VNU Journal of Science, Mathematics - Physics 24 (2008) 197-208

A web-based decision support system for the evaluation and strategic planning using ISO 9000 factors in higher education

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Received 30 November 2008

Abstract. ISO 9000 standard which is playing a significant role in higher education is originally began for universities and institutes in the training international standard. Evaluating and planning strategies have the key roles in a university for the development of educational management. Web-based Decision Support System (DSS) can be used as an evaluation tool as well as a strategic planning tool for schools / universities. Currently, there are few studies in DSS using a domain of ISO 9000 in a traditional education. Compared with some algorithms of DSS, Analytic Hierarchy Process (AHP) is a good candidate to solve problems in planning strategies in a university management. Based on AHP model, this study focuses on using ISO 9000 factors of higher education in order to build Web-based DSS application applied in a university in Vietnam. The Web-based DSS application helps educational leaders make better decision for an evaluation and a strategic planning in educational management. For the system implementation, Web-based DSS application was developed for a case study of Vietnam National University Hanoi.

Keywords: Web-based decision support system, decision support system, planning strategy, ISO 9000 standard, evaluation, and educational management.

1. Introduction

Vietnam has officially joined in the member of World Trade Organization (WTO) since 2006. The International Standards Organization - ISO 9000 standard which is playing significant role in higher education was originally began for organizations and institutions in the training educational standard [1]. Since the early 1990s, ISO 9000 certificate for an education or training organization provided "assurance" that it is well organized and qualified the outcomes of educational standard [2,3]. How to apply DSS model based on ISO 9000 factors in evaluation and strategic plan development of educational institutions effectively is a challenging area for educational experts since they are mainly using traditional methodologies for evaluation of educational management. In some cases, educational leaders have some troubles in evaluating institutions as well as a strategic university planning.

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Currently, there are few studies using ISO factors in order to evaluate schools / universities and plan for a strategy in educational management of organizations in Vietnam and Asia [3]. However, there are no DSS applications to apply a real case in the domain of an evaluation and a strategic planning. For solving the problem, the first study step of this study focuses on analyzing ISO factors for a DSS model in educational management. The second step of this study is to find out good techniques in DSS. The third step of this study is to make the best model using ISO 9000 factors. The forth step is to analyze the hierarchy model using ISO 9000 factors for an evaluation and a strategic planning. The final step is to build a Web-based DSS application based on AHP model for an evaluation and a strategic planning of a university.

Analytic Hierarchy Process (AHP), developed by Thomas L. Saaty [4], is one of several useful models in decision making for DSS. AHP models are structured by decomposing a problem into a hierarchy of elements such as attributes and alternatives influencing a system by incorporating levels: objectives, attributes, sub attributes and alternatives [4,5]. The purpose of this study is to develop Web-based DSS application using ISO 9000 factors for an evaluation and a strategic university planning. For the implementation, a Web-based DSS is based on ISO 9000 factors for the evaluation and strategic planning for a case study of Vietnam National University Hanoi (VNU).

2. Background an AHP and ISO 9000

2.1. Overview of ISO 9000 quality system standard

ISO 9000 is a core of educational quality system elements which are standards as a single system originally designed to cover all manufacturing in service industries, and education and training [2,6]. In addition, ISO 9000 is a series of generic international standards developed by the International Organization for Standardization for Quality Management and Quality Assurance [2,7].

The ISO 9000 series cover a broad scope of quality system elements and consist of five standards: ISO 9000-1, ISO 9001, ISO 9002, ISO 9003 and ISO 9004-1 [1,2]. Currently, ISO 9000 standards have been adopted by more than 74 countries as national standards for quality assurance. The representative of ISO for the USA is the American National Standards Institute (ANSI) and the ISO 9000 series is administered by the American Society of Quality Control (ASQC) [2]. Management responsibility is central to ISO 9000 series, which is the highest for the total quality system. A key management responsibility of setting up a quality system is defined as a quality policy in higher education. Trainers and educators manage the review processes so that it follows the basic principles of evaluation in education system. As applied to educational institutions, the implementation of ISO 9000 is relied on significant ISO 9000 factors in educational management in order to evaluate or make a strategic planning of the institutions.

2.2. Overall AHP model using ISO 9000 factors

For the evaluation and strategy planning of university using ISO 9000 factors, the study analyzes ISO factors based on AHP model. In fact, the AHP is a systematic procedure for presenting the elements of any problem hierarchically. The structure model identifies the hierarchical factors for its smaller constituted parts and guides decision makers of pairwise comparison judgments to express an

impact of the elements in the hierarchy. Fig. 1 shows the overall model of Analytic Hierarchy Process (AHP) using ISO 9000 factors in an evaluation and a strategic planning for educational management.

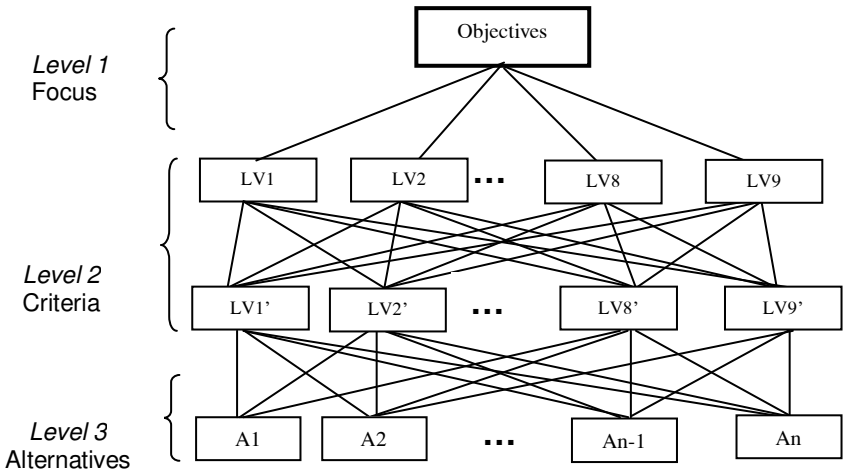

Fig. 1. Structure model of the AHP hierarchy.

The structure of AHP model is divided into three primary levels as follows:

Level 1 – Objectives: A strategic university plan / evaluation model using ISO 9000 factors of educational management in a university.

Level 2 – Criteria: They include both factors and sub factors analyzed in AHP hierarchy.

Level 3 – Alternatives: Choosing the best choice decision among alternatives for an evaluation model / a strategic university planning.

3. DSS model application for an evaluation and a strategy planning

3.1. Application model using ISO 9000 factors for a strategic planning

In a case study of Vietnam National University Hanoi, the AHP model using ISO 9000 factors is applied in Faculty of Education, where the faculty will be a College of Education (COE) in the near future. COE will have a strategic plan in higher education focusing on ISO 9000. Fig. 2 shows AHP model using ISO 9000 factors in the case of study. The first level is the objective for choosing the best strategic planning of COE in the future. The second level is the primary factors as a group of criteria in which the factors (LV1, LV2, …LV9) are influent to the formulation of the sub criteria. In this level, the subcriteria (LV11, LV12, …, LV91) encompass possible evaluation options required to be selected to reflect the primary factors. For the alternative level, COE will choose the best strategic planning among four alternative choices.

A fast model (planning in 1 – 2 years) is to change quickly a strategy in university development for COE in higher education. In this case, it is necessary to drop almost traditional educational management methods. To adapt rapidly the teaching, learning methods and total quality management will be focused on ISO 9000.

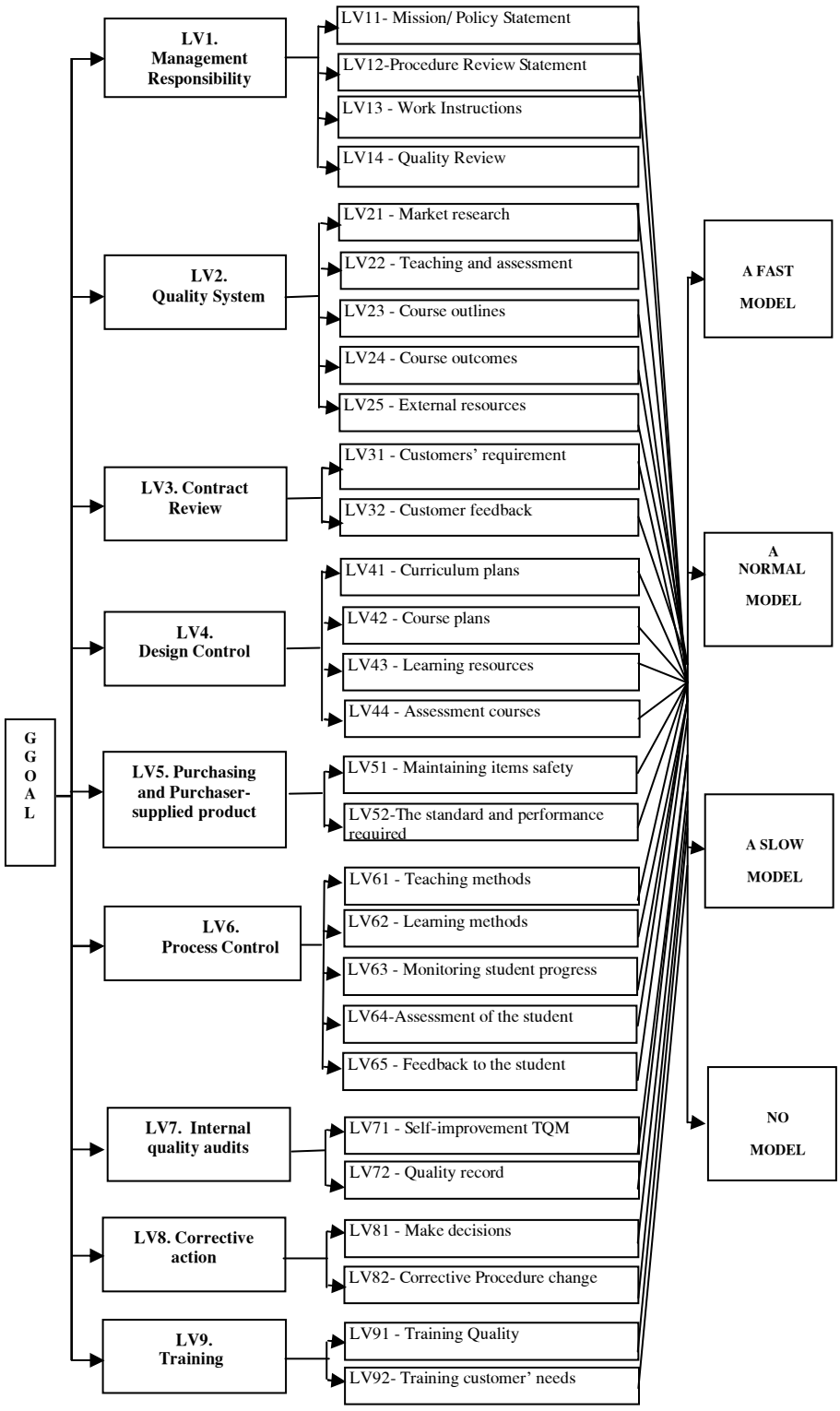

Fig. 2. AHP model using ISO 9000 factors of COE.

A normal model (planning in 3-4 years) is to reform the organization combining with the strategy of Total Quality Management (TQM) evaluation model applying in COE. The model can be combined with traditional educational management.

A slow model (planning in 5-6 years) is very slow to progress a strategic planning since there are many objectives and subjective factors that make a planning different to apply ISO 9000. Some educational leaders do not want to adapt with the new model because of difficulty in improvement for all college activities following the international standard.

No Model focuses on educational leaders' decision, not allowing to apply a strategic planning in a College / School using ISO 9000 factors because of an insufficient international standard resources. For instance, lack of funding, good staffs and good instructors are significant factor to mainly affect a model.

3.2. Application model using ISO 9000 factors for evaluation of educational management

At present, Vietnam National University Hanoi is the largest university which belongs to multi-disciplinary type of university. Based on the model of ISO 9000 factors – international standard in higher education of Vietnam, the hierarchy model using ISO 9000 factors in education of Vietnamese universities consists of 9 categories (Management Responsibility, Quality System, Contract Review, Design Control, Purchasing and Purchaser-supplied product, Process Control, Internal quality audits, Corrective action, and Training) and 29 factors. Fig. 3 shows the overall model of Analytic Hierarchy Process (AHP) using ISO 9000 factors in evaluation of educational management.

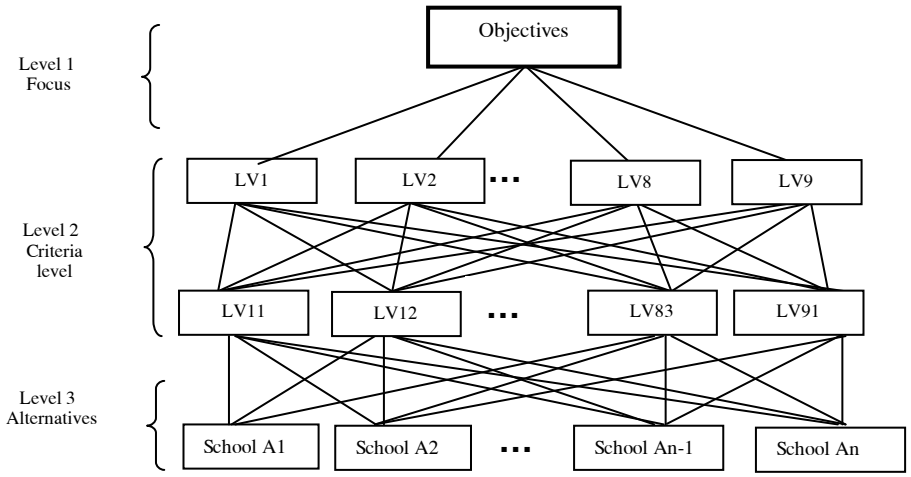

Fig. 3. AHP Model using ISO 9000 factors in evaluation of schools.

Figure 3 shows the first level of the structure which is the purpose of model in order to evaluate an international standard in higher education of schools / colleges using ISO 9000 factors of VNU. The second level is the primary factors as a group of criteria in which the factors (LV1, LV2, …LV9) are influent to the formulation of the sub criteria. In this level, the subcriteria (LV11, LV12, … LV91) encompass possible evaluation options required to be selected to reflect the evaluation of an international standard in higher education in VNU. For the alternative levels, a case of study is

evaluated among faculty / college (A1, A2, … An) alternatives of VNU and consider which faculty / college is carrying out the best evaluation of international standard in higher education based on ISO 9000 factors.

3.3. Decision making in group decision support systems (GDSS) for VNU

Based on ISO 9000 factors for a case study of VNU, the factors will be analyzed by the VNU domain that focuses on an international standard in order in enhance higher education quality of the university. For decision making process, DSS / GDSS is a good solution to evaluate the domain of VNU which is shown in Fig. 4.

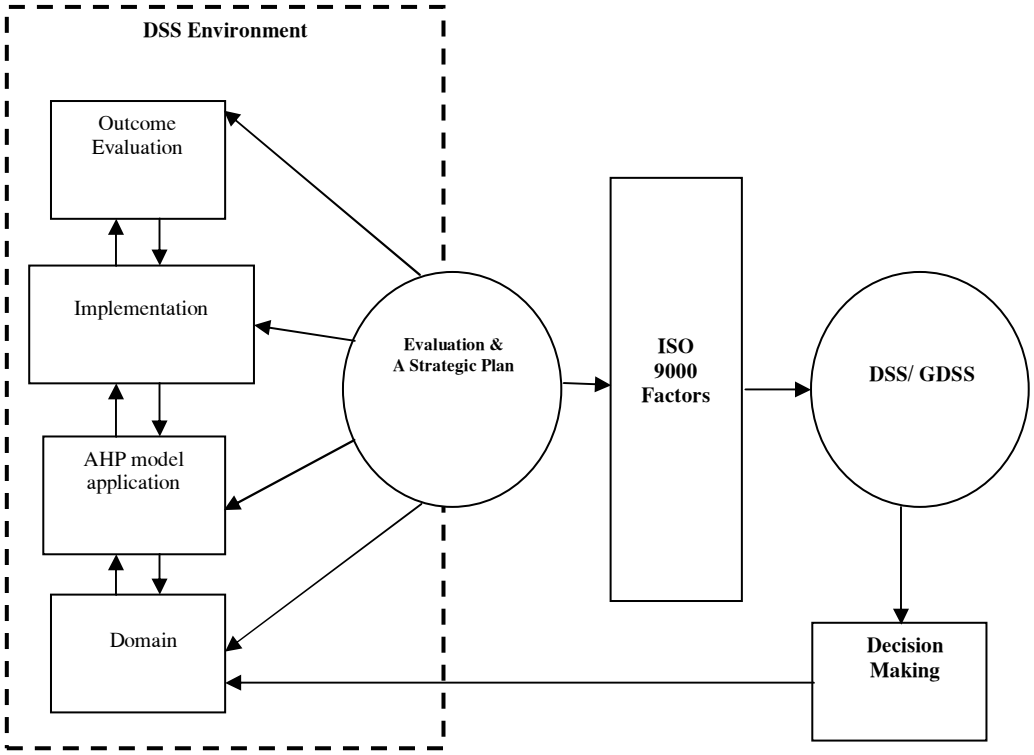

Fig. 4. VNU strategic plan / evaluation model in DSS environment.

Basic requirements of VNU evaluation and a strategy planning model based on ISO 9000 factors are as follows:

Domain: The goal of the DSS is to choose the best strategic plan among proposed long-term plans of VNU. In evaluation model, the best school / university is to applly ISO 9000 factors in VNU.

AHP model application: identification of the application model based on system capabilities, assessment of input data and suggestion DSS design application.

Implementation: Web-based DSS application is a main implementation part for AHP model application.

Outcome evaluation: Results are measured and interpreted by the construction of the DSS. Choosing the best strategy plan model of university is based on ISO 9000 factors.

According to VNU evaluation and a strategic planning model, decision maker can choose the best alternative choice using ISO 9000 factors in schools / colleges. However, groups are better than individuals in understanding problems and catching errors. Working in a group can be divided by different GDSS purposes such as top administrations, staffs and instructors.

3.4. Data collection

VNU educational experts answer survey questionnaires for an evaluation or a strategic planning of educational management. Designing questionnaire' survey is a very important step to match with AHP model using ISO 9000 factors. Schools / Colleges can choose either a DSS or GDSS for decision making of the Web-based DSS application. The main step of data collection can be divided into several steps. Firstly, questionnaires are used for collecting data through direct interviews or paper-based forms. Group interviews can be divided into some groups such as educational experts, dean, staff and instructor groups. Secondly, the questionnaires are pre-tested before they become standard questionnaires used for survey. During pre-testing the questionnaires, it is necessary to check AHP model that consists of criteria built as well as comprehensive questionnaire instructions. Finally, the questionnaires are sent to VNU by email for data collection. Data evaluation uses the collected data through email questionnaires. After calculating the average of each question, data are inputted into Web-based DSS application.

4. Architecture of Web-based Decision Support System

4.1. Prototype of the system

In order to present a logical model of the system, the flowchart of Web-based DSS application is presented as shown in Fig. 5.

The whole system can be presented details for the prototype of Web-based DSS application. Web interface is described in login process steps of the system. System and evaluation modules include input steps and AHP algorithm processing of Web-based DSS application. For the web interface, admin user either can login to the system or view DSS results on website. The system module will verify the account authorized information as well as check its username and password for the permission of the system. All logical modeling steps of the system module can be shown as follows:

Menu control system: The user can view DSS list results or input a new DDS application.

Input data module: The user can construct AHP model based on input factors as well as identify the problem decomposition and hierarchy model in order to input numerical data into AHP comparison matrix.

Evaluation module: It is described inside the mechanism of AHP as well as the process of the system in order to view a DSS result.

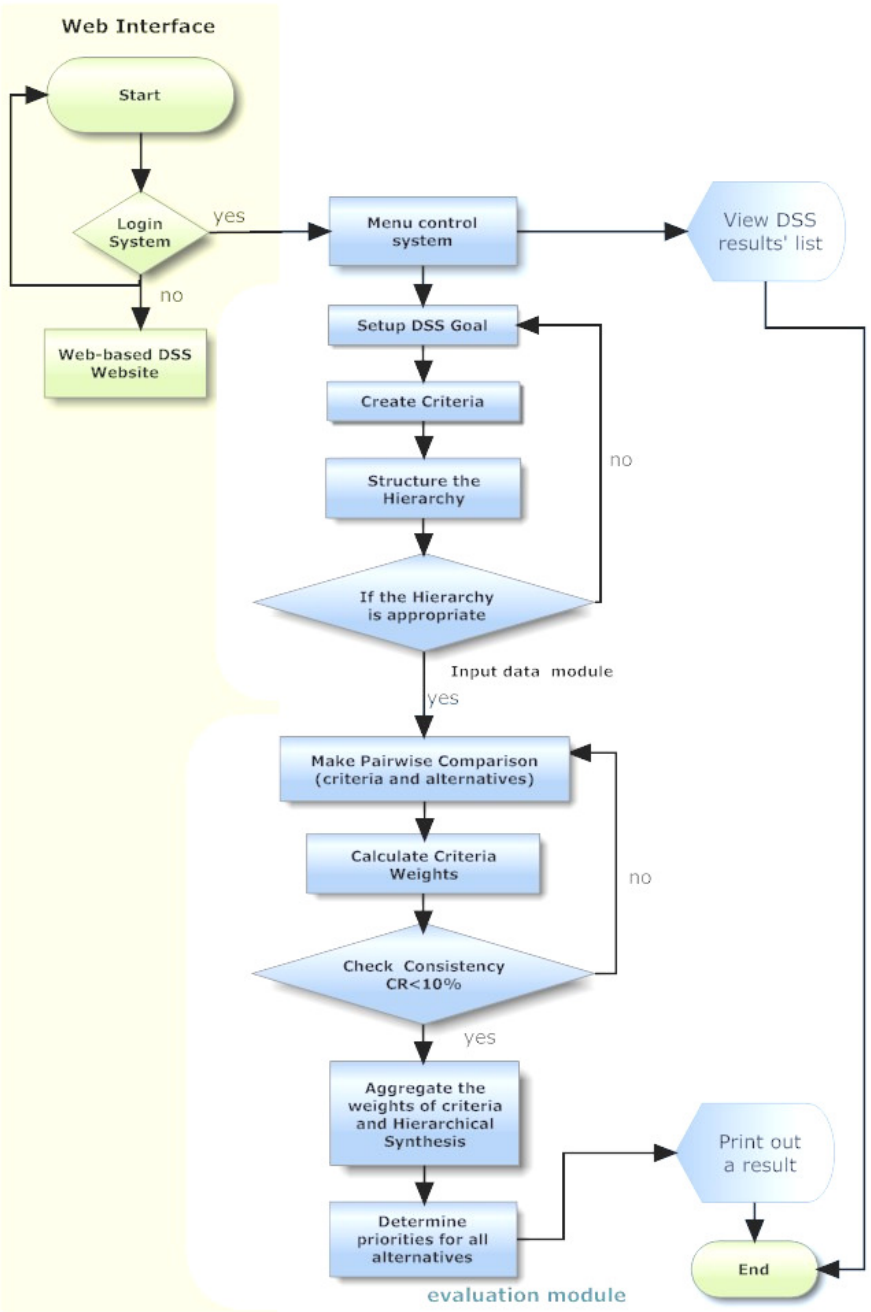

Fig. 5. The logical modeling of Web-based DSS application.

4.2. System architecture

The recent development of the web generates further momentum to the design and implementation of a support system. Web-based DSS is to provide a way for storing, presenting, gathering, sharing, processing, and using information. Web-based DSS is also to provide a distributed infrastructure for

information processing, interaction and tool with user-friendly interface. This allows users to access the system remotely and instantly at anytime, anywhere. Fig. 6 shows the system architecture for a case study of VNU.

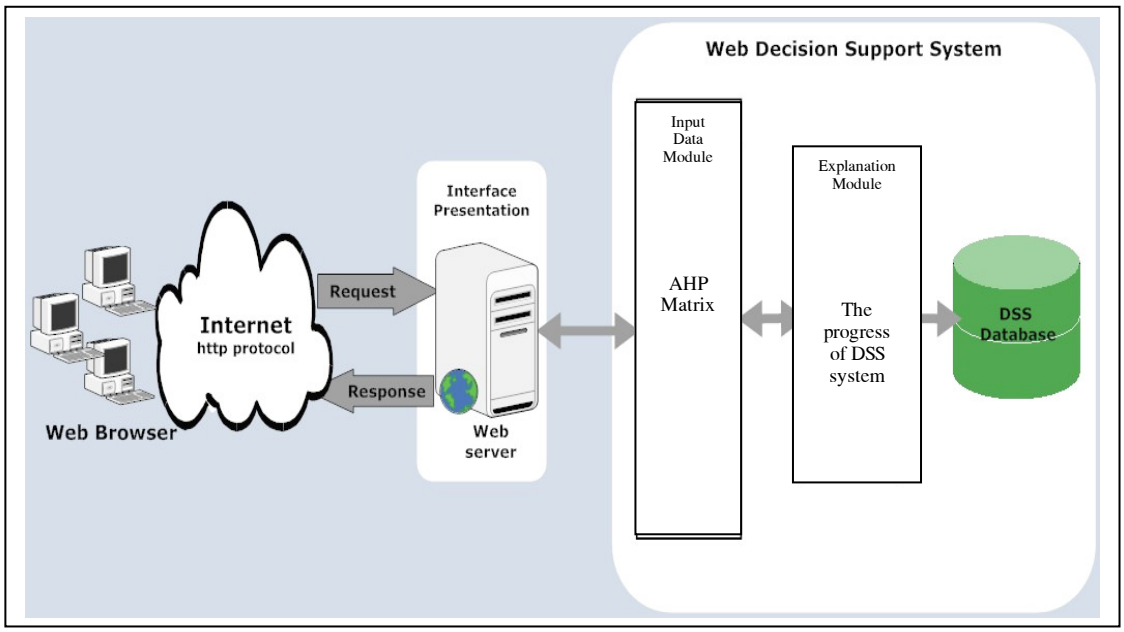

Fig. 6. The architecture of web-based DSS application.

Web-based DSS is based on Client / Server model on the Internet, which is included in all characteristics of decision support system. Currently VNU has a good network infrastructure connected all campuses through the Intranet/ Internet. Hence, Web-based DSS application is a good solution as intelligent web application can be useful for the case of study to implement its application on Vietnam National University Hanoi network. Schools or Colleges of VNU can be applied either an evaluation or a strategic planning using ISO 9000 factors. The implementation on Web-based application is demonstrated via a Website at http://www.eduf.vnu.edu.vn/webdss

5. Result evaluation, conclusion and future works

5.1. Result evaluation

According to a case study of COE, VNU, decision maker can create a new DSS for a strategic planning via the Internet with different purposes in educational management. AHP model has the priority of each element that is weighted by the priority of its corresponding higher level element which was used as the criteria in making the parities comparison. This procedure is continued by moving downward along the structure of hierarchy, computing the weight of each element at every level and using them to determine composite weight for succeeding levels, resulting in a composite priority vector for the lowest level of the AHP hierarchy. Fig. 6 shows the result of a strategic planning for College of Education, VNU.

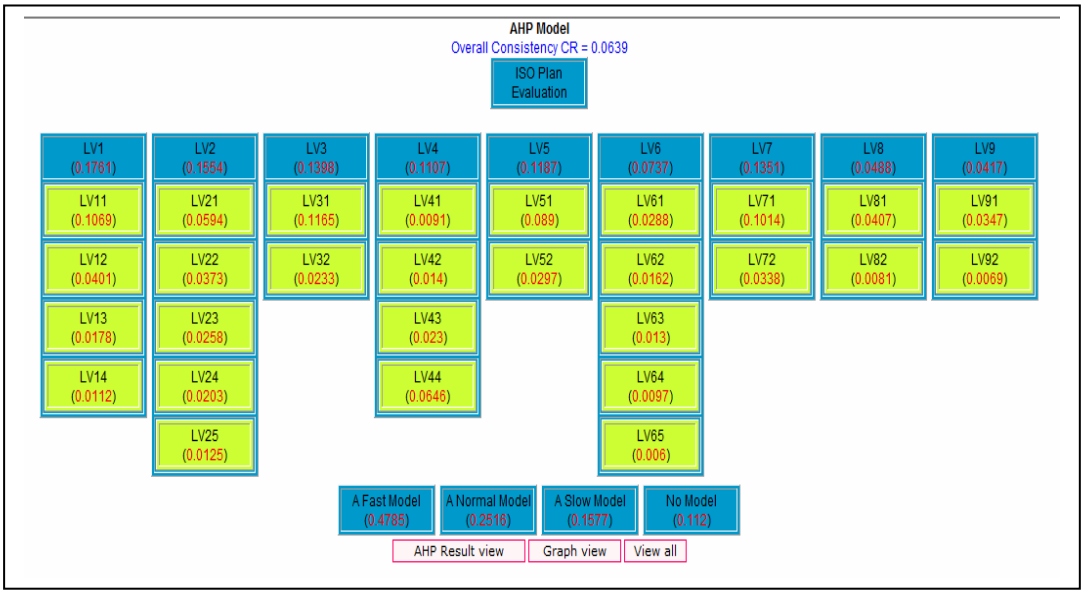

Fig. 7. Result of strategic planning using ISO 9000 factors.

A Web-based DSS shows a real-time result as follows: a fast model is the best choice of the strategy planning since the priority (0.4885) is the highest. The second best model is a normal model (0.2621); the third choice (0.1477) is a slow model and the last model (0.1014). The strategy planning of COE, VNU can be shown as a graph from the result of Web-based DSS application in Fig. 7.

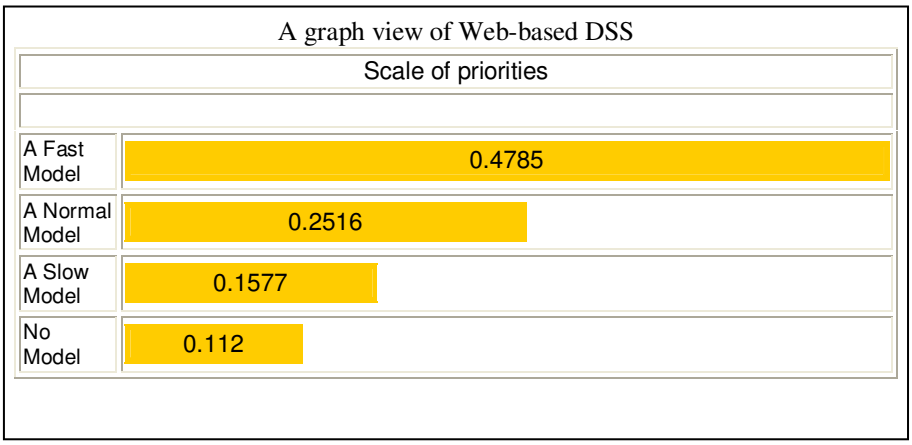

Fig. 8. The result of graph view in planning strategies based on ISO 9000 factors of COE, VNU.

For evaluation of schools / colleges using ISO 9000 factors, a group of experts answer questionnaire. Data are inputted in to Web-based DSS application as shown results of DSS via website http://www.eduf.vnu.edu.vn/webdss

5.2. Conclusions

This is the first study applied Web-based DSS application for an evaluation and a strategic planning of educational management in Vietnam. This study has contributed in effective evaluation for educational management using ISO 9000 factors, and showed the successful result for a case study of VNU as well as the development of Web-based DSS in educational management of a university.

ISO 9000 has a significant role in the development of Vietnamese universities. In Vietnam, currently both national and private universities have used ISO 9000 for a vision as long-term strategies in higher education. ISO 9000 factors are analyzed into the hierarchy model using TQM factors. DSS application helps educational leaders choose the best appropriate evaluation model based on ISO 9000 factors. The result of research is a good solution for educational leaders to decide the best appropriate evaluation model in future.

Among DSS algorithms, Analytic Hierarchy Process (AHP) is used to support decisions in a strategic planning of educational management. This study focuses on using AHP in order to build a Web-based DSS application based on ISO factors in a strategic planning. The DSS application helps educational leaders choose the best strategy model among multiple planning choices (a fast model, a normal model, a slow model and no model) in applying ISO 9000.

Web-based DSS application is a good solution shows complex functions of the system with a convenient web service application. The system allows a decision maker to easily decide or create a new model application on the Intranet/ Internet. The Web-based DSS application implementation has completed successfully using full features of Web-based DSS application for various purposes in educational management. In addition, the Web-based DSS application has implemented in a good security on web application standard so that the application can be applied in most colleges of VNU as well as Vietnamese universities in the future. According to VNU training model, the system can apply all hierarchy model using a variety of ISO 9000 factors with different purposes.

The study has opened a new way for Web-based DSS application to be applied in educational management. Clearly, the development of Web-based DSS application is very significant for Vietnamese universities nowadays because DSS can be helpful to support the decision of the strategy planning development in educational management.

5.3. Recommendation for future works

This study is applied AHP model for semi-structured decision making in evaluation and planning strategies of educational management. ISO 9000 factors can be presented in AHP model in the hierarchy model. In some complex cases of decision making, decision factors might be depended on each other. The AHP model with feedback and factor dependency can easily deal with all aspects of factors and alternatives involved in the decision process. The Analytic Network Process (ANP) technique assumes dependency of factors on alternatives being considered. Therefore, solving problem in communicated cases in educational management needs to combine both AHP and ANP techniques.

AHP model using ISO factors can be applied to many types of decision making in educational management such as prediction, forecasting, planning and evaluation. For further development of DSS application, AHP model will be easily adapted to another domain in real-time applications.

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