006). How to Implement a New Strategy Without Disrupting Your Organization, Boston, MA: Harvard Business Review.
21. _____ (1996a). The Balanced Scorecard: Translating Strategy into Action, Boston, MA: Harvard Business School Press.
22. Kaufman, R. (1988). Preparing Useful Performance Indicators, *Training & Development*, p. 80.
23. Laurie L.B., and Nancy J.S., (2010). The Relationship Between Balanced Scorecard Characteristics and Managers' Job Satisfaction, *Journal of Managerial Issues*, Vol. 22, pp. 166-181.
24. Li Hui (2010). Building up a Performance Indicator System of International Projects, Based on the Balanced Scorecard, *Management Science and Engineering*, Vol. 4, Issue 2, p. 82, 10.
25. Libby, R., R. Bloomfield, and M.W. Nelson (2002). Experimental research in financial accounting, *Accounting, Organizations and Society*, 27 (8), pp. 777-812.
26. Libby, T., S.E. Salterio, and A. Webb (2004). The balanced scorecard: The effects of assurance and process accountability on managerial judgment, *The Accounting Review*, 79 (4), pp. 1075-1094.

27. ____ (2002). A note on the judgmental effects of the balanced scorecard's information organization, *Accounting, Organizations and Society*, 27 (6), pp. 531-540.
28. Lipe, M.G., and S.E. Salterio (2000). The balanced scorecard: Judgmental effects of common and unique performance measures, *The Accounting Review*, 75 (3), pp. 283-298.
29. Niven, P.R. (2002). Balanced Scorecard Step by Step: Maximizing Performance and Maintaining Results, New York, NY: Wiley.
30. Porter, M.E., (1985). Competitive advantage: creating and sustaining superior performance, New York: Free Press.
31. Rigby, D., and B. Bilodeau (2009). Management Tools and Trends, Boston, MA: Bain & Company.
32. Roberts, M.L., T.L. Albright, and A.R. Hibbets (2004). Debiasing balanced scorecard evaluations, *Behavioral Research in Accounting*, 16, pp. 75-88.
33. Saaty, T. L. (1980). The Analytic Hierarchy Process, McGraw Hill: New York.
34. Silk, S. (1998). "Automating the balanced scorecard", *Management Accounting*, Vol. 79, No. 11, pp. 38-42.
35. Simon, R. (2000). Performance Measurement & Control Systems for Implementing Strategy, Prentice Hall.
36. William, B. Tayler (2010). The Balanced Scorecard as a Strategy-Evaluation Tool: The Effects of Implementation Involvement and a Causal-Chain Focus, *The Accounting Review*, pp. 1095-1117.
37. Xu, Bing (2008). Analysis on Construction Enterprises Project Management Performance Evaluation, Based on Balanced Scorecard Construction Economics, Vol. 12, pp. 29-32.
38. Yin, R.K. (1987). Case Study Research: Design and Methods, Sage Publication.