Expert Systems with Applications 38 (2011) 4875–4881

Contents lists available at ScienceDirect

Expert Systems with Applications

journal homepage: www.elsevier.com/locate/eswa

Developing strategic measurement and improvement for the biopharmaceutical firm: Using the BSC hierarchy

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ARTICLE INFO

Keywords:
Balanced scorecard
Performance management
Analytic hierarchy process

ABSTRACT

The balanced scorecard (BSC) provides an enterprise view of an organization's overall performance. It integrates financial measures with other key performance indicators around customer perspectives, internal business processes, and organizational growth, learning, and innovation. The strategy planning is a virtual necessity for business activities, and this paper presents the use of the analytic hierarchy process (AHP) to prioritize all of the measures and strategies in a BSC framework. This study has found related strategies and objectives from four perspectives of balanced scorecard. This case illustrates selection or design of the most appropriate and helpful measures of the BSC in the pharmaceutical firm in an emerging market.

1. Introduction

In the current phase of globalization and market liberalization, competitions among biopharmaceutical firms are growing. When facing threats from global pharmaceutical companies, the local pharmaceutical firms should find out the niche market in order to gain more market share. Accordingly, pharmaceutical firms have been developing their strategic measurements to improve their organizational performance and competitive advantage. Also, the efficient indices can be used to evaluate the impact of improves performance on pharmaceutical firms. A measure of efficiency proves a good indicator of the success or otherwise of a pharmaceutical firm in a competitive market. So far, the pharmaceutical firm must have a clearer vision about the strategies that fit its owner optimal management policies, and puts such strategies into effect through vision-oriented projects. This paper uses the AHP model to analyze strategic performance of a pharmaceutical firm in Taiwan, and proposes the use of the analytic hierarchy process to prioritize all of the measures and strategies in a BSC framework. This study has found the related strategies and objectives from four perspectives of balanced scorecard. Consequently, this case illustrates selection or design of the most appropriate and helpful measures of the BSC in the pharmaceutical firm in an emerging market.

The balanced scorecard developed by Kaplan and Norton (1992) suggests a sequence of perspectives that reflects the value-creating activities of the company. The sequence begins with the learning and growth perspective, followed by internal/business process, customer, and financial perspectives. Core outcome measures (performance measures) within each perspective are assumed to be leading indicators of core outcome measures in the next perspective. Within each of the four perspectives of the balanced scorecard, performance drivers (performance measures) exist that are presumed to be leading indicators of core outcome measures (Kaplan & Norton, 1993, 1996a, 1996b, 1996c, 2001a, 2001b, 2001c, 2001d, 2004a, 2004b, 2004c). Since its introduction in the early 1990s, the balanced scorecard has evolved from a performance measurement tool to a strategic management tool. The BSC methodology creates an infrastructure for strategic management activities by introducing four new management processes that, separately and in combination, contribute to linking long-term strategic objectives with short-term actions (Kaplan & Norton, 1996a). By combining the financial, customer, internal process, and learning/growth perspectives, the balanced scorecard helps managers to understand many interrelationships and causal effects. This understanding can help managers to break free from traditional notions about functional barriers and ultimately lead to improved decision making and problem solving.

In recent years, many studies regarding BSC have been published, and several practical implementations have been reported in journals. Following one another, firms now employ new performance measurement systems to track non-financial metrics and related researches by authors such as Barad and Dror (2008), Fernandes, Raja, and Whalley (2006), Banker, Chang, and Pizzini (2004), Said, HassabElnaby, and Wier (2003), Frigo (2002), Banker,

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0957-4174/$ - see front matter © 2010 Published by Elsevier Ltd.
doi:10.1016/j.eswa.2010.09.069

Potter, and Srinivasan (2000), and Andrews (1996). The current balanced scorecard strategic management literature suggests that there should be a strong linkage between strategic plans and performance measures (Kloot & Martin, 2000), and this is confirmed in studies by Kaplan and Norton (1992), Michael (2003), Lipe and Salterio (2002), Nørreklit (2000), and Evert (1998). However, when analyzing these issues and studies, developing strategic criteria and measurement is important for balanced scorecard hierarchy. Measurement and strategic criteria are fundamental and essential to the BSC hierarchy. A key topic is selection or design of the most appropriate and helpful measures for performance improvement. The purpose of this paper is sought to answer the following research questions: What should be the objectives and measures on the learning/growth, internal/business process, customer, and financial perspectives? How can management select or choose the objectives and measures with the balanced scorecard hierarchy? To answer these questions, this paper employs the analytic hierarchy process (AHP) and addresses two critically important topics: setting up objectives in BSC and choosing the measures for those objectives.

The rest of this paper is organized as follows. Section 2 presents a brief review of the BSC theorem and related research. Section 3 describes the analytic hierarchy process (AHP) theorem. Section 4 presents the results of empirical analysis, including decision hierarchy analysis, relative weights analysis, consistency value analysis, and strategic map analysis, followed by a discussion of the management strategies and a construction of a pharmaceutical firm's strategy map. Finally, some concluding remarks and a summary are given in Section 5.

2. Balanced scorecard

2.1. Balanced scorecard (BSC) perspective

First devised by Kaplan and Norton in 1992, the balanced scorecard approach consists of four perspectives: learning and growth perspective, internal process perspective, customer perspective, and financial perspective (Kaplan & Norton, 1993, 1996a, 1996b, 1996c, 2001a, 2001b, 2001c, 2001d, 2004a, 2004b, 2004c, 2004d, 2006). BSC is a strategic approach and performance management system which organizations can use for vision and strategy implementation. The BSC model contains four new management processes that, separately or together, help to link long-term strategic objectives with short-term actions (Kaplan & Norton, 1996a). Numerous companies and industries have adopted BSC, which meets several management needs. The BSC model is more than a collection of financial and non-financial measurements, and represents a translation of business unit strategy into a linked set of measures that define both long-term strategic objectives and the mechanisms for achieving/obtaining feedbacks regarding those objectives (Kaplan & Norton, 1996a). Furthermore, Kaplan and Norton (2004a) created a powerful new tool, *strategy map*, which companies can use to describe the links between intangible assets and value creation with an unprecedented degree of clarity and precision. Strategy map can be used to link processes with desired outcomes; to evaluate, measure, and improve the processes most critical to success, and to target investments in human, informational, and organizational capital (Kaplan & Norton, 2004a, 2004b).

The BSC model identifies four related perspectives on activities that are likely to be critical to most organizations and to all levels within organizations: (a) investing in learning and growth capabilities, (b) improving internal process efficiencies, (c) providing customer value, and (d) increasing financial success (Kaplan & Norton, 1992, 1993, 1996a, 1996b, 1996c, 2001a, 2004b).

a. The learning and growth perspective.
   Kaplan and Norton (1992) based their BSC model on activities that develop the learning and growth perspective. This perspective captures the ability of employees, information systems, and organizational alignment to manage a business and adapt to change. Process success depends on skilled and motivated employees, as well as accurate and timely information.
b. The internal process perspective.
   A causal model of BSC assumes that employee capabilities drive internal process improvement. Kaplan and Norton divided firm generic value chain activities into four high level process areas: (1) innovation; (2) customer management; (3) operations; and (4) regulations and environment. Each of these areas can include both major processes and sub-processes. The organizational pie thus can be sliced in various ways (Beiman & Sun, 2003).
c. The customer perspective.
   The customer perspective also identifies the outcomes associated with delivering differentiated value propositions. These outcomes include market share in specific customer segments, account sharing with targeted customers, acquisition and retention of customers in targeted segments, and customer profitability. Some studies have identified a significant relationship between customer satisfaction and performance, including Banker et al. (2000), Heskett, Jones, Sasser, and Schlesinger (1994), and Ittner and Larcker (1998).
d. The financial perspective.
   Financial performance measures indicate whether firm strategy, implementation, and execution contribute to bottom-line improvement. The financial perspective includes three measures important to shareholders. Return-on-capital and cash flow reflect short term preference, while forecast reliability indicates the desire of the corporate parent to reduce historical uncertainty associated with unexpected performance variation. Finally, project profitability focuses on the project as the basic unit for planning and control, while sales backlog helps reduce performance uncertainty (Kaplan & Norton, 1993).

2.2. AHP and BSC

Owing to its ability to assist organizations or firms in selecting among alternative missions/visions, selecting among alternative strategies, and allocating resources to implement organizational strategies and objectives, AHP has been successfully applied in numerous BSC studies, including Huang (2009), Kim and Kim (2009), Varma, Wadhwa, and Deshmukh (2008), Chan (2006), Leung, Lam, and Cao (2006), Fletcher and Smith (2004), Reisinger, Cravens, and Tell (2003), Stewart and Mohammed (2001), and Liberatore and Miller (1998). Within the above studies, Huang (2009) proposed an integrated approach for the balanced scorecard tool and knowledge-based system using the analytic hierarchy process (AHP) method, and then develops an intellectual BSC knowledge-based system for strategic planning that sets or selects firm management or operational strategies based on the following perspectives: learning and growth, internal/business process, customer, and financial performance. Kim and Kim (2009) suggested that analytic hierarchy process (AHP) prioritizes the evaluation factors on the CRM scorecard. The CRM scorecard contains antecedent/subsequent and objective/perceptual evaluation factors in four different perspectives to comprehensively measure corporate CRM capability and readiness. Another example of AHP applications in BSC studies is a study by Varma et al. (2008), which used a combination of analytical hierarchy process (AHP) and balanced scorecard (BSC) for evaluating performance of the petroleum

supply chain. The choice of factors determining supply chain performance under the four perspectives of BSC has been validated using opinion from subject matter experts (SMEs).

3. Data and methodology

3.1. Data

The method for carrying out this study is by survey, which included questions and statements to which the participants are expected to respond anonymously. Since AHP requires inputs from experts, data in this study are collected from managers in pharmaceutical firms in Taiwan. The responses were gathered from a sample of 50 interviewers including top managers and professors with at least 10 year work experiences in pharmaceutical fields. The resulting sample is diverse in terms of demographic characteristics: 60% of interviewers are male and 40% are female, and most respondents have a university education. A total of 50 persons ranged in age from 35 to 45 with a mean of 40. The data is gathered in the year of 2009, over roughly 3 months.

3.2. Analysis model

To address this issue, analytic hierarchy process (AHP) is conducted. Designed to reflect the way people actually think, the development of analytic hierarchy process (AHP) could be backtracked to as early as 1970s, in response to the scarce resources allocation and planning needs for the military (Saaty, 1994, 1980). The analytic hierarchy process (AHP) is a powerful and flexible decision making process which helps people to set priorities and make the best decision when both qualitative and quantitative aspects of a decision need to be considered. By reducing complex decisions to a series of one-on-one comparisons and synthesizing the results, AHP not only helps decision makers to arrive at the best decision, but also provides a clear rationale validating the choice.

The AHP is a hierarchical representation of a system. The AHP engages decision makers in structuring a decision into smaller parts, proceeding from the goal to objectives to sub-objectives down to the alternative courses of action. Decision makers then make simple pair-wise comparison judgments throughout the hierarchy to arrive at overall priorities for the alternatives. The decision problem may involve social, political, technical, and economic factors. The AHP helps people to cope with the intuitive, the rational and the irrational, and with risk and uncertainty in complex settings. It can be used to: predict likely outcomes, plan projected and desired futures, facilitate group decision making, exercise control over changes in the decision making system, allocate resources, select alternatives, do cost/benefit comparisons, evaluate employees and allocate wage increases. The analytic hierarchy process (AHP) is a comprehensive, logical and structural framework, which allows one to gain the understanding of complex decisions by decomposing the problem in a hierarchical structure. The incorporation of all relevant decision criteria, and their pair-wise comparison allows the decision maker to determine the trade-offs among objectives. Moreover, the application of the AHP approach explicitly recognizes and incorporates the knowledge and expertise of the participants in the priority setting process, by making use of their subjective judgments, a particularly important feature for decisions to be made on a poor information base. Also, AHP integrates objectively measured information (e.g., yields) where this information is available.

The AHP is based on three principles:

(1) decomposition of the decision problem,
(2) comparative judgment of the elements, and
(3) synthesis of the priorities.

AHP is a hierarchical representation of a system. For illustrating the functions of AHP, a step-by-step description of the method is used in this paper as follows as shown in Fig. 2.

Step1. Decision problem: weighting the selection criteria.
Step2. Framework for personnel selection.
Step3. Setting up the decision hierarchy.
The step is to structure the decision problem in a hierarchy as depicted in Fig. 1.
Step4. Data collection from the selection panel.
Step5. Employing the pair-wise comparisons.
This step is the comparison of the alternatives and the criteria. They are compared in pairs with respect to each element of the next higher level. For this relative comparison, the fundamental scale of Table 1 can be used. It allows expressing the comparisons in verbal terms which are then translated in the corresponding numbers.
Step6. Estimating relative weights of elements on each level in the hierarchy.
Step7. Calculating the degree of consistency (CI) in order to validate the results.
If the pair-wise comparison matrix is consistent, then the maximum eigenvalue (λ) should be equal to its number of order (n). The difference value between these two values can be used to judge the degree of consistency. In order references, the calculation of the consistency ratio is also used to judge the degree of consistency. For simplicity, the CI is used in this system:

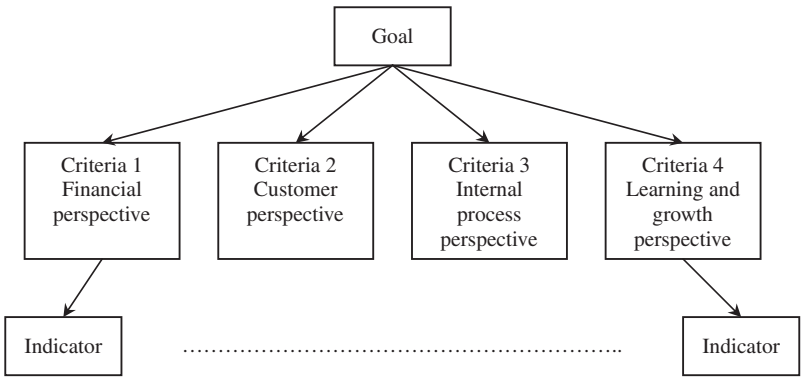

Fig. 1. The basic structure of the hierarchy.

Table 1
Fundamental scale for pair-wise comparisons.

Verbal scale	Numerical values
Equally important, likely or preferred	1
Moderately more important, likely or preferred	3
Strongly more important, likely or preferred	5
Very strongly more important, likely or preferred	7
Extremely more important, likely or preferred	9
Intermediate values to reflect compromise	2, 4, 6, 8

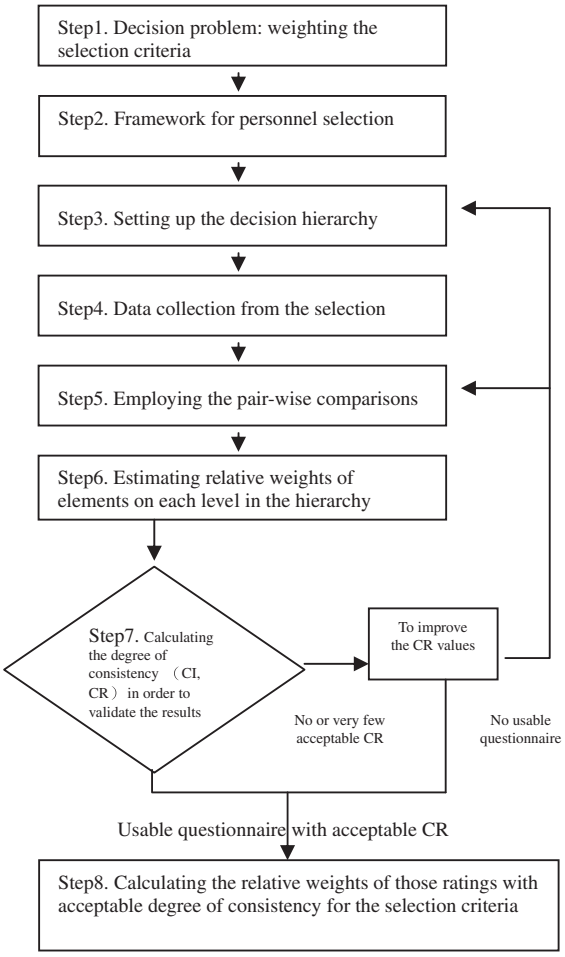

Fig. 2. The AHP method for weighting the construction information.

$$\mathrm{CI} = (\lambda - n)/(n-1). \quad (1)$$

If the consistency index (CI) is less than or equal to 0.1, it means that the consistency level is satisfactory.

Step8. Calculating the relative weights of those ratings with acceptable degree of consistency for the selection criteria.

4. Analysis results

4.1. Decision hierarchy analysis

A hierarchy is constructed to link the goal to alternatives. Alternatives can be viewed as strategic opinions for achieving the goal. The hierarchy is illustrated in Fig. 3 and translated as follows:

(1) Goal: Maximize overall performance.
(2) Criteria: Key strategic performance measures are presented under each of BSC respective perspectives (i.e. the learning and growth perspective, internal process perspective, customer perspective and financial perspective).

The bottom level of a hierarchy is represented by various strategies. The following describes primary strategies of balanced scorecard.

- Financial perspective: The strategies of financial perspective include assuring sustainable shareholder value, assuring intellectual property, and maintaining the asset quality.
- Customer perspective: The strategies of customer perspective include customer relationship management, customer returns, and customer satisfaction.
- Internal process perspective: The strategies of internal process perspective include average length of time for product design and development, innovation culture, investment in product R&D, and operations management.
- Learning-growth perspective: The strategies of learning-growth perspective include a good working environment, an environment of self-development for employees, strengthening professional management, and manpower training.

4.2. Consistency value analysis

A consistency ratio (CR) is calculated to determine reasonable consistency. The consistency ratio (CR) is calculated as follows:

$$\text{Consistency ratio (CR)} = \mathrm{CI}/\mathrm{RI} \quad (2)$$

where CI = consistency index = $(\lambda - n)/(n-1)$, λ = the average consistency measure for all alternatives, n = the number of alternatives, and RI = the appropriate random index.

The consistency ratio (CR) calculated is 0.092. A consistency ratio of 0.1 or less is considered acceptable, so the scores calculated appear reasonably consistent.

4.3. Relative weights analysis

The relative weights of all selection strategies of this paper were calculated and used to calculate the scores for the strategies as shown in Table 2. Table 2 also lists the rating results for each strategy of pharmaceutical firm. For example, the team members would have chosen 'assure sustainable shareholder value' in the financial perspective, 'customer relationship management' in the customer perspective, 'investment in product R&D' in the internal process perspective, and 'manpower training' in the learning and growth perspective.

According to AHP, assure sustainable shareholder value (final weight = 14.59%), intellectual property (final weight = 10.37%), maintain the asset quality (final weight = 10.19%), and customer relationship management (final weight = 11.44%) are the prioritizing strategies for strategy execution. In this study, the scorecards are approximately 65% non-financial perspective. It shows a greater emphasis on financial perspective and customer perspective. This reflects the understanding that customer performance measures are the drivers of financial performance measures. Further, the pharmaceutical firm must establish a relationship that allows them to maintain contact with their customers because managing the customer relationship has become the single most important perspective and strategy of pharmaceutical firm.

4.4. Strategic map analysis

Kaplan and Norton (2004a) have created a powerful new tool, the "strategy map," that enables companies to describe the links between intangible assets and value creation with a clarity and precision never before possible. The BSC includes this tool for

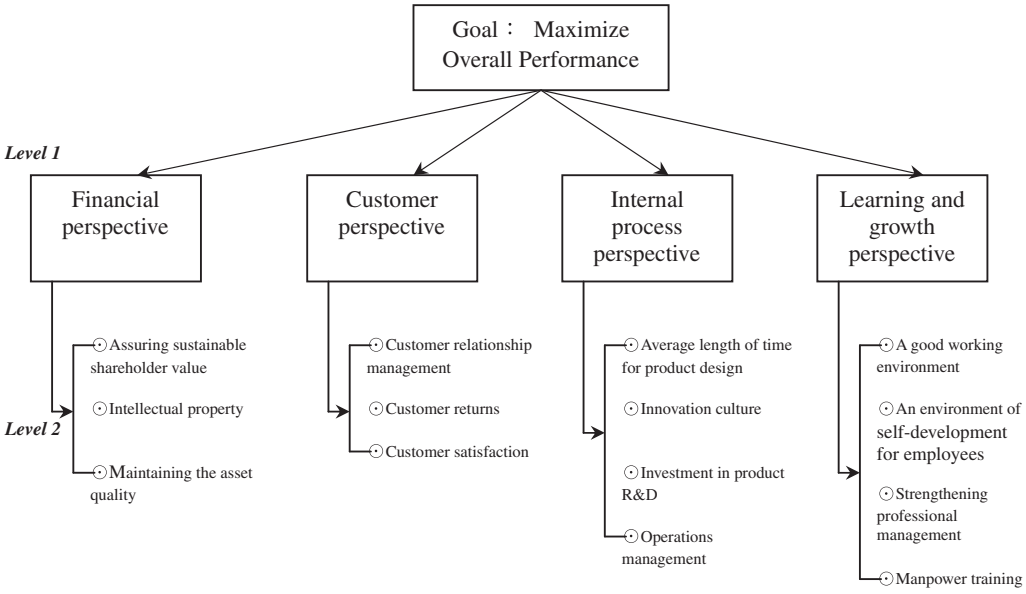

Fig. 3. Decision hierarchy of BSC.

Table 2
CR value and relative and final weights for the hierarchy.

Selection criteria and strategies	Relative weight of selection criteria matrix (%)	Relative weight of the four selection criteria matrices (%)	Final weight to each selection strategies (%)
Financial perspective	35.17		
1. Assuring sustainable shareholder value		41.5	14.59
2. Intellectual property		29.5	10.37
3. Maintaining the asset quality		29.0	10.19
Customer perspective	27.45		
4. Customer relationship management		41.7	11.44
5. Customer returns		35.2	9.66
6. Customer satisfaction		23.1	6.34
Internal process perspective	23.62		
7. Average length of time for product design and development		31.7	7.48
8. Innovation culture		18.2	4.29
9. Investment in product R&D		34.8	8.21
10. Operations management		15.3	3.61
Learning and growth perspective	13.76		
11. A good working environment		23.5	3.23
12. An environment of self-development for employees		20.6	2.83
13. Strengthening professional management		24.7	3.39
14. Manpower training		31.2	4.29
CR value of the selection criteria matrix	0.092		
Total weight of all selection strategies			1.00

senior management to define their strategy for success. The map provides a visual representation of the strategy with a single-page view of how objectives in the four perspectives integrate and combine to describe the strategy (Kaplan & Norton, 2004c). It is a diagram of the key elements of the company and industry's strategies. Strategy map can include objectives, targets, learning-growth perspective, internal process perspective, customer perspective, financial perspective, key competencies and more.

The results for the balanced scorecard strategy map of pharmaceutical firm are shown in Fig. 4. They define the set of short-term objectives and the drivers that will create its long-term value and the outcomes. The pharmaceutical firm builts its strategies around four strategic themes. In the balanced scorecard strategy map of pharmaceutical firm, as items for measuring the learning and growth perspective, the team members adopt a good working environment, an environment of self-development for employees, strengthening professional management, and manpower training as strategy. As items for measuring the internal process perspective, the team members adopt average length of time for product design and development, innovation culture, investment in product R&D, and operations management as strategy. As items for measuring the customer perspective, the team members adopt customer relationship management, customer returns, and customer satisfaction as strategies. As items for measuring the financial perspective, the team members adopt assuring sustainable shareholder value, assuring intellectual property, and maintaining the asset quality as strategies.

The balanced scorecard can create efficient pharmaceutical firm using the balanced scorecard strategy map. Such strategy map helps pharmaceutical firm to deal with the conflicting priorities in the long term versus short term decision making. The balanced scorecard strategy map of pharmaceutical firm enables senior

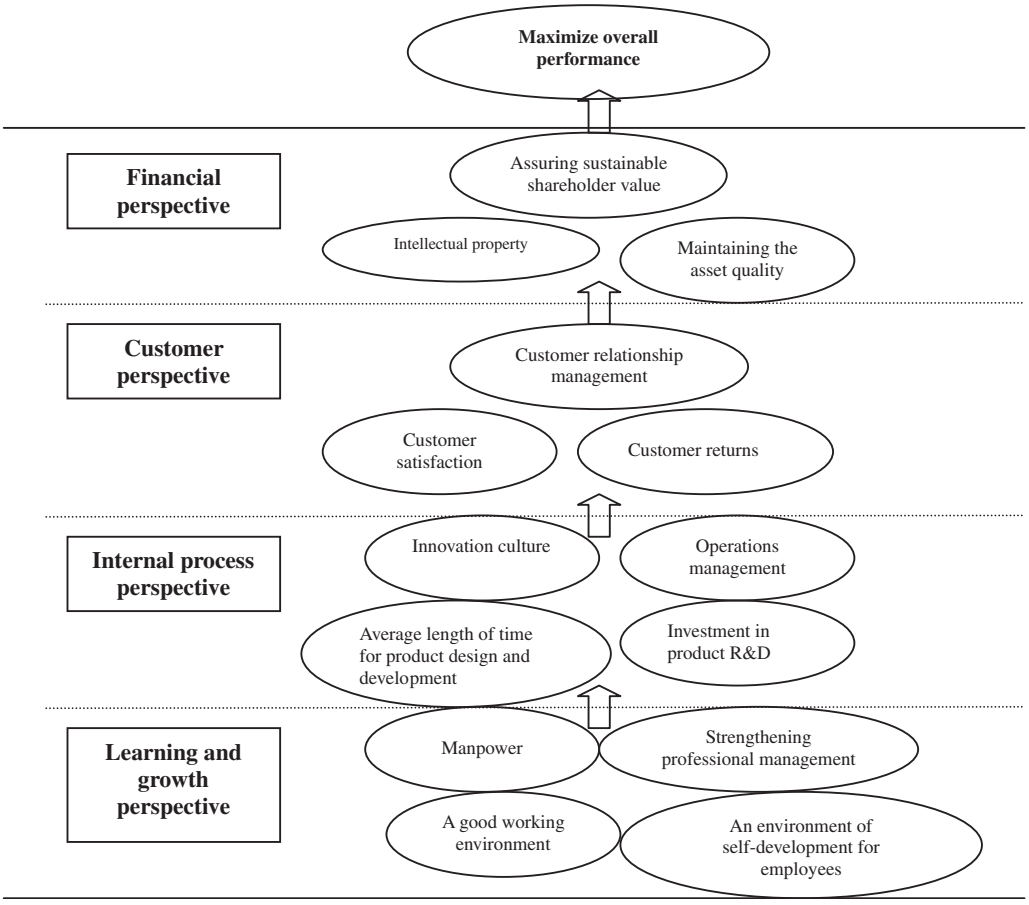

Fig. 4. The strategic map for BSC strategic performance and objectives of pharmaceutical firm.

Table 3
Strategic objectives and performance measures for pharmaceutical firm.

BSC perspective	Strategic objectives	Key performance measures	Measure owner
Financial perspective	1. Assuring sustainable shareholder value	EPS, EVA, ROE	Financial department
	2. Intellectual property	Number of invention patents, number of patents used effectively	R&D department
	3. Maintaining the asset quality	Capital adequacy ratio (%)	Financial department
Customer perspective	1. Customer relationship management	Number of customers, average duration of customer relationship	Sales department
	2. Customer returns	Customer loyalty (%), product returns as a proportion of sales (%)	Sales department
	3. Customer satisfaction	Customer satisfaction (%)	Sales department
Internal process perspective	1. Average length of time for product design and development	Time	R&D department
	2. Innovation culture	Creativity	HR department
	3. Investment in product R&D	RD expense/total revenues, R&D productivity	Financial department
	4. Operations management	e-Business capability	IT department
Learning and growth perspective	1. A good working environment	Employee satisfaction (%)	HR department
	2. An environment of self-development for employees	Internal promotion	HR department
	3. Strengthening professional management	Professional license	HR department
	4. Manpower training	Training performance	HR department

management to explicitly clarify their hypotheses about the critical causal relationships in their strategy or mission.

To implement the strategic map, the final selection of the 20 performance measures for pharmaceutical firm is shown in Table 3. Of the 20 key performance measures involved in this study, six belong to the financial perspective, five belong to the customer perspective, five belong to the internal process perspective, and four belong to the learning and growth perspective. Key model components, strategic objectives, performance measures, and measure owner within each BSC perspective are described below as

shown in Table 3. Performance measures of the financial perspective include EPS, EVA, ROE, number of invention patents, number of patents used effectively, and capital adequacy ratio (%). Performance measures of the customer perspective include number of customers, average duration of customer relationship, customer loyalty (%), product returns as a proportion of sales (%), and customer satisfaction (%). Performance measures of the internal process perspective include time, creativity, RD expense/total revenues, R&D productivity, and e-business capability. Finally, performance measures of the learning and growth perspective include employee satisfaction (%), internal promotion, professional license, and training performance.

5. Conclusions

This paper presents a nonparametric AHP method and Delphi method for facilitating performance measurement and strategic management in the pharmaceutical firm. The main findings can be summarized as follows.

The study concludes with implications for theory, research, and practice. Its results provide a logical and reliable way for individual business units to describe and implement their strategies. According to the AHP, assure sustainable shareholder value, intellectual property, maintain the asset quality, and customer relationship management are the prioritizing strategies for strategy execution. The AHP can help managers to more effectively execute strategic plans for improved business results. It is suitable for substantial start-ups, established business and strategic business units.

It is recommended that the approach outlined in this study be replicated in other industries and companies. Future research works will focus on validating the proposed BSC model and associated strategic objectives and performance measures, as well as on implementing the BSC to the other pharmaceutical firms to test the effectiveness of this BSC strategic management approach.

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