# An Analytic Hierarchy Framework for Evaluating Balanced Scorecards of Healthcare Organizations

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***Abstract***
*Healthcare organizations have been operating in a turbulent environment for years. Pressures from the government and competition as well as escalating costs have driven administrators to search for effective management tools. Balanced scorecard (BSC), a strategic management system, has been implemented in business organizations with success and is gaining acceptance in the not-for-profit and healthcare sectors. Despite potential benefits, there are challenges for implementers of BSC such as judgment biases, information overload, and the synthesis of information. This paper proposes to apply the analytic hierarchy process (AHP) to hospital scorecards in performance assessment. Although AHP could be a time-consuming exercise, it allows participative input in determining a comprehensive measure for comparing performance of healthcare organizations.*

***Résumé***
*Depuis des années, les organisations de soins de santé évoluent dans un environnement difficile. Les pressions gouvernementales, la concurrence et l'envolée des coûts poussent les administrateurs à rechercher des outils de gestion plus efficaces. C'est dans ce cadre que le Tableau de bord équilibré (BSC) a été mis en œuvre. Malgré ses avantages potentiels, le BSC bute sur certains problèmes dont la partialité des jugements, l'excès, et la synthèse des informations. Cette étude applique la méthode de la hiérarchie multicritère aux tableaux de bords des hôpitaux dans la gestion de la performance. Même si l'application de cette méthode peut s'avérer chronophage, elle permet de déterminer une mesure d'ensemble pour la comparaison de la performance des organisations de soins de santé.*

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Administrators of healthcare organizations in Canada continuously face the challenge of escalating healthcare costs as well as increased pressure from the public and governments to control costs while maintaining quality of care. Although the healthcare system is publicly funded in Canada, in recent years both the federal and provincial governments have reduced their funding to healthcare organizations and mandated the mergers of healthcare organizations through restructuring initiatives. To cope with the astronomical increase in healthcare costs, some provincial governments are evaluating the alternative of a two-tiered healthcare system: the current publicly funded system alongside private for-profit organizations providing healthcare services. This uncertainty of funding creates turbulence for the operating environment as Canadian healthcare organizations not only have to deal with the increasing pressure from the government to manage efficiently and effectively, but also operate in a market with increasing competition from for-profit healthcare providers.

Pressures like these are not new to companies in the for-profit sectors, especially in the last decade of increased global competition. Many companies have been successful in responding to the increasingly competitive environment by undergoing fundamental changes in their ways of doing business. A team-based

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process-oriented management approach, where the customer is the first and foremost priority, and which views the entire organization holistically rather than as a number of disjointed business units (Hammer and Champy, 1993), has evolved. Given the magnitude of the organizational changes, there is a need for performance measures to gauge progress towards organizational goals, to provide feedback on efforts for continuing improvement, and to guide the transformation through successive stages. Many business organizations have found the balanced scorecard to be a valuable tool in performance and strategic management (Maisel, 1992; Hoffecker and Goldenberg, 1994; Kaplan, 1994; Kaplan and Norton, 1996a; 1996b; 1996c; 2001c; Fonville and Carr, 2001; Gumbus and Lyron, 2002). The objective of this paper is to examine the value of balanced scorecard in the management of healthcare organizations and to describe an analytic hierarchy framework that can be used to evaluate scorecards of departments and programs within healthcare organizations and the performance of healthcare organizations as a whole.

The organization of the paper is as follows: First, we will briefly review the implementation of balanced scorecard in not-for-profit organizations, followed by a discussion of the potential benefits and uses of balanced scorecard in healthcare organizations. We will then describe the Analytic Hierarchy Process, or AHP as described in this paper (Saaty, 1980), an analytic framework proposed for evaluating balanced scorecards, and present a case study of its application in evaluating the performance of hospitals. The final section provides concluding remarks and discusses applied implications.

## Balanced Scorecard in Not-For-Profit Organizations

Kaplan and Norton (1996b, 2001c) have proposed the use of balanced scorecard (BSC) as a tool for performance measurement and strategic management to business organizations for more than a decade. According to Kaplan and Norton (2001a, p. 90), BSC provides a framework for organizing strategic objectives into four perspectives: financial, customer, internal business process, and learning and growth. When implementing BSC as a strategic management system, an organization has to define and communicate its strategic objectives to employees throughout the organization, setting specific goals and linking rewards to performance measures. The organization then allocates resources and sets milestones for action plans that are aligned with their strategic goals. Periodically, it is essential to provide feedback to employees to facilitate ongoing strategic review and learning. In this way, the process of implementing a BSC can translate an organization's vision into specific strategies where business plans are set, resources allocated, and performance monitored.

The implementation of BSC is gaining acceptance in the not-for-profit sector, especially the government sector (e.g., Atkinson and McCrindell, 1997; Silk, 1998; Kloot and Martin, 2000; Cameron, 2002; Chan and Ho, 2002; Chan, 2004) where performance measurement and management has been an issue of concern among administrators (Foltin, 1999; Poister and Streib, 1999). Kaplan (2001) states that BSC, as a tool, is useful in the management of not-for-profit organizations in:

- bridging the gap between *vague* mission and strategy statements with day-to-day operational measures
- facilitating a process by which an organization can achieve strategic focus
- shifting the organization's focus from programs and initiatives to the outcomes the programs and initiatives are supposed to accomplish;
- helping organizations avoid the illusion that they have a strategy because they are managing a diverse and non-cumulative set of programs and initiatives; and
- enabling organizations to align initiatives, departments, and individuals to work in ways that reinforce each other so that dramatic performance improvements can be achieved.

Even though there are fewer not-for-profit and government organizations than business organizations that have employed BSC in their strategic management, the implementers, in general, commented positively on the contribution and experience of working with BSC (Chan and Ho). As more and more not-for-profit and government organizations gain experience with BSC, there will be further empirical evidence on its value to management.

## Balanced Scorecard in Healthcare Organizations

The value of BSC to healthcare organizations is similar to that of other for-profit and not-for-profit sectors. BSC can assist management in clarifying and gaining consensus about strategy, communicating strategy throughout the organization, aligning departmental and personal goals to the strategy, linking and aligning strategic objectives to long-term and annual budgets, performing periodic and systematic strategic review, and providing feedback to evaluate and improve strategy (Kaplan and Norton, 1996b, p. 19).

MacStravic (1999) argues that a *true* BSC, which includes performance perspectives and measures linked in a cause-and-effect relationship that reflect the organization's strategy, can provide at least six benefits to

healthcare organizations. It can add customer insights, refocus internal operations, energize internal stakeholders, strengthen customer acquisition efforts and customer relations as well as increase customer loyalty and returns of value. Chow, Ganulin, Haddad, and Williamson (1998) also advocate the use of BSC in healthcare organizations. They state that translating general concepts into concrete action is one of the most challenging aspects of management (p. 276). In order to gain full benefits from BSC, Chow et al. (pp. 267-277) suggest that a healthcare organization must first determine its mission, decide on its most important objectives, and formulate strategies to accomplish its objectives. As each hospital operates in a unique environment, it has to develop its own strategies and action plans, and accordingly, its own BSC as part of the strategic management system.

With the advocacy of BSC for healthcare organizations, there is an increasing use of BSC in hospitals. What follows is a description of the implementation of BSC in the healthcare sector.

*Balanced Scorecard and Applications in Healthcare Organizations*

The implementation of BSC in the Canadian healthcare sector began as early as 1994. At that time, a number of hospitals in Ontario and Alberta explored the use of BSC with researchers from the University of Toronto (Baker and Pink, 1995). The Women's College Hospital in Toronto has developed a report card, which includes a set of performance measures that accounts for the key issues of the major stakeholders. Each issue is linked to the key processes in the hospital, which include patient care processes, academic processes, community outreach, organizational change and development, materials management, resource utilization, work force support, and the hospital as a hotel (Baker and Pink, p. 11). Moreover, each key process' performance is judged in terms of six key quality characteristics: customer satisfaction, efficiency, efficacy (outcome), cycle time, response time, and error rate. The University of Alberta Hospitals, on the other hand, have constructed an organizational dashboard, which includes financial measures, utilization measures, outcome measures, access measures, and satisfaction measures for the major case mix groups (CMG), which is a patient classification system. However, the report cards and dashboards developed by the two hospitals may not be a true BSC as the performance perspectives and measures chosen do not reflect the hospitals' strategy. Nevertheless, both hospitals did recognize the importance of a performance management system that should incorporate the concern of the hospital's stakeholders, focus on the hospital's processes, and include both financial and non-financial indicators.

Despite the substantial amount of resources needed to develop BSCs in healthcare organizations, the Ontario Hospital Association (OHA) decided to go ahead with the use of a hospital scorecard, called the *Hospital Report*, to evaluate performance of Ontario hospitals. OHA's hospital scorecard identifies the provision of quality healthcare as the mission of Ontario hospitals, and OHA published its first *Hospital Report* in 1998. Since then, the hospital scorecard has undergone changes to reflect changes in the operating environment of Ontario hospitals. To provide the highest quality of care to patients and to reflect changes in the operating environment, the four performance perspectives of OHA's hospital scorecard are patient satisfaction, clinical utilization and outcomes, financial performance and condition, and system integration and change. The hospital scorecard includes 39 indicators, and the data are collected from surveys as well as from the hospital's clinical and management information system. Even though the administrators of a hospital can use the hospital scorecard to assess their organization's performance against its peer group, the hospital scorecard serves more as an external accountability mechanism than as a strategic management system, as advocated in Kaplan and Norton's BSC. This is because the performance indicators included in the hospital scorecard are the same for all Ontario hospitals, and they do not account for differences in hospitals' strategies.

In a survey on the implementation of BSC in healthcare organizations, Chan and Ho (2000) reported that 43 Canadian hospitals, about 8% of a random sample of 555 hospitals, have developed BSCs for their organizations. Furthermore, about three-quarters of the adopters indicated that their experience in BSC implementation has been quite successful. This self-assessment on the success of implementing BSC represents the adopters' overall perception of the implementation process of BSC in their organizations, which is not related to the achievement of any specific objectives and performance perspectives in their organization's BSC. In the same survey, administrators of the Canadian hospitals that have implemented BSC predicted that use of BSC in their organizations would change significantly over the five years after its implementation. The interest of healthcare organizations (e.g., Meliones, 2000; Kershaw and Kershaw, 2001) in implementing BSC continues to grow, and thus, healthcare administrators need to have a good understanding of its implementation issues to ensure a smooth and successful adoption of BSC as a strategic management tool in their organizations.

*Implementation Issues of Balanced Scorecard in Healthcare Organizations*

Based on the experience of a few Canadian hospitals that have developed organizational report cards and dashboards, Baker and Pink (1995) identify a number of key implementation issues for BSC in healthcare organizations. They conclude that the development of reliable, valid, and comparable data for BSC will require a major investment in resources. Even with well-defined performance measures, there will be a continued need for investment in the hospitals' information management capabilities. For the report cards and dashboards to become a useful management tool in healthcare organizations, administrators must learn how to link the new information to action such that performance of employees will be rewarded accordingly. This, again, requires resources for the training of management and building of infrastructure for the organization. Unfortunately, in a period of scarce resources, hospitals' boards of directors may not approve the financial commitment needed to develop BSC.

Respondents from Canadian hospitals that have implemented BSC indicated that management focus on solving short-term organizational problems has been an important factor contributing to their unsuccessful implementation (Chan and Ho, 2000). The efforts and difficulty involved in developing performance perspectives and measures of the BSC are cited as significant implementation issues (Chan and Ho, Meliones, 2000). Furthermore, healthcare organizations that have implemented BSC have a tendency to develop and use a large number of indicators (Baker and Pink, 1995). Since people generally can handle seven elements of information (plus or minus two) simultaneously (Miller, 1956; Atkinson and Epstein, 2000), administrators may find the task of evaluating an extensive number of indicators in a BSC extremely complex. In fact, Edmunds and Morris (2000, p. 21), after extensive research on the impact of information overload, conclude that information overload "seriously affects people at work and their ability to do their job". Meliones also reports that the slicing and dicing of the enormous amount of data into useful information is one of the many challenges arising from the implementation of BSC. Moreover, the large number of performance indicators in a BSC makes it difficult for management to focus on strategic priorities.

McWhorter (2003), on the other hand, reports that users of BSC find the information relevant and strategically oriented as performance indicators chosen for a BSC are all directed towards a consistent strategy. Accordingly, if BSC includes mostly relevant information, one can alleviate the adverse impact of information overload by excluding irrelevant information. The Analytic Hierarchy Process (AHP), as proposed in this paper, can be a valuable tool in screening and prioritizing performance indicators such that the BSC includes only relevant performance indicators with the highest priority. Furthermore, since the number of performance indicators in a BSC is likely to be greater than the optimum number of seven, the method can be useful to management in synthesizing a significant amount of relevant information into a composite measure.

Apart from information overload, there is empirical evidence on judgment biases in using BSC for performance evaluation and bonus determination. Lipe and Salterio (2000) conducted an experiment in which MBA students, who played the role of supervisors in evaluating performance of two divisions, ignored measures unique to each division. This results in a common-measure bias in the decision process. Although common-measure bias is not an issue in the current study of *Hospital Reports* that include identical measures, it undermines the value of BSC in strategic management, as scorecard measures are likely to be different for divisions with different business strategies. One way to overcome such common-measure bias is to apply disaggregation-plus-mechanical-aggregation (Roberts, Albright and Hibbets, 2004) such that the decision maker only has to focus on one measure at a time in performance evaluation as part of the disaggregated judgment strategy, while exerting more efforts as the number of evaluations and computations increases as part of the aggregation process. Other approaches that can alleviate the common-measure bias are invoking process accountability and requiring an independent third-party assurance report on the BSC (Libby, Salterio and Webb, 2004). AHP, as described in this paper, is another approach that can lessen the impact of common-measure bias. For instance, since BSCs for divisions with different strategies are different, the decision maker can apply AHP to assess each division's performance against its specific scorecard targets first, thereby taking into account the unique scorecard and performance measures for each division. The decision maker can then use the assessment of each division's performance against its scorecard target, as determined by AHP, as the basis for evaluating the relative performance of the different divisions.

In addition to common-measure bias, Ittner, Larcker and Meyer (2003) report that when subjectivity is present in applying BSC for bonus determination, short-term financial performance measures become the primary determinants of a bonus as decision makers systematically ignore other BSC measures. Decision makers also consider discretionary factors other than BSC measures in bonus determination. This again reduces the value of BSC in strategic and performance management. Conversely, since AHP requires the deci-

sion maker to compare performance of divisions for each performance measure, the method forces the decision maker to consider both financial and non-financial measures in a BSC for bonus determination. As well, the algorithm of AHP only accounts for performance measures specified in the decision problem, thereby ensuring that the decision maker cannot add subjective discretionary factors that may bias bonus determination. Thus, AHP alleviates the impact of systematic biases caused by focus on financial measures and subjectivity in bonus determination.

Even though BSC provides opportunities for developing, communicating, and implementing strategies in one corporate setting, Malina and Selto (2001) report that BSC causes significant conflict and tension between corporate office and business units when scorecard measures are inaccurate or subjective, communication is top-down, and benchmarks are inappropriate for performance evaluation. Then again, since the Analytic Hierarchy Process is a decision-making tool that can be used in a group setting, it can facilitate conflict resolution by allowing and incorporating inputs from managers of business units in the selection of scorecard measures and establishment of performance targets.

As discussed above, information overload and judgment biases are some issues identified with the implementation of BSC. The phenomenon of information overload, where information on 20 to 30 performance indicators has to be analyzed and interpreted simultaneously, could diminish the benefits of BSC to healthcare organizations. Similarly, judgment biases caused by common measures, focus on financial measures, and subjectivity could affect the value of BSC in strategic management. In this case, AHP can be a valuable tool as it can assist management in developing priorities of performance indicators such that the BSC includes performance indicators with the highest priority. The method not only allows management to focus on the few performance indicators with the highest strategic priority, but also helps management to synthesize information on a BSC into a composite measure. Moreover, the algorithm of AHP accounts for all performance measures in a BSC, common and unique as well as financial and non-financial, in the decision-making process thereby alleviating the impact of judgment biases when decision makers use the BSC as part of a strategic management system.

What follows is a detailed description on the Analytic Hierarchy Process (Saaty, 1980), a decision-making tool, that can be valuable to organizations utilizing BSC as it provides a structured framework in evaluating performance of departments and programs of a healthcare organization as well as among healthcare organizations.

## An Analytic Hierarchy Framework in Evaluating Balanced Scorecards

Formulating strategic objectives and monitoring how well they are achieved are key processes in the implementation of the BSC. However, such processes are complicated. Part of the complexity, as discussed earlier, arises from the inability of the human mind to interpret a vast amount of information objectively, or more specifically, to analyze and synthesize multiple objectives as well as to evaluate the results. Furthermore, agreement on the relative significance of the multitude of organizational goals, performance perspectives, and performance measures, is difficult to achieve in large organizations because of the diverse beliefs of organizational employees. AHP is a method that helps management set priorities on organizational goals and performance measures. As a decision-making tool that may be used in a group setting, AHP also allows for multiple inputs in the decision-making process.

### *The Analytic Hierarchy Process*

Saaty's (1980) analytic hierarchy process is a model of the way in which the human mind conceptualizes and structures a problem. The method has been used in various decision settings, dating as early as the 1970s, in the design of alternative future outcomes for a developing country (Saaty, 1977), the evaluation of political candidates (Saaty and Bennett, 1977), and the allocation of energy resources (Saaty and Mariano, 1979). In management literature, AHP has seen a number of applications including the evaluation of organizational effectiveness (Chan and Lynn, 1993), the assessment of risk and uncertainty in new technology investments (Accola, 1994), the assessment of the risk of management fraud (Millet and Deshmukh, 1998), and the evaluation of internal control for electronic data processing systems (Hardy and Reeve, 1998). AHP has also been advocated as a useful tool in facilitating the implementation of BSC for practical use (Clinton, Webber and Hassell, 2002; Searcy, 2004) and in prioritizing key performance indicators and value drivers in a group decision setting in the healthcare industry in Taiwan (Pan, 2004). Apart from these AHP applications in management decision problems, there are a number of AHP applications in medical research when patients are involved (e.g., Dolan, 1990; Dolan and Bordley, 1993; Dolan, 1995; Dolan, 1998). Largely, any problem, such as the evaluation of a BSC, where a group of decision makers has to evaluate multiple factors simultaneously to reach a solution, is a potential candidate for applying AHP.

Saaty (1990, p. 259) describes the process succinctly:

> The Analytic Hierarchy Process ... is a theory of measurement. When applied in decision-making it assists one to describe the general decision operation by decomposing a complex problem into a multi-level hierarchic structure of objectives, criteria, sub-criteria and alternatives. The Analytic Hierarchy Process provides a fundamental scale of relative magnitudes expressed in dominance units to represent judgments in the form of paired comparisons. A ratio scale of relative magnitudes expressed in priority units is then derived from each set of comparisons. An overall ratio scale is then synthesized to obtain a ranking of the alternatives .... The Analytic Hierarchy Process as a descriptive theory encompasses procedures leading to outcomes as would be ranked by a normative theory.

In modeling the problem-solving process of the human mind, a user of AHP first identifies the factors that affect the problem. He then classifies the factors into groups based on some common characteristics. These groupings become the different levels of the hierarchy. In this way, the user has constructed a hierarchy of criteria, subcriteria, and alternatives, which is the cornerstone of AHP.

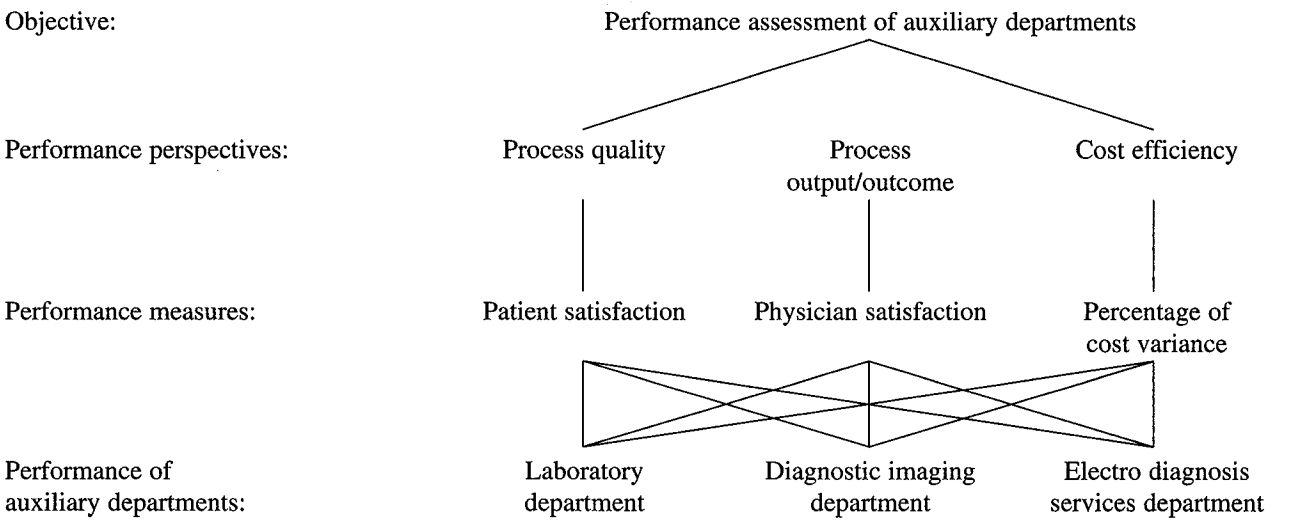
In addition to structuring the decision problem as a hierarchy, AHP allows for multiple inputs in the decision making process. In the case of a group decision-making setting with multiple inputs, there are four ways for determining group priorities (Dyer and Forman, 1992). They are consensus, vote or compromise, use of geometric means in combining judgments of paired comparisons (Aczel and Saaty, 1983), and use of separate models where geometric or arithmetic means are applied to the resultant priorities (Forman and Peniwati, 1998). The choice in aggregating judgments or priorities all depends on whether the decision makers are considered as a group or as separate individuals. Furthermore, equal weights or different weights can be applied to individual judgments or priorities in aggregation, depending on the significance of each individual's influence on the decision. AHP, as reported by Pan (2004), is an effective tool when applied to a group decision-making setting. In Pan's study, a group of senior and second level executives in healthcare organizations evaluated and prioritized a group of 47 indicators chosen for eight objectives into a reduced set of 14 indicators for four performance perspectives. Pan concludes that AHP substantially helps the decision-making process in terms of speed and quality, which is especially valuable to healthcare organizations where group decision-making is common. For instance, the Board of Directors of a regional health authority, as a group, is responsible for making decisions on how to allocate resources among the many healthcare facilities under its jurisdiction. As a board, the directors of a healthcare organization are also responsible for evaluating and approving proposals on clinical programs and capital projects. Moreover, at the clinical level, program management in healthcare organizations encourages physicians, nurses, and other medical professionals to work as a team and consequently, group decisions are required to determine the most effective care for their patients. Thus, apart from its application in evaluating BSC, AHP facilitates group decision-making in various strategic, operational, and clinical domains in healthcare organizations.

### *An Example of Analytic Hierarchy Process*

To illustrate the method, we can use a simple example of performance evaluation. Assume that ABC Hospital wishes to evaluate the performance of three of its diagnostic departments: the Laboratory, the Diagnostic Imaging Department, and the Electro Diagnostic Services Department. Administrators of ABC Hospital have decided that process quality, process output/outcome, and cost efficiency are the critical perspectives in evaluating performance of diagnostic departments. Each critical performance perspective may include two or more performance measures. For illustrative purpose, we assume that the hospital administrators have chosen one measure for each performance perspective. They are: (a) a patient satisfaction index on the care and services provided as an indicator of process quality; (b) a physician satisfaction index on the accuracy and throughput of reports as an indicator of process output; and (c) percentage of cost variance per unit of service as an indicator of financial performance with an emphasis on cost efficiency.

To decide which of the departments has the best performance in relation to these performance perspectives, administrators of ABC Hospital need to evaluate two aspects of the problem: (a) the priority of the performance perspectives and (b) the performance priorities[1] of the departments with respect to each performance measure. Different administrators of ABC Hospital may have divergent beliefs about the relative importance of the performance perspectives. For instance, one administrator may believe in the primacy of cost efficiency while another contends that process quality is the most important part of departmental performance. In this case, AHP provides a means for not only establishing priorities of the performance criteria, but also amalgamating the administrators' beliefs on the relative importance of the performance perspectives and the relative performance priorities of the departments (Forman and Peniwati, 1998). Table 1 shows the hierarchy and the values of the three performance measures for the three auxiliary departments. Normal evaluation procedures would require that some subjective (possibly unspecified and

**Table 1**
*Hierarchy[1] and Key Performance Measures of the Three Auxiliary Departments Being Evaluated*




| Key performance measures[2] | Laboratory department (LAB) | Diagnostic imaging department (DIA) | Electro diagnostic services department (EDS) |
|---|---|---|---|
| Patient satisfaction (PAT) | 5 | 7 | 2 |
| Physician satisfaction (PHY) | 7 | 4 | 2 |
| Cost variance percentage (VAR) | -10% (unfavourable) | -3% (unfavourable) | +5% (favourable) |

*Notes*:
1 In this example, since there is one performance measure for each performance perspective, a three- level hierarchy is adequate in structuring the decision problem. In other cases when there are two or more performance measures chosen for each performance perspective, the structure of the decision problem is a four-level hierarchy.
2 Patient satisfaction survey is used to collect data on patients' assessment of the quality of care and services received as an indicator of process quality. Similarly, physician satisfaction survey is used to collect data on physicians' assessment on the accuracy and throughput of reports received as an indicator of process output. On the other hand, each auxiliary department's benchmark is used to compute the cost variance percentage as an indicator of cost efficiency.

unconscious) weighting of the three performance perspectives be done to prioritize the three key measures. Using AHP, senior administrators of ABC Hospital will compare each pair of performance perspectives. Even though a certain degree of subjectivity exists in the paired comparisons of performance perspectives, it is preferable to the subjective weights assigned by the senior administrators because the transitivity in judgments can be ascertained by evaluating the consistency ratio computed for each matrix of paired comparisons (see Table 3).

Once the senior administrators of ABC Hospital have defined the problem, they can set priorities for the performance perspectives with respect to their beliefs about the way in which they relate to the effective operation of the departments. To maintain simplicity for this illustration, the Vice President of Finance and the Vice President of Auxiliary Services are the two senior administrators responsible for assessing the performance of the three departments. The two hospital administrators set priorities for the performance perspectives by comparing the criteria in pairs and responding to questions included in Table 2, section A.

Rather than a simple "more or less important" answer to these questions, the AHP procedure conventionally uses a 9-point ratio scale that measures the rela-

**Table 2**
*Paired Comparisons of Performance Perspectives and Performance of Diagnostic Departments*

(A) Paired comparisons of performance perspectives

1. a. Which is more important, patient satisfaction or physician satisfaction, in evaluating the effectiveness of the departments?
   b. How many times more important?

2. a. Which is more important, patient satisfaction or cost variance, in evaluating the effectiveness of the departments?
   b. How many times more important?

3. a. Which is more important, physician satisfaction or cost variance, in evaluating the effectiveness of the departments?
   b. How many times more important?

Using 9-point response scale where:
1 = the performance measure is as important as the other;
3 = the performance measure is weakly more important than the other;
5 = the performance measure is strongly more important than the other;
7 = the performance measure is demonstrably more important than the other;
9 = the performance measure is absolutely more important than the other;
and 2, 4, 6, and 8 are intermediate judgments.

(B) Paired comparisons of performance of auxiliary departments per patient satisfaction

1. a. Which department's performance, Laboratory or Diagnostic Imaging Department, is better with respect to patient satisfaction?
   b. How many times better?

2. a. Which department's performance, Laboratory or Electro Diagnostic Services Department, is better with respect to patient satisfaction?
   b. How many times better?

3. a. Which department's performance, Diagnostic Imaging Department or Electro Diagnostic Services Department, is better with respect to patient satisfaction?
   b. How many times better?

Using 9-point response scale where:
1 = the department is as good as the other;
3 = the department is weakly better than the other;
5 = the department is strongly better than the other;
7 = the department is demonstrably better than the other;
9 = the department is absolutely better than the other;
and 2, 4, 6, and 8 are intermediate judgments.

tive degree of importance of one criterion as compared to the other. For example, if patient satisfaction is *weakly more* important than cost variance percentage, then the score is three for the patient satisfaction and cost variance comparison, that is to say, patient satisfaction is three times more important than cost variance in evaluating performance of the departments. For the reverse comparison of cost variance and patient satisfaction, AHP assumes that cost variance is much less important than patient satisfaction, and Saaty (1980) proposes the

use of the reciprocal of 3 (i.e., $^1/_3$) as the value for this reverse comparison. Thus, the number of paired comparisons required for N criteria is {N x (N-1) ÷ 2}. In this case, the hospital administrators have to conduct three (3 x 2 ÷ 2 = 3) paired comparisons to assess the relative importance of the three performance perspectives (or performance measures). Included in Table 3, section A is the square matrix of paired comparisons of the performance measures where the lower half of the matrix is comprised of the reciprocals of the elements in the upper half.

Given the matrix of paired comparisons, Saaty (1980) proposes the eigenvector approach to determine the priorities of the performance measures. In general, the performance measure with the highest value is the most important and vice versa. The results shown in Table 3, section A indicate that patient satisfaction is the most important performance measure (value = 0.54) for evaluating the auxiliary departments while cost variance percentage (value = 0.16) is the least important. Since a ratio scale is used in the paired comparison, it is appropriate to conclude that patient satisfaction is 3.375 times (0.54/0.16 = 3.375 times) more important than cost variance percentage in evaluating performance of the three auxiliary departments. Furthermore, the consistency ratio computed for the matrix of paired comparisons is 0.0079, which implies that there is good consistency in the judgment of paired comparisons of performance measures.

Once the hospital administrators have established the relative priorities of the key performance measures, they can evaluate how well each of the three auxiliary departments performs on each performance measure as compared to each of the other departments. For the ABC Hospital illustration, Table 2, section B includes questions used for comparing the departments' performance for the patient satisfaction measure.

Using the 9-point ratio scale, the two hospital administrators continue their evaluation of the three departments' performance for each of the other two performance measures. For example, a score of 2 assigned to a comparison of the Diagnostic Imaging Department with the Laboratory on patient satisfaction indicates that the Diagnostic Imaging Department is weakly (or two times) better than the Laboratory on this key performance measure. The results of the departmental comparisons on the three key performance measures are summarized in three matrices, and their department performance priorities are given by the corresponding vectors in Table 3, sections B, b, i, ii, and iii. The results show that the Diagnostic Imaging Department has the highest priority score with respect to patient satisfaction (value = 0.57) while the Laboratory and the Electro Diagnostic Services Department are the best with respect to physician satisfaction (value = 0.56) and cost variance (value = 0.54), respectively.

While the three sets of department performance priorities on the key performance measures communicate valuable information to the administrators, AHP can assist further by deriving the overall department performance priorities. As shown in Table 3, section C, the overall department performance priorities are determined by multiplying the vectors of department performance priorities with the vector of priorities of the key performance measures. The results indicate that the Diagnostic Imaging Department (value = 0.45) is the best in performance based on an evaluation of the three key performance measures, and its performance is two times (0.45/0.20 = 2.25) better than that of the Electro Diagnostic Services Department (value = 0.20).

### *Pros and Cons of the Analytic Hierarchy Process*

From the above example, one can glean a number of positive attributes of AHP. First, AHP is superior to ad hoc weighting schemes when multiple criteria are involved because a consistency ratio can be computed to assess the transitivity in judgments of the paired comparisons. Second, it allows for the synthesis of multiple viewpoints on multiple criteria into a single unified result. Because of its flexibility, AHP can handle a large number of criteria, subcriteria, and alternatives and far more than a three-level hierarchy as illustrated in this example (see Table 1). Third, by forcing organizational members to make the required paired comparisons, the participants have to reveal their preferences. The communication is likely to make it easier for participants to resolve conflicts and reach a consensus. If there is no consensus, individual judgments and priorities can still be aggregated (Dyer and Forman, 1992; Forman and Peniwati 1998), thereby incorporating each individual's inputs in the decision-making process.

The use of AHP does require educating the participants on the method, which can be time-consuming. Aside from the training and time commitment, there are four major areas of criticism of AHP. They are a lack of an axiomatic foundation, an ambiguity of the questions that the decision maker must answer, the scale used to measure the intensity of preference, and the Principle of Hierarchical Composition and rank reversal (Harker and Vargas, 1987, p. 1384). Saaty and other proponents of AHP have refuted these criticisms. Saaty (1986) provides an axiomatic foundation of AHP while Harker and Vargas address the other three areas of criticism. With respect to the frame of reference, Harker and Vargas agree that the decision maker's frame of reference does matter and ambiguity is a phenomenon of all preference eliciting methods, including AHP. They also argue that

AHP is applicable with unbounded ratio scale and that an individual's needs determine the choice of the scale. Furthermore, Harker and Vargas have shown in an example that the 1 to 9 ratio scale is superior to two linear scales (1 to 5 and 1 to 15 ratio scales) and two other nonlinear scales (1 to $x^2$ and 1 to $\sqrt{x}$ ratio scales where $x$ is the upper limit of the scale). There is also growing support that the 1 to 9 ratio scale has accurately portrayed an individual's intensity of preference. Finally, although judgment inconsistency can cause rank reversal, Harker and Vargas (1987) and Saaty and Vargas (1984) argue that rank reversal does make sense when there is a change in the frame of reference, as demonstrated by changes in values of paired comparisons, with the addition or deletion of alternatives (or criteria). The real problem with rank reversal is ratio instability caused by changing units of measure upon renormalization after an alternative (or criterion) is added or deleted.

Nonetheless, AHP is a valuable tool in modeling decision problems with multiple attributes and multiple decision makers, such as evaluating BSC and performance of healthcare organizations as described in the following section.

## A Case Study of The Analytic Hierarchy Process in Evaluating Balanced Scorecards of Healthcare Organizations

As indicated earlier, the OHA is in its eighth year of publishing the *Hospital Reports* for Ontario hospitals. OHA's *Hospital Report* is different from the BSC that Kaplan and Norton (2001c) advocate as a strategic management system[2] within an organization, because the scorecard indicators are the same for all Ontario hospitals and they are not linked to any one hospital's strategy. Even though the hospital scorecards serve as an external accountability system, stakeholders can utilize the scorecard indicators to assess organizational performance among Ontario hospitals. With the 39 indicators grouped into four performance perspectives, there is an intrinsic hierarchy in the hospital scorecard (see Table 4). Thus unlike most AHP applications, it is not necessary to decompose and structure the problem into a hierarchy when evaluating hospital scorecards. However, since the vast amount of information in these hospital scorecards makes it difficult for citizens and politicians to interpret the information meaningfully, AHP is a valuable tool in evaluating hospital performance because it synthesizes information on hospital scorecards and provides an overall assessment on hospital performance.

Besides OHA, other stakeholders are interested in examining the hospital scorecards to learn more about the performance of the hospitals. For instance, the public is keen to know the quality and accessibility of health services provided by their community hospitals as compared to others in the neighbouring communities. The hospital's board of directors is concerned about the financial viability of the hospital, while ensuring a high quality of service. The government also wants to make sure that hospitals are accountable for the funds provided, and that they operate both effectively and efficiently as compared to other hospitals in the peer group. Thus, different stakeholders have different expectations about hospital performance. In this case, AHP provides a useful framework for evaluating performance of hospitals in a peer group, depending on the stakeholders' diverse interest.

OHA's *Hospital Report 2002 – Acute Care* reports on the performance of 95 acute-care hospitals on 39 indicators grouped into four performance perspectives.[3] Since it is extremely complex to evaluate the scorecards of 95 hospitals that have different operating characteristics, the following illustration focuses on a sample of eight community hospitals in a specific region in Ontario, with three performance indicators (see Table 5) selected for each of the four performance perspectives.[4] By excluding teaching hospitals and smaller hospitals as well as limiting the sample to a geographic region, it is likely that the operating environment of the eight community hospitals are quite similar, thereby making the performance evaluation among hospitals more informative.

The first step in applying AHP to these hospital scorecards is to identify the relative importance of the four performance perspectives. It is likely that different stakeholders will have different views but their judgments can still be aggregated (Forman and Peniwati, 1998). An example of the matrix of paired comparisons from a citizen as well as the results of the prioritization using AHP is included in Table 6, section A. From the citizen's viewpoint, patient satisfaction is the most important of all performance perspectives in the hospital scorecard. It is three times (0.581/0.174 = 3.34) more important than clinical utilization and outcome and seven times (0.581/0.083 = 7) more important than the hospital's efforts on system integration and change, the least important of all performance perspectives. The results are consistent with the general concerns of a patient who is worried about how he is being cared for in the hospital, while paying less attention to processes and changes that do not affect his well-being directly.

The second step of the AHP is to determine the relative importance of the three performance indicators selected for each perspective. By focusing on three indicators per performance perspective, the citizen needs to make 12 (4 x [(3 x 2) ÷ 2]) paired comparisons. This simplifies the task substantially and the vector of priori-

**Table 5**
*Selected Indicators of Hospital Scorecards*

I. Patient satisfaction, PS
   1. Global quality, GQ – patient's opinion on the overall quality of care received at the hospital
   2. Process quality, PQ – patient's satisfaction with care and services
   3. Housekeeping, HK – patient's overall impression of housekeeping services provided in the hospital

II. Clinical utilization and outcome, CUO
   1. Access to coronary angiography, ACA
   2. Acute myocardial infarction (AMI) complications, AMIC
   3. Pneumonia complications, PC

III. Financial performance and condition, FPC
   1. Total margin, TM – the percentage by which total revenues exceed total expenses, excluding the effect of amortization
   2. Unit cost performance, UCP – the percentage by which expected cost per weighted case differs from the actual cost per weighted case
   3. Nursing care hours, NCH – nursing care hours as a percentage of total inpatient nursing hours

IV. System integration and change, SIC
   1. Coordination of care, COC – focus on how the hospital staff manage a patient's care at home after discharge
   2. Clinical data collection, dissemination and benchmarking, CD – the extent to which a hospital is collecting, disseminating and benchmarking clinical outcomes and clinical appropriateness data
   3. Health human resources, HHR - how a hospital implements innovative training programs and employee practices may help explain a hospital's reaction to its changing environment

*Note*: Source from Ontario Hospital Association. 2002. Hospital Scorecard 2002: Acute Care. Toronto: Ontario Hospital Association.

ty[5] for each set of three performance indicators is included in Table 6, section B. The results[6] indicate that there is one dominating indicator in each performance perspective. For patient satisfaction, global quality is the most important component in evaluating hospital performance. The citizen also places high priority on access to coronary angiography with respect to clinical utilization and outcome as compared to AMI (acute myocardial infarction) and pneumonia complications. With respect to financial performance and condition, total margin is the most important indicator of a hospital's financial health and finally, the hospital's effort in coordinating care after discharge is vital to the citizen in terms of the organization's efforts on system integration and change.

As the priorities of the performance perspectives and indicators are established using AHP, the citizen goes on to compare the performance of the hospitals in pairs with respect to each performance indicator.[7] The priorities of the hospitals with respect to each performance indicator are included in Table 6 section C. The results,[8] in general, indicate that for each performance indicator, several of the hospitals' performance priorities are identical. For instance, the performance assessment of hospitals H2, H4, H5, H6, and H8 are the same with respect to process quality. This may be attributed to the five-asterisk scoring system used in the hospital scorecard where *** is the provincial average. The variability in performance among hospitals will be more transparent if the actual value of each performance indicator can be used in the paired comparisons (see note 3). Furthermore, all hospitals are at the provincial average with respect to the performance indicator, Health Human Resources. This may be attributed to the bias in the responses to the questionnaire designed for the measurement, since respondents tend to paint a positive picture on their hospitals' efforts on system integration and change. Nevertheless, some hospitals do stand out in specific areas. For instance, hospital H7 is the best performer in terms of process quality, and it is four times better than hospital H2. Such diverse performance will not be detected in the five-asterisk scoring system as hospital H7 has an original score of **** whereas hospital H2's score is ** on process quality. Hence, AHP forces the decision maker to compare the performance of

**Table 6**
*Matrices of Paired Comparisons and Vectors of Priorities for Performance Perspectives and Indicators of Hospital Scorecard*

*(A) Evaluation of performance perspectives*

(a) Paired comparisons

| | PS | CUO | FPC | SIC |
|---|---|---|---|---|
| PS | 1 | 4 | 3 | 7 |
| CUO | ¼ | 1 | 1 | 2 |
| FPC | 1/3 | 1 | 1 | 2 |
| SIC | 1/7 | ½ | ½ | 1 |

Consistency ratio = 0.0029

(b) Priorities

| | | |
|---|---|---|
| PS | 0.581 | patient satisfaction |
| CUO | 0.174 | clinical utilization and outcome |
| FPC | 0.162 | financial position and condition |
| SIC | 0.083 | system integration and change |

*(B) Priorities of performance indicators*

(a) Patient satisfaction, PS

| | | |
|---|---|---|
| GQ | 0.558 | global quality |
| PQ | 0.320 | process quality |
| HK | 0.122 | housekeeping |

Consistency ratio = 0.0158

(c) Clinical utilization and outcome, CUO

| | | |
|---|---|---|
| ACA | 0.633 | access to coronary angiography |
| AMIC | 0.192 | AMI complications |
| PC | 0.175 | pneumonia complications |

Consistency ratio = 0.0046

(b) Financial performance and condition, FPC

| | | |
|---|---|---|
| TM | 0.540 | total margin |
| UCP | 0.297 | unit cost performance |
| NCH | 0.163 | nursing care hours |

Consistency ratio = 0.0079

(d) System integration and change, SIC

| | | |
|---|---|---|
| COC | 0.655 | coordination of care |
| CD | 0.133 | clinical data collection |
| HHR | 0.211 | health human resources |

Consistency ratio = 0.0270

*(C) Hospital performance priority, H1 to H8, per performance indicator*

| | GQ | PQ | HK | ACA | AMIC | PC | TM | UCP | NCH | COC | CD | HHR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H1 | 0.022 | 0.133 | 0.048 | 0.035 | 0.087 | 0.063 | 0.046 | 0.045 | 0.094 | 0.045 | 0.084 | 0.125 |
| H2 | 0.055 | 0.093 | 0.263 | 0.142 | 0.023 | 0.063 | 0.112 | 0.220 | 0.094 | 0.045 | 0.084 | 0.125 |
| H3 | 0.022 | 0.031 | 0.019 | 0.035 | 0.087 | 0.063 | 0.336 | 0.220 | 0.094 | 0.119 | 0.024 | 0.125 |
| H4 | 0.162 | 0.093 | 0.048 | 0.035 | 0.035 | 0.063 | 0.028 | 0.045 | 0.278 | 0.119 | 0.084 | 0.125 |
| H5 | 0.227 | 0.093 | 0.048 | 0.142 | 0.086 | 0.087 | 0.112 | 0.045 | 0.034 | 0.317 | 0.084 | 0.125 |
| H6 | 0.055 | 0.093 | 0.048 | 0.412 | 0.036 | 0.312 | 0.112 | 0.045 | 0.034 | 0.119 | 0.084 | 0.125 |
| H7 | 0.343 | 0.371 | 0.263 | 0.142 | 0.322 | 0.312 | 0.112 | 0.045 | 0.278 | 0.119 | 0.472 | 0.125 |
| H8 | 0.114 | 0.093 | 0.263 | 0.057 | 0.322 | 0.062 | 0.112 | 0.335 | 0.094 | 0.117 | 0.084 | 0.125 |
| C.R. | 0.039 | 0.072 | 0.032 | 0.033 | 0.045 | 0.000 | 0.024 | 0.002 | 0.034 | 0.019 | 0.016 | 0.000 |

where C.R. = Consistency Ratio

all 28 (8 x 7 ÷ 2) pairs of hospitals, and the paired comparisons reinforce the superiority of one hospital's performance against others.

Even though a hospital has an outstanding performance priority in one indicator, it may not perform well in other areas. For instance, although hospital H2 has the highest priority in terms of its housekeeping services, its performance in global and process quality is among the worst. In this case, what is the overall assessment of hospital H2's performance with respect to the perspective of patient satisfaction? An aggregate assessment of the hospitals' performance with respect to patient satisfaction

**Table 8**
*Overall Performance Assessment on Hospital Scorecards*

| | PS | CUO | FPC | SIC | | | | | Performance Priority |
|---|---|---|---|---|---|---|---|---|---|
| H1 | 0.060 | 0.050 | 0.054 | 0.067 | | PS | 0.581 | | H1 0.057 |
| H2 | 0.093 | 0.105 | 0.141 | 0.067 | | CUO | 0.174 | | H2 0.101 |
| H3 | 0.025 | 0.050 | 0.278 | 0.108 | | | | | H3 0.077 |
| H4 | 0.126 | 0.040 | 0.074 | 0.116 | X | FPC | 0.162 | = | H4 0.102 |
| H5 | 0.162 | 0.117 | 0.079 | 0.245 | | SIC | 0.083 | | H5 0.148 |
| H6 | 0.066 | 0.322 | 0.079 | 0.116 | | | | | H6 0.117 |
| H7 | 0.342 | 0.206 | 0.119 | 0.167 | | | | | H7 0.268 |
| H8 | 0.125 | 0.110 | 0.175 | 0.114 | | | | | H8 0.130 |

can be determined by weighting the hospitals' performance priorities on the three indicators of patient satisfaction (global quality, process quality, and housekeeping) with the priorities of the performance indicators determined earlier in the second step. The results of the assessment are given in Table 7, section A. In this case, hospital H7 fares well in the perspective of patient satisfaction, and hospital H3 needs to work harder to improve various areas of patient care. Table 7, sections B, C, and D give the relative performance assessment of the eight hospitals in the other three perspectives of clinical utilization and outcome, financial position and condition, and system integration and change. Accordingly, hospitals H6, H3, and H5 are the best performers in each of the three perspectives, respectively. Hospital H7 is the hospital with consistently good performance in all perspectives whereas hospital H1 is at the other end of the performance continuum. Although Hospital H3 has outstanding performance in the perspective of financial performance and condition, it fares poorly in the perspectives of patient satisfaction as well as system integration and change. Such inconsistencies in performance assessment can be handled in the last step of AHP where the performance priorities of the hospitals in each perspective are weighted by the priorities of the four performance perspectives as determined in the first step. The results in Table 8 indicate that hospital H7 is the best performer and hospital H1 is the worst. Hospital H3 is the second worst performer despite its outstanding performance in financial performance and condition. This is simply because the citizen values the performance perspective of patient satisfaction much more highly than financial performance and condition.

This application of AHP in assessing the hospitals' scorecards has taken into account the citizen's perceived relative importance of the performance perspectives and indicators. The overall performance assessment of the hospitals will depend on how the priorities of the performance perspectives and indicators are perceived by the decision makers who could be hospital administrators, board directors, and government agencies.

## Concluding Remarks and Applied Implications

Formulating strategic goals and monitoring how well they are achieved are complex exercises for an organization. Kaplan and Norton (2001a, 2001b) advocate the BSC as a tool for strategic management in both for-profit and not-for-profit organizations. As BSC is gaining acceptance in the healthcare sector, administrators should be aware of issues that could affect its successful implementation as a strategic management system. Leadership of top management, buy-in of medical and administrative staff, and support of the infrastructure are critical for the change initiative to succeed, and they all can be achieved as long as the organization commits itself to the process. Other implementation issues, more specifically, the interpretation and use of information of BSC in decision support will require training, experiential learning, and as proposed in this paper, an analytic framework for analysis.

Given a healthcare organization's goals, the task of evaluating its performance against competitors and others in the peer group requires some agreement on the priorities of the goals and some ways to synthesize these inputs for comparison across the healthcare sector. With multiple goals and measures in the BSC, information overload may force the decision maker, either consciously or subconsciously, to apply an ad hoc weighting to the data to achieve some overall, comprehensive measure to use for comparative purposes. The analytic hier-

archy process provides a structure as well as an algorithm to develop such a comprehensive measure.

As a multi-attribute decision model, AHP dissects the variables of a decision problem into a hierarchy of criteria, subcriteria, and alternatives. Since there is an intrinsic hierarchy of performance perspectives, performance indicators, and organizational and departmental performance in the hospital scorecard, AHP will not be utilized to decompose and structure the BSC in performance evaluation. AHP, however, is a valuable tool to management as it alleviates the impact of judgment biases, synthesizes the vast amount of information on the BSC, and provides a comprehensive measure for performance assessment. The method also allows for participative inputs both at the stage of setting the priorities for the performance indicators and that of comparing the organizations or departments on the indicators. Using paired comparisons and the eigenvalue approach, priorities of performance perspectives, performance indicators per perspective, organizational and departmental performance per indicator, and overall performance are determined. AHP improves on ad hoc procedures and many other weighting models as consistency of judgments in paired comparisons can be ascertained by evaluating the consistency ratio computed for each matrix of paired comparisons.

Even though AHP provides an improvement over other ad hoc weighting and multi-attribute decision models, it takes time to learn the method and complete the paired comparisons. However, with participative inputs from a number of administrators, their diverse belief systems can be brought together in a consistent and organized way. Since participation gives rise to greater buy-in and commitment from staff of the organization, AHP facilitates conflict resolution when management uses BSC in performance evaluation. Furthermore, the consensus arrived at the priorities of the strategic goals and performance measures allows the organization to manage and monitor its strategies more effectively.

In addition to evaluating an organization's scorecard against those of its competitors, there are many possible futures for AHP in the healthcare sector. For instance, since the Canadian healthcare sector has undergone fundamental system changes in regionalization, AHP can be a valuable tool to the board of directors and management of regional health authorities in evaluating performance of healthcare facilities under its jurisdiction as well as allocating resources among programs and healthcare facilities in the delivery of healthcare services. Apart from AHP applications in performance evaluation and resource allocation, healthcare administrators can set their short-term and long-term competitive goals based on an assessment of their organization's performance priority. The performance perspectives and indicators can also be incorporated in incentive schemes so that achievement of target levels lead to rewards and recognition.

*Limitations and Future Research Discussions*

As noted earlier, there are potential limitations to AHP. Pragmatically, the method may appear complicated and time-consuming. Theoretically, the ratio scale and possible rank reversal may inhibit its applicability. Furthermore, empirical studies on AHP applications thus far have not examined the impact of AHP decisions on managers whose performance and bonus depend on their division's performance priority. For instance, since AHP allows for multiple evaluators in performance assessment, managers may not be able to identify the perspectives and measures that are critical to their division's performance. Thus, further studies that focus on the behavioural impact of AHP decisions on managers would provide better insights on the value of AHP to decision makers. Nevertheless, AHP is a method that has seen a number of applications, especially as an aid to decision-making where multiple viewpoints and multiple objectives, such as that of a BSC, prevail.

## Notes

1 An evaluation of the relative performance of departments normally results in an ordinal ranking, that is, the department with the best performance is ranked number one; the department with the second best performance is ranked number two; etc. However, since the response scale used in AHP is a ratio scale, the resultant vector of priorities is more than an ordinal ranking of the departments' relative performance. The resultant vector specifies how much more (or less) a department's performance is better (or worse) than another department's. Accordingly, in this paper, the term *performance priority* replaces *ranking* when describing the relative performance of a department as compared to another department.

2 The BSC and performance measures for organizations (or business units of an organization) with different strategies are likely to be different. As a strategic management system, an organization's (or business unit's) BSC should include action plans for achieving strategic goals and targets for performance measures. In the case when organizations (or business units) have different BSCs and performance measures, one can still apply AHP to prioritize performance perspectives and measures for each organization (or business unit) independently. Each organization's (or each business unit's) performance should then be evaluated against its goals (targets for performance measures), which are in alignment with its strategies. The overall performance assessment (or priority) of each orga-

nization (or each business unit) against its scorecard or performance targets, as determined by AHP, can then be used to establish the relative performance priorities of organizations (or business units), which have different strategies, balanced scorecards, and performance measures.

3 As indicated by an administrator of a participating hospital, OHA has asked the hospitals not to release the value of the 39 indicators for public consumption. OHA, on the other hand, recommends publishing the hospital scorecard with the five-asterisk scoring system (where ***** = above average performance; *** = provincial average, and * = below average) to avoid public outcry. Theoretically, we should apply AHP to the original data of the 39 indicators. Since the actual data of the 39 indicators are not available, this study has to work with the ordinal data given in the five-asterisk scoring system to illustrate the potential value of AHP in structuring complex decision problems and evaluating hospital performance.

4 It is not informative to compare performance of all 95 hospitals included in OHA's *Hospital Report* because they are different in size, geographical location, specialization, and involvement in medical education. It is only fair to assess a hospital's performance against its peer group, e.g., teaching hospitals in the same region. Furthermore, the number of items under each node in an AHP application should be limited to nine. Thus, pragmatically, a decision maker will evaluate performance of hospitals in a peer group, but not all 95 hospitals simultaneously. Accordingly, when evaluating performance of N hospitals in a peer group, N x (N-1) ÷ 2 paired comparisons are required per performance indicator. With 39 indicators, the number of paired comparisons increases to N x (N-1) ÷ 2 x 39, which can be significant. This is one of the implementation problems with BSC when a large number of performance indicators are used. In fact, one can use the AHP as a screening tool such that performance indicators with relatively low priorities are eliminated first. For instance, stakeholders may decide to include only three performance indicators with the highest priorities for each of the four performance perspectives. In this case, for a peer group of eight hospitals, the maximum number of paired comparisons required is 354 (8 x 7 ÷ 2 x 4 x 3 + 4 x (3 x 2 ÷ 2) + 4 x 3 ÷ 2). Furthermore, as suggested by Harker (1987), the minimum number of paired comparisons of M factors is M – 1, since the paired comparison of two factors, i and k, $a_{ik}$ , is given by $a_{ij}$ x $a_{jk}$ when there is perfect consistency. Accordingly, the minimum number of paired comparisons needed to evaluate the performance of eight hospitals, with three performance indicators for each of the four perspectives, is 95 (7 x 4 x 3 + 4 x 2 + 3). In this way, the task of paired comparisons is more manageable, and it forces the stakeholders to focus on the most important scorecard indicators for performance evaluation. Alternatively, the number of paired comparisons can be reduced within the range of N-1 and N x (N-1)/2, using Harker's (1987) incomplete comparison method.

5 Details of the resultant matrices of the paired comparisons of each set of three performance indicators are available from the author upon request.

6 As a sensitivity analysis, we have used a 5-point response scale in the paired comparisons of performance perspectives and indicators. The resultant priorities are similar to those of a 9-point response scale, with the exception that the ratio of one priority to another is of a smaller magnitude.

7 Details of the resultant matrices of the paired comparisons of the eight hospitals for each performance indicator are available from the author upon request.

8 As a sensitivity analysis, we have used a 5-point response scale in the paired comparisons of hospital performance per indicator. The resultant priorities of the hospitals are not identical to those of a 9-point response scale, and the ratio of one hospital performance priority to another is of a smaller magnitude as compared to the 9-point response scale. The overall performance priority of the best and the worst hospitals, however, are similar between the two response scales.

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