Managing healthcare performance in analytical framework

Prasanta K. Dey, Seetharaman Hariharan and Ozren Despic

1 Introduction

Healthcare services are complex and challenging to measure. Traditionally, healthcare delivery has been evaluated by three categories of measurement: structure, process and outcome (Donabedian, 1980). The progress report "America's best hospitals" released annually since 1990 uses these three quality dimensions to rate the best hospitals in the USA (US News & World Report, 1990). The human and material resources available in each hospital are used to assess the structure of the hospitals. Outcomes are usually evaluated by the standardized mortality ratio (SMR) which is the ratio of the observed to expected mortality rate in each hospital. However, the process dimension has been more difficult to measure; a survey conducted amongst physicians from the American Medical Association asked them to name five "best" hospitals in their respective field using process as the primary factor, but without giving any guidance for which specific measures to use or what techniques should be used to measure them; this highly subjective assessment did not reach a consensus (US News & World Report, 1996). However, the expert stakeholders in this study identified "patient care" and "patient comfort" as the most significant process measures.

Until recently measuring the performance of these was done by prognostic scoring systems such as the "acute physiology and chronic health evaluation" (APACHE); the simplified acute physiology score or the "mortality prediction model" (Zimmerman, 2002). All of these systems consider binomial patient outcome namely "survival" or "death" as the indicators of measurement. These systems incorporate logistic regression equations to predict the mortality for a case-mix in a particular intensive care unit (ICU). The ratio of the predicted mortality to the observed mortality (SMR) is used to compare the performance of different ICUs (Becker and Zimmerman, 1996). Although used by many studies, there are many inherent problems with these models; a study which has used all the three models to compare ICUs from 32 hospitals (Project IMPACT) reported only a fair-to-moderate agreement in the identification of quality measures (Glance et al., 2002). Other studies have reported poor goodness of fit for these scoring systems, implying that the prognostic models do not perform consistently in all ICUs (Marik and Varon, 1999; Markgraf et al., 2000; Katsaragakis et al., 2000). Although patient outcome should always be the primary goal of any ICU, there are many other contributory factors that also have to be considered which are omitted from these scoring systems. Attempts have been made to resolve these omissions using such methods as data envelopment analysis which have helped to improve structural measures (Field and Emrouznejad, 2003; Dlugacz et al., 2002).

Changes in individual ICU outcome factors such as an increase in "mortality rate" could be interpreted as a reduction in the level of overall performance. However, it is imperative that before any conclusions are finalised all possible causes must be considered. Unless an entire system covering input, output and process is analyzed, true performance measure is not possible and improvement is difficult to derive. Moreover, there is lack of integration between performance measurement and implementing means for improvement. Therefore, the objective of this paper is to develop a quantitative model for measuring performance of healthcare services, panning, implementing and evaluating improvement measures.

2 Literature review

Performance management consists of measuring performance, planning, implementing, and evaluating improvement measures. Performance measurement is a means of monitoring and controlling organizations' activities to ensure they achieve predefined objectives (Brignall and Ballantine, 1996); they can be used to quantify both the efficiency and effectiveness of activities (Neely et al., 1995). Conventional performance measurement models have focused on the achievement of a limited number of key financial measures like earnings per share and return on investment (Johnson and Kaplan, 1987). However, many researchers (Brignall et al., 1992; Euske et al., 1993; Fitzgerald et al., 1991; Govindarajan and Gupta, 1995; Gregory, 1993; Lynch and Cross, 1991; Nanni et al., 1992; Neely, 1995; Shank and Govindarajan, 1992) have highlighted the shortcomings of finance-based performance measurement models. For example, Eccles and Pyburn (1992) argue that one of the major limitations of using

financial measures of performance is that they are the results of management actions and organizational performance, and not the cause of it. Whilst Emmanuel and Otley (1985) argue that organizational success depends not only on achieving financial measures, but also how well the organization adapts to the environment within which it exists. One of the common key weaknesses of performance measurement systems adopted by many firms is being overly narrow, or even uni-dimensional in focus (Neely et al., 2000). To deal with the new challenges, new performance measurement systems have been proposed, such as the activity-based costing system (Cooper, 1988a, b, c, 1989), the balanced score card (Kaplan and Norton, 1992, 1996), the SMART system (Cross and Lynch, 1988/1989), and the performance measurement questionnaire (Dixon et al., 1990).

Despite these numerous frameworks being available for developing performance measurement systems, very few studies have specifically tried to quantify their effect upon actual performance. Some notable exceptions are however documented by Lee et al. (1995), Rangone (1996), Liberatore and Miller (1998), Suwignjo et al. (2000) and Bititci et al. (2001) using examples drawn predominantly from the manufacturing sector. These frameworks are undoubtedly valuable but their effective use is often limited by mis-implementation (Neely et al., 2000). Moreover, although they have considered multiple factors (both objective and subjective) for performance measurement, none of the models analyze the success factors of an entire system.

In healthcare, performance measurement methods emphasize on consideration of multiple factors. Schneider et al. (1999) suggested that in order to track clinical performance just clinical data are not sufficient to develop information systems, but an integrated health information framework needs to be developed. Li and Benton (1996) reviewed researches on criteria for performance measurement for healthcare organizations. Additionally, Galvin and McGlynn (2003) have shown that performance measurement is not only identifying the means for improvement, but also developing a road map for improvement.

Researchers have suggested use of various tools and techniques for healthcare performance measurement and management. Majority of the works suggested the application of process reengineering (Kwak and Lee, 2002), benchmarking (Maleyeff, 2003), balanced score card (Inamdar et al., 2002), analytic hierarchy process (AHP) (Dey et al., 2006), and Fuzzy theory (Nieto and Torres, 2003). All of the above frameworks identify multiple factors for performance evaluation, analyze them with the involvement of the concerned stakeholders, quantify performance parameters and suggest improvement measures. However, none of the frameworks suggest planning, implementing and evaluating frameworks for the improvement measures. This is very improvement as quality initiatives should bring changes in the organization level with due consideration of strategic intent. Therefore, this study bridges the gaps.

3 Methodology

This study uses case study method and develops a conceptual framework for performance measurement and implementing improvement projects. It adopts a combined AHP and logical framework approach (LFA). AHP helps model relative performance of the system under study and logical framework (LOGFRAME) plans, implements and evaluates improvement projects dynamically in order to achieve operational excellence. The proposed framework was the applied to three ICUs of three hospitals in the developing countries in order to identify improvement projects of one ICU for superior performance and developing project plans for implementing improvement measures. Numerous stakeholder focus groups were held to:

- understand the services under investigation in depth;
- to scope, develop and validate the performance measurement model; and
- to assess the model's impact on performance and derive initiatives for improvement.

3.1 Analytic hierarchy process and logical framework

The AHP developed by Saaty (1980) provides a flexible and easily understood way of analyzing complicated problems. It is a multiple criteria decision making technique that allows subjective as well as objective factors to be considered in a decision making process. AHP allows the active participation of stakeholders and gives managers a

rational basis on which to make decisions (Saaty, 1983). AHP is based on the following three principles: decomposition, comparative judgement, and synthesis of priorities. AHP is a theory of measurement for dealing with quantifiable and intangible criteria that has been applied to numerous areas, such as decision theory and conflict resolution (Vargas, 1990).

Performance measurement is usually a team effort, and AHP is one available method for forming a systematic framework for group interaction and group decision making (Saaty, 1982). Dyer and Forman (1992) describe the advantages of AHP in a group setting as follows:

- both tangibles and intangibles, individual values and shared values can be included in an AHP-based group decision process;
- the discussion in a group can be focused on objectives rather than alternatives;
- the discussion can be structured so that every factor relevant to the discussion is considered in turn; and
- in a structured analysis, the discussion continues until all relevant information from each individual member in a group has been considered and a consensus choice of the decision alternative is achieved.

Further, detailed discussion for conducting AHP-based group decision-making sessions are given by Saaty (1982) and Golden et al. (1989); these include: suggestions for assembling the group; constructing the hierarchy; getting the group to minimize inequalities of power, concealed or distorted preferences; and how to implement any results. Problems using AHP in group decision making are discussed further by Islei et al. (1991). AHP has been applied in numerous areas including supplier selection (Chen and Huang, 2007), logistics performance measurement (Chan and Chan, 2006) and post project evaluation (Dey, 2002).

The LFA is an effective strategic planning and project management methodology with wide applications (Akroyd, 1999, 1995a, b; Argeetey, 1998; Cordingley, 1995). It comprises an integrated package of tools for analyzing and solving planning problems, and for designing and managing their solutions within a stakeholder participatory framework. LFA was developed in the USA and has since been adopted and adapted for use by many other donors, including the Department for International Development (DFID) in the UK (DFID, 1997). A LOGFRAME summarizes, in standard format (Dey and Hariharan, 2006) what the project is going to achieve, what activities will be carried out to achieve its outputs and purpose, what resources are required, what are the potential problems which could affect the success of the project, and how the progress and ultimate success of the project will be measured and verified.

The method is robust and more disciplined than traditional expert-driven planning tools. Its effectiveness is enhanced by early and intimate involvement of stakeholders in the design phase, systematic logical analysis of problems, and application of a matrix in which development goals, activities, impact indicators and risk are all logically related in a succinct organizational framework.

This method is now widely used in a number of countries, as well as by the main international and bilateral aid agencies, for formulating strategies, designing regional and community development programs and investment projects. However, according to the authors' knowledge this study is the first application of LFA for improving services quality in general and healthcare in specific.

LOGFRAME is an analytical management tool, which helps managers to analyze the existing situation during project preparation, establish a logical hierarchy of means by which objectives will be reached, identify the potential risks to achieve the objectives and to sustain the outcomes, establish how outputs and outcomes might best be monitored and evaluated, present a summary of the project in a standard format, monitor and review projects during implementation, communicate project information, make decisions across various phases of project, and evaluate project after completion.

The approach involves problem analysis, stakeholder analysis, developing a hierarchy of objectives and selecting a preferred implementation strategy. The product of this analytical approach is the matrix (the LOGFRAME), which

summarizes the intentions and modus operandi of the project, its key assumptions and the methods of monitoring and evaluating outputs and outcomes.

In the early 1970s, LFA was first formally adopted by the USAID as a planning tool for overseas development activities. LFA has since been successfully applied as a planning and management tool by a variety of agencies. Despite some criticisms, LFA has become widely accepted and its use continues to expand into new areas. This is because it not only helps to provide a standardized summary and the logic of a project, but also applicable to various functions of any organization. The present study adds another new dimension to its application. LOGFRAME has been applied in many healthcare projects in the public health arena, which includes implementation of national level tuberculosis project, HIV/AIDS project, malaria project, etc. (Dey and Hariharan, 2006).

LFA's main strength lies in its diagnostic capability. It provides a sound basis for identifying problems and for generating appropriate solutions and interventions to achieve specific objectives and goals. It has three basic steps:

1. brainstorming for problem analysis and deriving solutions;
2. formulating a LOGFRAME from above objective analysis; and
3. systematic monitoring and evaluating using key success indicators before, during and after implementation.

Dey and Hariharan (2006) has shown application of LOGFRAME in critical care.

In summary, AHP helps analyze performance of specific healthcare system by benchmarking with other systems with the consideration of multiple factors through group decision-making approach and LFA helps plan, implement and evaluate improvement measures.

4 A new performance measurement model using AHP

The proposed model has the following six steps:

1. Identify factors to measure performance. Leidecker and Bruno (1984) define critical success factors as the characteristics, conditions or variables that can have a major impact on the success of the company in a certain industry if they are properly sustained, maintained and managed. Such critical success factors form the basis for the proposed framework, as they are the key variables on which an organization should focus and measure. The outcome, structure and process categorisation of factors considers every aspect of an organization at a high level. Stakeholders are interviewed to determine critical sub-factors under each category.
2. Identify organizations/services that can provide a comparative analysis. This is a challenging task as the success of performance measurement depends on it. Many organizations use criteria such as similarity between operations, an organizations' desire to share information, availability of information, commonality of business attributes, achieved performance levels in order to select a comparator.
3. Develop a hierarchical model in an AHP framework. An AHP-based model is formulated whose first level is the goal: to define the performance for a specific service. The second level defines factors to achieve that goal, such as: structure, outcome and process of the service under study. The third level defines the sub-factors for success with respect to structure, outcome and process. The forth level defines the sub-sub-success factors. Whilst the last level presents the alternative outcomes.
4. Analyse service performance using the AHP framework. This will determine the comparative measures of performance for the systems under study. First, the factors in the second level are pair-wise compared in order to derive their importance. Similarly, the critical success factors and sub-factors of system components are also pair-wise compared in order to determine their importance for measuring service performance. Lastly, the alternate services are compared with respect to each critical sub-sub-factor. Subsequently, the results are synthesized across the hierarchy in order to derive the relative performance of alternate options for the services under study.

5. Derive improvement measures. The above analysis helps decision makers to derive improvement measures to catalyse change.
6. Plan, implement and evaluate improvement measures. Subsequent planning, implementation and dynamic evaluation of improvement measures should ensure superior performance, which completes the entire cycle of the performance management.

All the above steps are required to be repeated iteratively in order to keep the spirit of performance improvement up and to remain competitive.

5 Application

The proposed AHP-based model has been applied to the ICUs of three hospitals in three developing nations (Barbados, Trinidad and India) in order to show the effectiveness of the newly proposed model. The complex alternatives decision options generated in this study are now discussed.

5.1 How the study was conducted for the ICUs of three hospitals

The model was applied to the surgical ICU of the Queen Elizabeth Hospital, affiliated to the University of the West Indies, Barbados; the ICU of the Eric Williams Medical Sciences Complex, Mount Hope, in Trinidad; and the ICU of University General Hospital, Vijayawada in India. All the hospitals are tertiary care teaching hospitals with a comparable profile of capabilities.

The study was conducted using a series of focus groups, held in Barbados, involving clinical professionals (15 anaesthesiologists, five senior nurses (sisters) and ten staff nurses) from all three hospitals who were involved in the day-to-day management of the ICUs, each of these participants had more than 15 years experience of working in ICUs.

Prior to engaging in an in-depth performance measurement exercise the authors conducted an informal session with the participants to equalise the knowledge about each of the three ICUs. Additionally, all the participants had been educated with a working knowledge of AHP and use of the supporting software (Expertchoice™). Factors at every level were identified using through brainstorming; this enabled the researchers to objectively develop a hierarchical structure of factors, sub-factors and sub-sub-factors and alternates for analyzing operational level performance. The ICU professionals of each hospital were asked to prepare performance data against each appropriate level of factor for the AHP hierarchy (Table I). The pair-wise comparison for all factors and the alternative options were carried out using Saaty's scale (1980) in a group consensus building scenario. These derived the relative performance of the system under study by comparing the factors within levels of the hierarchy. Finally, the improvement suggestions were presented to the directors of the respective hospitals. The remainder of this section describes each methodological step of the application in detail.

5.1.1 Step 1. Identify factors to measure performance

The clinical professionals identified measures of performance for patient care in the ICUs under the factors of structure, outcome and process as follows.

5.1.1.1 Processes

Process was divided into sub-factors: patient care and patient comfort. The sub-sub-factors related to patient care were:

- Therapeutic interventions – aggressive interventions such as invasive lines, early tracheotomy in deserving patients, bedside procedures.
- Monitoring – availability of constant monitoring conditions for all the patient parameters.
- Admission-discharge protocols – defining admission and discharge criteria and adhering to them.
- Daily rounds – organizing rounds to review patients' condition and progress.
- Case conferences – conducting regular case conferences to avoid future mortalities.

The sub-sub-factors relating to patient comfort were:

- Sedation – appropriate use of sedatives and muscle relaxants.
- Audiovisual comforts – providing music and television for appropriate patients.
- Attitudes of staff – friendly behaviour of staff towards patients and relatives.

5.1.1.2 Structure

Performance of an ICU depends upon the availability of the overall resources and facilities in the ICU. Sub-factors were identified as:

- Capital equipment – ensuring state-of-art technology equipment.
- Staffing – adequate and competent medical, nursing, paramedical and support.
- Maintenance – appropriate and regular maintenance of equipment by a dedicated bio-medical engineering team.
- Supply-chain management – ensuring a constant supply (sub-sub-factors were identified as drugs and materials, establishing good interdepartmental and intradepartmental communication and maximising the availability of related departments such as laboratory and radiology).

5.1.1.3 Outcome

The participants considered morbidity of a patient as an adverse patient occurrence resulting from either a prolonged stay in the ICU/hospital, a disability caused during the hospital stay and/or after discharge. Morbidity is an important factor in the assessment of the quality of an ICU, because a poorly performing ICU may show an increased morbidity of patients, even if mortality may be to the expected standards. Morbidity/mortality of the patients are influenced by these factors:

- Patient factors – the initial patient condition – clinical presentation of the patients in an ICU.
- Iatrogenic complications – reducing complications caused by therapeutic procedures and drugs to minimum.
- Nosocomial infections – hospital acquired infections being minimal.
- Antimicrobial drugs – avoiding inappropriate and overuse of antimicrobials by establishing and adhering to prescription protocols.
- Patient nutrition – ensuring the availability of enteral and parenteral nutrition (nutrition offered to critically ill patients either by the alimentary route or by intravenous route) and appropriately using them.

5.1.2 Step 2. Identify organizations/services that can provide a comparative analysis

The ICUs of three different hospitals were chosen: that had identified a desire to increase performance through a comparative study. There were enough similarities between each of the hospitals to make a meaningful comparison, as they were all tertiary care teaching hospitals in developing countries. There were also enough differences present, such as varied socio-economic parameters, to provide potential for interesting within-case and across-case analysis to ensure learning could take place.

5.1.3 Step 3. Develop a hierarchical model in an AHP framework

Figure 1 shows the hierarchical performance measurement model for ICUs in an AHP framework. The first level (Level I) identifies the goal for the ICUs, the second level (Level II) identifies the process, structure and outcome of the entire system, whilst the third level (Level III) identifies the critical success sub-factors with respect to process, structure and outcome. The forth level (Level IV) identifies the critical success sub-sub-factors. The last level (Level V) consists of three alternate options for the ICUs.

5.1.4 Step 4.Analyze service performance using the AHP framework

The next step determined the importance of each factor and sub-factor through a pair-wise comparison. Extensive brainstorming sessions were held and the priorities were derived by comparing the factors and alternatives in a pair-

wise fashion (Wind and Saaty, 1980). A nine-point numerical scale was used for the comparison. The intensity and the definitions of the pair-wise comparison are given in Table II.

The numerical representations for each critical success factor in the nine-point scale were derived through a combination of consensual discussion, voting, and averaging (Dyer and Forman, 1992). A normalized matrix was derived from these comparisons. The overall importance of the factors is the average of all the weights for each factor (Table III). The relative importance of each sub-factor was derived in a similar manner. Consistency checks of each normalized matrix revealed that consistency ratio was < 0.1.

The next step was to derive preferences for each ICU (Barbadian, Trinidadian and Indian) with respect to all factors. The researchers developed proxies against each subfactor and database was formulated for each ICU (Table I). Again, focus group discussions were carried out with the involvement of the clinical professionals using a Saaty type scale (Table I). and the results were synthesized across the hierarchy to determine the relative ranking of each ICU. Table IV shows the overall result.

5.1.5 Step 5. Derive improvement measures

The clinical professionals identified that the process factor was the single most important for improving the performance of the ICUs and that patient care and patient comfort were judged as equally significant. The monitoring of patients' conditions and sedations were the most important criteria of patient care and patient comfort, respectively.

The structure and outcomes of ICUs were judged to be less important than process, but had equal importance to one another. The adequacy of staff (doctors, nurses and support) was the judged to be the main criteria for better performance of structure. The outcome was mainly influenced by patient factor (severity of illness at the time of initial admission) and availability of equipment.

The overall ranking revealed that the Barbadian ICU performed much better (44 percent) than both the Trinidadian ICU (33 percent) and the Indian ICU (23 percent) (Table IV). However, the participants agreed that although the Barbadian ICU outranked the other ICUs, there was still room for improvement in the areas of: patient admission and discharge protocols; the organization of daily rounds; an improvement to staff attitude to patients and their families; inter and intra-departmental communication as well as dealing with iatrogenic complications (i.e. patient-care induced disease).

The analysis revealed that the Indian ICU required improvement in all areas of ICU operations except for two important patient care factors (admission and discharge protocol and the organization of daily rounds). A socio-economic explanation for the comparatively poor performance of Indian ICU was the patient factor (severity of initial illness whilst reporting to the ICU).

The results also showed that the Trinidadian ICU needed to improve their performance substantially in areas such as: patient care, sedation, equipment availability, staffing, availability of drugs, staff attitude, inter and intra-departmental communication, as well as iatrogenic complication and nosocomial infection.

Overall, the sensitivity analysis of the results revealed that improvement of ICU processes (sedation and staff attitude to patients) to improve patient comfort would substantially improve the performance of the ICUs. Additionally, the performance of ICUs was very sensitive to the factors like patient care monitoring, sedation, staff attitude, equipment availability, staffing and patient factor.

5.1.6 Step 6. Plan, implement and evaluate improvement measures

The above steps generated a number of improvement recommendations for each ICU that became improvement projects; each of these requiring a project manager and a LOGFRAME for deploying project management tools and techniques (Dey et al., 2006).

These included the following three projects for Barbadian ICU:

1. organizing separate training programs for doctors, nurses and support staff;
2. developing information technology-based communication network in order to establish admission discharge protocol and facilitate intra and inter departmental communication; and
3. managing supply chain effectively.

A problem tree was formed as shown in Figure 2 in order to derive the root causes of current performance of the system under study and a corresponding objective tree (Figure 3) provided the solutions to the issues. A LOGFRAME (Table V) was then developed using the information from the objective trees and other planning documents. The helped develop detailed project plan, implement and evaluate improvement projects.

All the projects are currently in various stages of implementation. The Steps 1-6 should be conducted periodically to reassess operational performance.

6 Discussion

Multi-dimensional performance measurement models are routinely deployed by researchers and practitioners using both qualitative and quantitative approaches to measure systems performance holistically in order to suggest improvement actions – this is commonly seen in both the manufacturing and service sectors. Each model tends to have its own advantages and disadvantages; for instance some models are just frameworks without implementation guidelines, and are therefore very difficult to use. This study proposes a multi-factorial quantitative performance measurement model based on the AHP method. The steps discussed above show how performance measures for organizational systems are derived and applied in a group decision-making framework. Completion of one cycle often initiates the beginning of a new cycle as achieving quality improvement is a continual endeavour.

This study has shown that measuring operational quality levels of healthcare delivery may be done by three parameters namely structure of the unit, process of care and outcome of patients, as described by Donabedian (1988). There have been controversies regarding process-based and outcome-based methods of quality assessment in healthcare services: the process-based quality measure may not be able to predict the outcome, and outcome-based quality measures may not always consider differences in patients due to factors beyond the control of physicians (Brook and McGlynn, 1996). Often, either such models fail to incorporate all three factors, or include all three parameters but do not then create a link between the process and the outcome (Lurie et al., 2002). The model proposed as a result of this research embodies all three factors and forms a link between them. The model also attaches more significance to measuring the processes of ICUs than the outcome of patients.

The specific and primary aim of ICUs after their introduction as a separate specialty has been prevention of mortality (Nierman, 2002). However, it is debatable whether mortality alone can be a reliable indicator for the measurement of ICU performance (Sherck and Shatney, 1996). Many patients admitted to ICUs may already have severe conditions and provision of the best possible care does not necessarily ensure preventing mortality. Therefore, even if a well-performing ICU is available, many other factors may influence the survival of the patient. This multi-factor aspect has been affirmed by another recent study (Rotondi et al., 2002).

In contrast to the mortality which depends predominantly on the patient factor, morbidity depends more on the ICU-care factor; therefore measuring morbidity will reflect the quality levels of the ICU service better than the mortality level. Hence, we included morbidity as the main outcome measure.

In previously published research, the researchers have utilized the APACHE II scoring system to compare the performance of Barbadian ICUs with the ICUs of developed countries using the SMR as the tool for comparison (Hariharan et al., 2002). The Barbadian ICU performed equally well compared to one in a developed country. This study furthers that research by considering many other factors in addition to mortality.

In the authors' view, patient comfort is a factor that has been most often ignored in evaluating an ICU performance. Providing better patient comfort should be considered as one of the most important aspects of ICU performance, which mortality-based models often do not take into account at all. If this factor is overtly used as measure of performance then, in general, the ICU nurses are motivated to provide much better patient comfort. The mortality rate of the Barbadian ICU is around 16 percent, which means 84 out of 100 patients recover from their critical illness. Therefore, it makes lot of sense when the clinical professionals emphasize providing a better patient comfort for the majority of the ICU patients and improves the measure of morbidity. The importance of the patient factor is now being recognized as, “what is best for the patient is best for the ICU” (Green, 2001).

There are many advantages of the proposed AHP and LOGFRAME-based performance management model. They are as follows:

- Services are multi-factorial and the factors are both objective and subjective in nature. The proposed model can analyze system performance with the consideration of both objective and subjective factors.
- The model is based on quantitative analysis.
- The model considers views of the process owners.
- Performance measurement is a group decision-making process, and the model works in a group consensus situation.
- The proposed model is dynamic in nature and helps organizations to continuously monitor performance.
- The model is easily understandable and user-friendly.
- The model enables deficiencies to be identified in the area under investigation allowing specific improvement initiatives to be undertaken.
- The sensitivity utility of the model allows prioritization of improvement measures.
- It allows benchmarking to be performed.
- Consideration of critical success factors for the entire system provides holistic measures of system performance and derives the means for improving performance.
- It helps to plan, implement and evaluate improvement projects.
- It links operational requirements with strategic intent of the organizations.

However, the proposed AHP based models do suffer from the following shortcomings:

- Although this study made every effort to quantify performance measures by modelling all factors of success in specific service operations in accordance with perceptions of experienced process owners, subjectivity could not be eliminated.
- Although this model allows a comparative analysis of performance to be performed arising in suggested improvement measures, it fails to derive an independent absolute performance measurement of a system.
- Although the study was conducted with the consensus judgement of the concerned stakeholders, differences of opinion were also observed in a few cases, which were resolved by detailed discussions.

Nevertheless, on the whole, AHP and LOGFRAME-based approaches have been useful in dealing with multiple hierarchical factors in many different qualitative problem domains.

7 Conclusion

The basic purpose for any performance management system is to drive continuous improvement and enhance operational performance in order to remain competitive. Consideration of appropriate factors (sub and sub-sub-factors) for success, an appropriate quantitative measurement framework, clear methodological steps for application that involve process owners and a group decision-making framework for deriving improvement measures are all essential ingredients to make this happen which the model proposed by this research contains. The AHP approach provides a quantitative hierarchical framework for performance measurement and LOGFRAME helps formulate projects for ensuring superior performance. The proposed framework involves process owners, desires

management commitment by linking operational requirements with the strategic intent of the organizations, focuses on customers' needs, has process orientation and hence goes with total quality management principle. Additionally, it follows entire PDCA cycle as proposed by Deming. This study indicates that the same techniques could be applied in other service operations such as higher education, tourism and various industrial services.

[UNAVAILABLE IN THIS VERSION]:

Figure 1Performance measurement model for ICUs of hospitals in analytic hierarchy process framework

Figure 2Problem tree for improving quality of the ICU

Figure 3Objective tree for improving quality of the ICU

Table IICU proxies

Table IINine-point scale for pair-wise comparison

Table IIIPair-wise comparison and normalized matrix of the factors

Table IVComparative analysis of ICU performance within the AHP framework

Table VLogical framework

References

Akroyd, D. (1995a), "The logical framework approach and the post-evaluation of health sector projects by the African Development Bank", Project Appraisal, Vol. 10 No.4, pp.210-22.

Akroyd, D. (1995b), "Steps toward the adoption of logical framework approach in the African Development Bank: some illustrations for agricultural sector projects", Project Appraisal, Vol. 10 No.1, pp.19-30.

Akroyd, D. (1999), "Logical framework approach to project planning, socio-economic analysis and to monitoring and evaluation services: a smallholder rice project", Impact Assessment and Project Appraisal, Vol. 17 No.1, pp.54-66.

Argeetey, E. (1998), "Consultative processes in community development in Northern Ghana", Community Development Journal, Vol. 33 No.4, pp.301-33.

Becker, R.B., Zimmerman, J.E. (1996), "ICU scoring systems allow prediction of patient outcomes or comparison of ICU performance", Critical Care Clinic, Vol. 12 pp.503-14.

Bititci, U.S., Suwignjo, P., Carrie, A.S. (2001), "Strategy management through quantitative performance measurement systems", International Journal of Production Economics, Vol. 69 pp.15-22.

Brignall, S., Ballantine, J. (1996), "Performance measurement in service business revisited", International Journal of Service Industry Management, Vol. 7 No.1, pp.6-31.

Brignall, T.J., Fitzgerald, L., Johnston, R., Silvestro, R., Voss, C. (1992), "Linking performance measures and competitive strategy in service businesses: three case studies", in Drucy, C. (Eds),Management Accounting Handbook, Butterworth-Heinemann, Oxford, in conjunction with CIMA, pp.196-216.

Brook, R.H., McGlynn, E.A. (1996), "Measuring quality of care", New England Journal of Medicine, Vol. 335 pp.966-9.

Chan, F.T.S., Chan, H.K. (2006), "An analytic hierarchy process approach in benchmarking logistics performance of postal industry", Benchmarking International Journal, Vol. 13 No.6, pp.636-61.

Chen, Y.M., Huang, P.N. (2007), "Bi-negotiation integrated analytic hierarchy process in supplier selection", Benchmarking International Journal, Vol. 14 No.5, pp.575-93.

Cooper, R. (1988a), "The rise of activity-based cost systems: Part I – what is an activity-based cost system?", Journal of Cost Management, Summer, pp.45-54.

Cooper, R. (1988b), "The rise of activity-based cost systems: Part II – when do I need an activity-based cost system?", Journal of Cost Management, Fall, pp.41-8.

Cooper, R. (1988c), "The rise of activity-based cost systems: Part III – how many cost driver do you need and how you select them?", Journal of Cost Management, Winter, pp.34-46.

Cooper, R. (1989), "The rise of activity-based cost systems: Part IV – what do activity-based cost system look like?", Journal of Cost Management, Spring, pp.34-46.

Cordingley, D. (1995), "Incorporating the logical framework into the management of technical co-operation projects", Project Appraisal, Vol. 10 No.2, pp.103-12.

Cross, K.F., Lynch, R.L. (1988/1989), "The SMART way to sustain and define success", National Productivity Review, Vol. 8 No.1, pp.23-33.

Dey, P.K. (2002), "Benchmarking project management practices of Caribbean organizations using analytic hierarchy process", Benchmarking International Journal, Vol. 9 No.4, pp.326-56.

Dey, P.K., Hariharan, S. (2006), "Integrated approach to healthcare quality management: a case study", The TQM Magazine, Vol. 18 No.6, pp.583-605.

Dey, P.K., Hariharan, S., Clegg, B. (2006), "Measuring the operational performance of intensive care units using the analytical hierarchy process approach", International Journal of Operations & Production Management, Vol. 26 No.8, pp.849-65.

DFID (1997), "Guidelines on humanitarian assistance, includes guidance on preparing log frames", May, available at: http://62.189.42.51./DFIDstage/faqs/files/guidelines_on_humanitarian_assistance _v5.0a.doc, .

Dixon, J.R., Nanni, A.J., Vollman, T.E. (1990), The New Performance Challenges: Measuring Operations for World Class Competition, Dow Jones-Irwin, Homewood, IL, .

Dlugacz, Y.D., Stier, L., Lustbader, D., Jacobs, M.C., Hussain, E., Greenwood, A. (2002), "Expanding a performance improvement initiative in critical care from hospital to system", Jt. Comm. Journal Quality Improvement, Vol. 28 pp.419-34.

Donabedian, A. (1980), "Basic approaches to assessment: structure, process and outcome", The Definition of Quality and Approaches to Its Assessment, Health Administration Press, Ann Arbor, MI, pp.77-128.

Donabedian, A. (1988), "The quality of care – how can it be assessed?", JAMA, Vol. 260 pp.1743-8.

Dyer, R.F., Forman, E.H. (1992), "Group decision support with the analytic hierarchy process", Decision Support Systems, Vol. 8 pp.99-124.

Eccles, R.G., Pyburn, P.J. (1992), "Creating a comprehensive system to measure performance", Management Accounting, October, pp.41-4.

Emmanuel, C., Otley, D. (1985), Accounting for Management Control, Chapman & Hall, London, .

Euske, K.J., Ledas, M.J., McNair, C.J. (1993), "Performance measurement in an international setting", Management Accounting Research, Vol. 4 pp.275-99.

Field, K., Emrouznejad, A. (2003), "Measuring the performance of neonatal care units in Scotland", Journal of Medical System, Vol. 27 pp.315-24.

Fitzgerald, L., Johnston, R., Brignall, S., Silvestro, R., Voss, C. (1991), Performance Measurement in Service Business, CIMA, London, .

Galvin, R.S., McGlynn, E. (2003), "Using performance measurement to drive improvement: a road map for change", Medical Care., Vol. 41 No.1, .

Glance, L.G., Osler, T.M., Dick, A. (2002), "Rating the quality of intensive care units: is it a function of the intensive care scoring system?", Critical Care Medicine, Vol. 30 pp.1976-82.

Golden, B.L., Wasli, E.A., Harker, P.T. (1989), The Analytic Hierarchy Process: Applications and Studies, Springer, New York, NY, .

Govindarajan, V., Gupta, A.K. (1995), "Linking control systems to business unit strategy: impact on performance", Accounting, Organization and Society, Vol. 10 No.1, pp.51-66.

Green, T.P. (2001), "What is best for the patients is the best for the intensive care unit", Critical Care Medicine, Vol. 29 pp.2038-9.

Gregory, M.J. (1993), "Integrated performance measurement: a review of current practice and emerging trend", International Journal of Production Economics, Vol. 30/31 pp.51-66.

Hariharan, S., Moseley, H.S.L., Kumar, A.Y. (2002), "Outcome evaluation in a surgical intensive care unit in Barbados", Anaesthesia, Vol. 57 pp.434-41.

Inamdar, N., Kaplan, R.S., Bower, M. (2002), "Applying the balanced score card in healthcare provider organizations", Journal of Healthcare Management, Vol. 47 No.3, pp.179-95.

Islei, G., Lockett, G., Cox, B., Stratford, M. (1991), "A decision support system using judgmental modeling: a case of R&D in the pharmaceutical industry", IEEE Transaction on Engineering Management, Vol. 38 pp.202-9.

Johnson, T., Kaplan, R. (1987), Relevance Lost: The Rise and Fall of Management Accounting, Harvard Business School Press, Boston, MA, .

Kaplan, R.S., Norton, D.P. (1992), "The balanced scorecard – measures that drive performance", Harvard Business Review, January/February, pp.71-9.

Kaplan, R.S., Norton, D.P. (1996), The Balanced Scorecard – Translating Strategy into Action, Harvard Business School Press, Boston, MA, .

Katsaragakis, S., Papadimitropoulos, K., Antonakis, P. (2000), "Comparison of acute physiology and chronic health evaluation II (APACHE II) and simplified acute physiology score II (SAPS II) scoring systems in a single Greek intensive care unit", Critical Care Medicine, Vol. 28 pp.426-32.

Kwak, N.K., Lee, C.W. (2002), "Business process reengineering for health-care system using multicriteria mathematical programming", European Journal of Operational Research, Vol. 140 No.2, pp.447-58.

Lee, H., Kwak, W., Han, I. (1995), "Developing a business performance evaluation system: an analytic hierarchy model", The Engineering Economist, Vol. 40 No.4, pp.343-57.

Leidecker, J.K., Bruno, A.V. (1984), "Identifying and using critical success factors", Long Range Planning, Vol. 17 pp.23-32.

Li, L.X., Benton, W.C. (1996), "Performance measurement criteria in health care organizations: review and future research directions", European Journal of Operational Research, Vol. 93 No.3, pp.449-68.

Liberatore, M.J., Miller, T. (1998), "A framework for integrating activity-based costing and the balanced scorecard into the logistics strategy development and monitoring process", Journal of Business Logistics, Vol. 19 No.2, pp.131-54.

Lurie, J.D., Merrens, E.J., Lee, J., Splaine, M.E. (2002), "An approach to hospital quality improvement", Med. Clin. N. Am., Vol. 86 pp.825-45.

Lynch, R.L., Cross, K.F. (1991), Measure Up! Yardstick for Continuous Improvement, Basil Blackwell, Oxford, .

Maleyeff, J. (2003), "Benchmarking performance indices: pitfalls and solutions", Benchmarking International Journal, Vol. 10 No.1, pp.9-28.

Marik, P.E., Varon, J. (1999), "Severity scoring and outcome assessment: computerized predictive models and scoring systems", Critical Care Clinic, Vol. 15 pp.633-46.

Markgraf, R., Deutschinoff, G., Pientka, L., Scholten, T. (2000), "Comparison of acute physiology and chronic health evaluations II and III and simplified acute physiology score II: a prospective cohort study evaluating these methods to predict outcome in a German interdisciplinary intensive care unit", Critical Care Medicine, Vol. 28 pp.26-33.

Nanni, A.J., Dixon, J.R., Vollmann, T.E. (1992), "Integrated performance – management accounting to support the new manufacturing realities", Journal of Management Accounting Research, Vol. 7 pp.1-19.

Neely, A. (1995), "Performance measurement system design: theory and practice", International Journal of Operations & Production Management, Vol. 15 pp.4.

Neely, A., Borne, M., Kennerley, M. (2000), "Performance measurement system design: development and testing a process-based approach", International Journal of Operations & Production Management, Vol. 20 No.10, pp.1119-45.

Neely, A., Gregory, M.J., Platts, K.W. (1995), "Performance measurement system design: a literature review and research agenda", International Journal of Operations & Production Management, Vol. 15 No.4, pp.80-116.

Nierman, D.M. (2002), "A structure for chronically critically ill", Critical Care Clinic, Vol. 18 pp.477-91.

Nieto, J.J., Torres, A. (2003), "Midpoints for fuzzy sets and their application in medicine", Artificial Intelligence in Medicine, Vol. 27 No.1, pp.81-101.

Rangone, A. (1996), "An analytical hierarchy process framework for comparing the overall performance of manufacturing departments", International Journal of Operations & Production Management, Vol. 16 No.8, pp.104-19.

Rotondi, A.J., Sirio, C.A., Angus, D.C., Pinsky, M.R. (2002), "A new conceptual framework for ICU performance appraisal and improvement", Journal of Critical Care, Vol. 17 pp.16-28.

Saaty, T.L. (1980), The Analytic Hierarchy Process, McGraw-Hill, New York, NY, .

Saaty, T.L. (1982), Decision Making for Leaders, Lifetime Learning, New York, NY, .

Saaty, T.L. (1983), "Priority setting in complex problems", IEEE Transaction on Engineering Management, Vol. 30 pp.140-55.

Schneider, E.C., Riehl, V., Courte-Wienecke, S., Eddy, D., Sennett, C. (1999), "Enhancing performance measurement: NCQA's road map for a health information framework", Journal of American Medical Association, Vol. 282 pp.1184-90.

Shank, J.K., Govindarajan, J. (1992), "Strategic cost management: the value chain perspective", Journal of Management Accounting Research, Fall, pp.178-98.

Sherck, J.P., Shatney, C.H. (1996), "ICU scoring systems do not allow prediction of patient outcomes or comparison of ICU performance", Critical Care Clinic, Vol. 12 pp.515-23.

Suwignjo, P., Bititci, U.S., Carrie, A.S. (2000), "Quantitative models for performance measurement system", International Journal of Production Economics, Vol. 64 pp.231-41.

US News & World Report (1990), "America's best hospitals", US News & World Report, April 30, pp.51-85.

US News & World Report (1996), "America's best hospitals", US News & World Report, New York, NY, .

Vargas, L.G. (1990), "An overview of the analytic hierarchy process and its applications", European Journal of Operation Research, Vol. 48 No.1, pp.2-8.

Wind, Y., Saaty, T.L. (1980), "Marketing applications of the analytic hierarchy process", Management Science, Vol. 26 pp.641-58.

Zimmerman, J.E. (2002), "Measuring intensive care performance: a way to move forward", Critical Care Medicine, Vol. 30 pp.2149-50.