The application of analytic hierarchy process in higher-learning institutions: a literature review

Azilah Anis

Faculty of Business Management,
Department of Operations Management,
Universiti Technologi Mara,
Shah Alam 40450, Malaysia
Email: azilahanis@salam.uitm.edu.my

Rafikul Islam*

Department of Business Administration,
Kulliyyah of Economics and Management Sciences,
International Islamic University Malaysia
Jalan Gombak, Kuala Lumpur 53100, Malaysia
Email: rislam@iium.edu.my
*Corresponding author

Abstract: Currently, there has been increasing interest in the application of the analytic hierarchy process (AHP) in the educational sector. However, little effort has been made in reviewing its applications particularly in higher-learning institutions (HLIs). Thus, this paper attempts to systematically review and critically examine the applications of the AHP in this context covering 33 empirical and conceptual studies published in the period of 1992–2013. The studies are examined on the basis of four specific dimensions: publication year, country of origin, integrated techniques that were simultaneously applied along with AHP and also the HLI areas wherein the AHP was applied. The systematic analysis reveals that the AHP was dominantly applied in measuring quality education of HLIs, faculty member evaluation, performance measurement, strategic planning, university choice and selection of university majors.

Keywords: AHP; analytic hierarchy process; HLIs; higher-learning institutions; quality education; faculty evaluation.

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Biographical notes: Azilah Anis is a Lecturer at the Centre of Transportation and Operations Management, Faculty of Business and Management, Universiti Teknologi MARA, Malaysia and currently pursuing her PhD in Business Administration at the International Islamic University Malaysia. Previously, she was a Senior Lecturer at Kuala Lumpur Metropolitan University College. She obtained BS in Resources Economics from the Universiti Pertanian Malaysia in 1996 and MS in Quantitative Sciences majoring in Operations Management from the Universiti Teknologi MARA in 2006. Her research interests include operations management and quality management, higher-learning institutions and education management.

Rafikul Islam received MS in Applied Mathematics from the University of Calcutta in 1988. Subsequently he obtained his PhD in Operations Research from Indian Institute of Technology, Kharagpur in 1996. Presently, he is working as a Professor at the Department of Business Administration, International Islamic University Malaysia. His papers have appeared in *European Journal of Operational Research*, *International Transactions in Operational Research*, *International Journal of Commerce and Management*. *International Journal of Business Information Systems*, *International Journal of Business and Systems Research, Socio-Economic Planning Sciences*, etc. His research areas include multiple criteria decision-making, operations and quality management.

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1 Introduction

The contribution of tertiary education to the nation's agenda has significantly evolved and increased of late. The growing influence of tertiary education means that it will not only improve the quality life of a person but also contribute to the formation of the nation's competent and competitive human capital. Indeed, in some countries tertiary education functions as a commodity that acts as an instrument for the GDP and economic growth (Becket and Brooke, 2008). Essentially, tertiary education is provided by HLIs, namely the universities, university colleges, colleges, polytechnics, community colleges, distance learning centres and many more, offering various categories of qualifications ranging from certificates, diplomas, bachelor degrees and post graduate programs.

Owing to the significant national contribution of HLIs, many countries have invested heavily in these institutions. Malaysia, for example, has consistently allocated a high percentage of its annual budget for educational development including in HLIs when compared with other countries in the region (Najib, 2006). This initiative aligns with the government's objective to produce the first-class human capital required to transform Malaysia into a developed nation (Mustapha, 2007). Likewise, the Tenth Malaysia Plan (2010–2015) also emphasises education services, particularly the HLIs, as one of the 12 national key economic areas (NKEAs) with vast potential to generate income for the country. The government initiative to create Malaysia as a centre of educational excellence in the Asian region also illustrates the prominent role of HLIs in the country (National Higher Education Action Plan, 2007–2010; Muhamad et al., 2006).

To achieve the above objectives, critical decisions have to be made through qualitative or quantitative approaches at the faculty, university and national level. As suggested by Liberatore and Nydick (2007), a variety of methods and tools are available to support the decision-making process in HLIs. One of the well-known and widely applied decision-making applications in HLIs is called the analytic hierarchy process (AHP).The AHP was first applied in HLIs by Liberatore et al. (1992) in a research comprising of a case study. It was reported that the AHP was successfully applied in a research awards program in a university in the USA. Ever since, application of the AHP has increased owing to its efficacy as a decision-making tool in the

educational sector, particularly in HLIs. Yet, despite its increasing prominence in various decision-making situations in HLIs as claimed by Sipahi and Timor (2010), few attempts have been made to review its use in this context. This paper, therefore, aims to review and assess the applications of the AHP in HLIs, specifically in addressing issues related to the functions and activities of HLIs.

2 The background of AHP

Making the right decisions is vital in both our professional and personal lives. Nevertheless, three circumstances present obstacles for the right decision to be made as pointed out by Saaty (1980) as well as Saaty and Vargas (1982). First, the complexities caused by the uncertainty, ambiguity and unstructured character of the decision-making process often lead to decisions being made on subjective grounds. This might occur due to unstructured steps and procedures in the process. For instance, the steps in making similar decision will be different from one person to another person depending on the character of the person as well as their objectives in life. Secondly, a problem is posed by the limitations of human nature itself that can only process a restricted amount of information. Moreover, at most, the amount of information is also too limited for objective decisions to be made. And lastly, decisions normally incorporate a large number of criteria to be considered. For example, there are several factors to be considered for a student to decide on which program to choose for further studies. Recognising these barriers, the AHP was developed and introduced by Thomas L. Saaty in the 1970s.

As defined by Saaty in 1990, AHP is a method of breaking down a complex, unstructured situation into its component parts and arranging the judgements according to the relative importance of each variable. These judgements are subsequently synthesised to determine the variable that has the highest priority and that should be acted upon to influence the outcome of the situation. Other researchers defined the AHP as a method that can deal with a number of decision criteria (Figueira et al., 2005), a tool capable of incorporating the elements of subjectivity and intuitions (Tsinidou et al., 2010; Al-Harbi, 2001; Crowe and Noble, 1998), a technique able to transform subjective judgements into objective measures (Sipahi and Timor, 2010) and ultimately, as a measurement theory competent to deal with qualitative and quantitative criteria (Henny and Jan, 2006; Vargas, 1990).

Essentially, the AHP is based on three principles namely: decomposition, comparative judgement and synthesis of priorities (Vargas, 1990). Specifically, the process begins by determining the pertinent factors, and then structuring these factors into a hierarchy. This hierarchy descends in successive levels from an overall objective to various dimensions and criteria, with numerical values assigned to each variable (Saaty and Vargas, 1982; Saaty, 1990). The detailed steps in the AHP as explained by Saaty (2008) are as follows:

- Define the goal of the problem.
- Structure the decision hierarchy with the goal of the problem from the top, through the intermediate levels (criteria and sub-criteria) to the lowest level (usually involves a set of alternatives). The skeleton of a hierarchy is displayed in Figure 1.

- Construct pairwise comparison matrices. Each element at an upper level is used to compare the elements in the level immediately below it. In pairwise comparison matrices, a scale of 1–9 (refer the reader to Table 1) is utilised to explain the extent to which one element is dominant over another with respect to the criterion used for comparison. Following this, the overall priority for the elements is obtained and finally, prioritisation of the alternatives is identified.

Table 1 Pairwise comparison scale

Intensity of importance	*Definitions*	*Explanations*
1	Equal importance	Two activities contribute equally to the objectives
2	Weak or slight	
3	Weak importance of one over another	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Essentials or strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is very strongly favoured over another. Its dominance is demonstrated in practice
8	Very, very strong	
9	Absolute importance	The evidence favouring one activity over another is of the highest possible order of affirmation

Source: Saaty (2008)

A software package called 'Expert Choice' was developed and released by Saaty in 1983 to facilitate researchers in calculating the final prioritisation of the alternatives besides processing collected data into numerical table and figures. As demonstrated by Henny and Jann (2006), no mathematical knowledge was required when utilising the 'Expert Choice'. Moreover, the software is also capable to identify the inconsistent judgements articulated by decision makers that enable a redefinition of the scores if necessary.

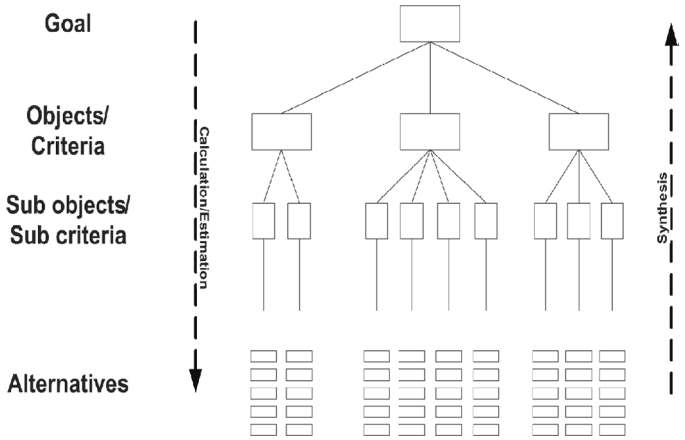
Indeed, several advantages have advanced the promotion of the AHP as a widely accepted and applied decision-making tool worldwide. The substantial elements inherent in the AHP as asserted by Jadhav and Sonar (2009) include:

- Its capacity to provide a hierarchical decomposition of a decision problem that helps in better understanding of the overall decision-making process.
- The AHP is based on relative pairwise comparisons of all decision-making elements. Instead of arbitrarily defining a percentage score and a weight for each decision element, the AHP allows the decision maker to focus on the comparison of two criteria/alternatives at a time. As a result, it decreases the possibility of defining rating bias on the personal perceptions of the evaluator or other external influences.

- The AHP is applicable to both individual and group-based decision-making. Group-based decision-making is often achieved by considering the geometric mean of comparison values.
- It enables consistency checks upon pairwise decision judgements.

Nevertheless, as asserted by Gerogiannis et al. (2009) and Saaty (1996), there are numerous drawbacks to be considered when applying the AHP. First, when determining 'crisp' comparative values, any uncertainties of the decision makers' judgements cannot be easily handled. Secondly, the AHP does not take into account dependencies and interrelations among factors whereas real-world problems usually consist of dependence between elements. However, this disadvantage is addressed with the introduction of the analytic network process (ANP) to measure both the intra- and inter-dependencies among the set of criteria as well as alternatives (Sipahi and Timor, 2010; Gerogiannis et al., 2009; Saaty, 1996). In terms of sample size, the AHP only requires a small number of respondents who are experts about one particular area. A large number of participants are not required as the technique is mainly applied in handling complex problems particularly involving a group of people (Takala et al., 2006).

Figure 1 The AHP hierarchy



Source: Sipahi and Timor (2010)

3 Research methodology

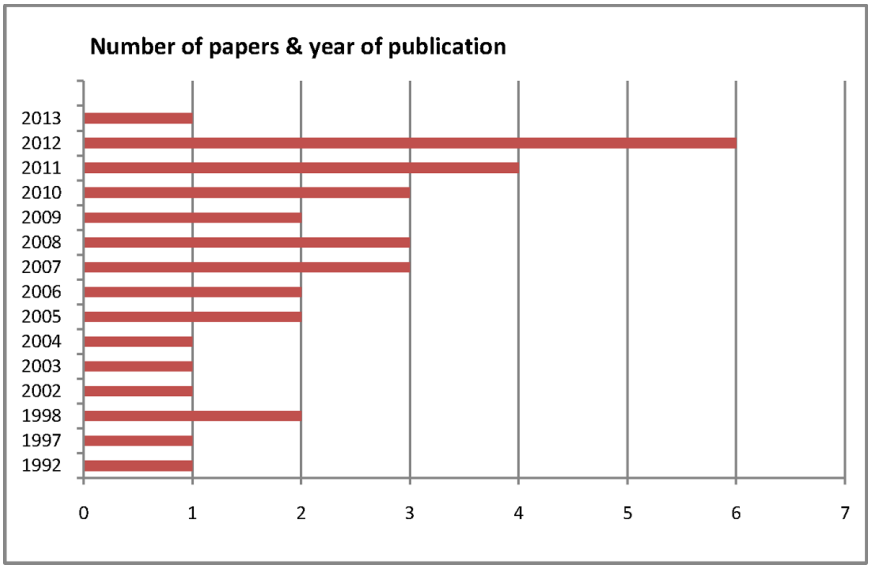
An extensive search was carried out from academic databases such as the Emerald, Science Direct, Proquest ABI/Inform and Ebscohost (Business Source Premier) to identify journal papers that discussed the application of the AHP in HLIs. The AHP keywords used include 'Analytic Hierarchy Process', 'AHP' 'pairwise comparison' together with 'HLIs', 'higher education institutions', 'tertiary education' as well as 'universities' represented the key words used for HLIs. The papers found in the search were then screened to ensure that the AHP has been appropriately applied as well as to confirm that the AHP application fits well within the HLI context. Conference proceedings and doctoral dissertations were excluded as Liberatore and Nydick (2007)

assumed that the more significant research will eventually appear largely in academic and professional journals. Non-English language publications were also excluded from the search.

4 Classification

A total of 33 papers with reported AHP applications in HLIs were included in this review. Each paper was studied and classified according to the following: publication year, country of origin, other integrated techniques or tools utilised simultaneously with the AHP (if any) and the areas wherein the AHP was applied in the context of HLIs. Figure 2, which illustrates the number of papers published by year, reveals that very few papers were published in the period from the 1990s to the early 2000s (Grandzol, 2005; Henny and Jan, 2006). Nevertheless, publication activity was dramatically increased especially after 2010 owing to the recognition of its effectiveness as a decision-making tool in HLIs (Sipahi and Timor, 2010).

Figure 2 Number of papers published by year (see online version for colours)



The classification of papers according to country of origin and publication year is shown in Table 2. It confirms that AHP applications in HLIs were mostly found in the USA (8 papers) followed by India (3 papers), Taiwan (3 papers) and Turkey (3 papers). The 33 papers on AHP application in HLIs appeared in 26 different journals (Table 3). The largest number of papers (3) appeared in the *International Journal of Educational Management* followed by the *International Journal of Quality and Reliability Management*, *International Journal of Business, Marketing and Decision Science, Quality Assurance in Education*, *The Electronic Library and Interfaces* which emerged with two papers each.

Table 2 Number of papers by country and publication year

	Year															
Country	*1992*	*1997*	*1998*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*Total*
China														1		1
Colombia											1					1
Croatia									1							1
Greece												1				1
Hong Kong			1							1						2
India												2			1	3
Iran													1	1		2
Malaysia									1				1			2
Nigeria							1									1
Saudi Arabia					1	1										2
Singapore									1							1
Taiwan								1		1				1		3
Turkey										1			1	1		3
USA	1	1	1	1			1						1	2		8
UK								1			1					2
Total	*1*	*1*	*2*	*1*	*1*	*1*	*2*	*2*	*3*	*3*	*2*	*3*	*4*	*6*	*1*	*33*

Table 3 Journal list and article count

No.	*Journal name*	*Article count*
1	*Academy of Strategic Management Journal*	1
2	*Advances In Management*	1
3	*American Journal of Business*	1
4	*Benchmarking: An International Journal*	1
5	*Central European Journal Of Operations Research*	1
6	*European Journal of Operational Research*	1
7	*European Journal of Scientific Research*	1
8	*Expert Systems with Applications*	1
9	*Interdisciplinary Journal of Contemporary Research in Business*	1
10	*Interfaces*	2
11	*International Business Research*	1
12	*International Journal of Business, Marketing and Decision Science*	2
13	*International Journal of Educational Management*	3
14	*International Journal of Quality & Reliability Management*	2
15	*International Workshop On Multiple Criteria Decision Making*	1
16	*IR Applications*	1
17	*IUP Journal of Operations Management*	1

Table 3 Journal list and article count (continued)

No.	*Journal name*	*Article count*
18	*Journal of Quality Measurement and Analysis*	1
19	*Library Management*	1
20	*Management Decision*	1
21	*Management Science and Engineering*	1
22	*Measurement*	1
23	*Quality Assurance in Education*	2
24	*Research in Higher Education*	1
25	*The Electronic Library*	2
26	*Total Quality Management*	1
	Total	*33*

Beside the use of the AHP as a stand-alone tool, previous researchers have integrated it with other decision-making techniques. The AHP integrated methodologies and the associated reference papers are tabulated in Table 4. Among the integrated techniques, the Quality Function Deployment is the most popular (6 papers), followed by the Kano model (2 papers).

Table 4 Integrated techniques and reference paper

Integrated technique/tool	*Reference papers*
Quality function deployment	Pourhasomi et al. (2012)
	Anis and Islam (2011)
	Ho et al. (2009)
	Bayraktaroglu and Özgen (2008)
	Rahorjo et al. (2007)
	Lam and Zhao (1998)
Kano model	Pourhasomi et al. (2012)
	Bayraktaroglu and Özgen (2008)
Cluster analysis, correspondence analysis	Ho and Hung (2008)
Goal programming	Ho et al. (2006)
Factor analysis	Begičevič et al. (2007)
Balanced scorecard	Karpagam and Suganthi (2010)
ANP	Cortés-Aldana et al. (2009)
Spearman rank correlation test	Yeşim and Ortaburun (2011)
TOPSIS	Hsieh et al. (2006)
VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR)	Wu et al. (2012)
Distance based approach (DBA)	Das (2013)

5 Analysis of applications by areas

For areas of application, the AHP was primarily employed in the six main domains, namely measuring quality of education, strategic planning, faculty evaluation, measuring performance, selection of university majors and university selection. As shown in Table 5, the AHP was mostly applied to measure the quality of education of HLIs (6 papers) and in faculty evaluation (6 papers). Measuring performance, strategic planning, selection of university majors as well as university selection are areas where the AHP has been moderately applied with 5, 4, 3 and 2 papers, respectively. Table 6 presents detailed information on the related areas and associated reference papers.

Table 5 Areas of AHP application in HLIs

Areas of application	*Count*
University library acquisitions	1
Faculty evaluation	6
Marketing strategies	1
Measuring performance	5
Measuring quality education of HLIs	6
Research award program	1
Resource allocation	1
Selection of university majors	3
Strategic planning	4
Total quality management	1
University procurement and bidding	1
University ranking	1
University selection	2
Total	*33*

5.1 AHP in measuring quality education of HLIs

The topics that gained interest by most researchers centred on measuring quality education of HLIs. Three concepts were used to define quality of education. First, it refers to the three elements of the educational system, namely quality of inputs, quality of processes and quality of output (Sahney et al., 2008). Inputs include factors related to students, teachers, administrative staff, physical facilities and infrastructure. Processes comprise the activities associated with teaching, learning and administration while the outputs concern to examination results, employment, earning and satisfaction. Secondly, quality education concerns the activities and functions of HLIs such as student intake, academic programs, lecturers, process of teaching and learning and adequate facilities (The World Declaration on Higher Education, 1998). Finally, quality education relates to stakeholders' definitions and approaches ranging from the government, institutions, employees of the institutions, parents, students as well as prospective employers of HLI graduates (Fion, 2009; Waaty, 2005).

Table 6 Areas of AHP application in HLIs and associated reference papers

Areas	*Reference papers*
University library acquisitions	Uzoka and Ijatuyi (2005)
Faculty evaluation	Iii et al. (1998)
	Bahurmoz (2003)
	Badri and Abdulla (2004)
	Grandzol (2005)
	Wan Mustaffa and Mohd Ali (2007)
	Hayrapetyan and Kuruvila (2011)
Marketing strategies	Ho and Hung (2008)
Measuring performance	Hsieh et al. (2006)
	Ho et al. (2009)
	Cortés-Aldana et al. (2009)
	Umayal Karpagam and Suganthi (2010)
	Das (2013)
Measuring quality education of HLIs	Lam and Zhao (1998)
	Bayraktaroglu and Ozgen (2008)
	Tsinidou et al. (2010)
	Anis and Islam (2011)
	Yeşim and Ortaburun (2011)
	Pourhasomi et al. (2012)
Research award program	Liberatore et al. (1992), Liberatore and Nydick (1997)
Resource allocation	Ho et al. (2006)
Selection of university majors	Strasser et al. (2002)
	Rad et al. (2010)
	Hayrapetyan (2012)
Strategic planning	Liberatore and Nydick (1997)
	Rahorjo et al. (2007)
	Begičevič et al. (2007)
	Jolayemi (2012)
Total quality management	Lam et al. (2008)
University procurement and bidding	Dan and Zhiguo (2012)
University ranking	Wu et al. (2012)
University selection	Jayakumar et al. (2010)
	Tas and Ergin (2012)

Evaluating the lecturers' quality of teaching and measuring service quality level are the two most common issues addressed. Anis and Islam (2011) who integrated the AHP and QFD to improve teaching effectiveness at a private HLI in Malaysia, utilised the QFD in identifying the students' needs and lecturers' design. The relationship between these two types of requirements was then identified by using the judgement of selected lecturers by

the principle of QFD and the AHP. Likewise, the same integrated technique was employed in evaluating the quality of teaching in a university in Hong Kong by Lam and Zhao (1998). In the QFD, 10 educational objectives were identified as the students' requirements and seven teaching techniques were determined as the technical design. The AHP was applied to calculate the average importance for each of the seven teaching techniques for achieving each of the 10 educational objectives inside the QFD relationship matrix.

In Turkey, Bayraktaroglu and Ozgen (2008) integrated the AHP, QFD and the Kano model to measure service quality level in a university central library. The students' needs for library services were identified and clustered by utilising the QFD and Kano model. The AHP was then applied to assess the importance level of these needs. In another study, the AHP was applied by Tsinidou et al. (2010) to prioritise the determinants and sub-determinants of a questionnaire developed by the Hellenic Quality Assurance Agency for Higher Education (HQAA). The ranking of HQAA illustrates the overall service quality level of an educational institution in Greece.

The AHP was also used in improving programs and ranking of the students' voice as the main customers of HLIs, as illustrated in the works of Yeşim and Ortaburun (2011) who integrated the AHP and Spearman correlation rank. Subsequently, the tools were used to measure the relationship on the feedback provided by academics and prospective employers on the undergraduate curriculum for technical design and construction education programs in Turkey. A study performed by Pourhasomi et al. (2012) combined the QFD and Kano model to classify the requirements of the students based on the students' preferences in a university in Iran. These student requirements were then ranked according to categories by applying the AHP.

5.2 AHP in HLI faculty evaluation

AHP was often used in the evaluation of faculty for hiring prospective lecturers as well as for promotion purposes. Grandzol (2005) developed a model that incorporated the AHP to improve faculty selection processes in a university in the USA. The criteria utilised in this model include experience, scholarly activities, technological skills, flexibility in teaching and capabilities as well as working experience. Moreover, the AHP was employed in the search for a college dean at Texas A&M University, Kingsville by Iii et al. (1998). The search committee identified four important attributes for the candidate that include experience with the AACSB accreditation processes, experience in an administrative position, a good publishing record and lastly, a proved ability at fund raising. In Saudi Arabia, a study by Bahurmoz (2003) identified the nine best potential lecturers for Dar Al Hekma, a private women's college in Jeddah. By applying the AHP, the author developed a model for the candidates' selection by using qualitative and quantitative criteria. The qualitative criteria were assessed via the character, working experience and other personal information of the candidates whereas the quantitative criteria evaluated the candidates' language proficiency and academic achievements.

In facilitating the evaluation process of faculty members' performance, Badri and Abdulla (2004) developed a framework that highlighted the three criteria namely research, teaching and services in a university in the UAE. The AHP was applied to prioritise these criteria. Similarly, in Malaysia, Wan Mustaffa and Mohd Ali (2007) also employed the AHP to develop a model to assess the promotion of academic staff in a public university. Three important components were identified in the model which are

teaching, research and publication as well as services, with research and publication recognised as the most important component in the said promotion exercise. Interestingly, Hayrapetyan and Kuruvila (2011) utilised the AHP steps and procedures to develop a decision support system named as 'Evaluator', an Excel file. This system replicated the concept and steps of the AHP for faculty member evaluation in an institution based on the three criteria namely teaching, research and service.

5.3 AHP in measuring performance of HLIs

The AHP was applied in measuring several activities related to HLIs. A study undertaken by Ho et al. (2009) combined the AHP and QFD to evaluate the performance of two virtual learning systems used by the administrators, lecturers and students of an institution in UK. The combination of the AHP and QFD helped them to measure and select the best system for the institution. Hsieh et al. (2006) developed a performance evaluation system for e-library of six universities libraries in Taiwan. Prior to that, the Delphi method was utilised to obtain the opinion of experts, scholars and library staff on the system of e-library in a university. The AHP and TOPSIS were then applied in assessing the performance of the e-library system in these universities.

On a wider scope, the AHP has been applied in evaluating overall university performance and its contribution to the society. In India, for example, Umayal Karpagam and Suganthi (2010) proposed a model that integrated the AHP and balanced scorecard in measuring performance of HLIs in India in order to maintain continuous quality improvement of the institution. Another study conducted by Das (2013) incorporated various stakeholder perspectives to propose a model for evaluating the performance for seven Indian technical institutions. The AHP and distance-based approach (DBA) methodology were utilised in developing the model by considering some important criteria such as faculty strength, student intake, number of PhDs awarded, number of patents applied, the campus acreage and tuition fee per semester in the local currency. On the other hand, in Colombia, Cortés-Aldana et al. (2009) developed a model that measured the degree of alignment between university strategic objectives with its technology transfer mechanism with the local community by applying the AHP and ANP. The study detected misalignments that required corrective action from the university policy makers in the particular country.

5.4 AHP in strategic planning of HLIs

In this area, Liberatore and Nydick (1997) employed the AHP in institution-wide strategic planning in which clear linkages between the goals, objectives and strategies of an institution in USA are illustrated through the prioritisation process of the technique. Jolayemi (2012) emerged with a new innovative framework for institution-wide strategic planning that modified and addressed the shortcomings of Liberatore and Nydick's (1997) framework by applying the AHP. The author asserted that this new framework will enhance strategic planners' capabilities in developing good and quality strategic plans for HLIs.

The AHP was also employed in this area so that the requirements of HLIs stakeholders can be fulfilled. In Singapore, for example, Rahorjo et al. (2007) integrated the AHP and QFD to formulate an effective strategic plan in fulfilling the requirements of internal and external customers of a university. The authors also provided a sensitivity

analysis to anticipate any changes or variability of the demanded qualities for the QFD so that the future needs of customers can be fulfilled.

In another study, the AHP and factor analysis were utilised in the strategic planning stage in modelling systematic implementation of e-learning and online education distance education at a university in Croatia (Begičevič et al., 2007). The study concludes that organisational readiness that covers university framework and faculty strategy for development as well as financial readiness acts as the most influential criterion in implementing e-learning in this institution.

5.5 AHP in the selection of university major

The selection of university majors has been addressed in several studies. Rad et al. (2010) for instance conducted a study in which the authors categorised university majors offered in Iran into eight main specialisation groups based on their similarities and differences by utilising *k*-means algorithm. The AHP was then used to rank these main specialisation groups based on Iran's current education and industry requirements.

Also, a model that applied the AHP for the selection of majors among college students was developed by Strasser et al. (2002) based on three criteria namely the subject, influence from others and career. By using an Excel file, Hayrapetyan (2012) developed a decision-making support system named as "May I help you?" that applied the AHP. The purpose was to assist students in selecting their college majors based on three common criteria: compensation, job availability and growth as well as the influence of others.

5.6 AHP in university selection

For university selection, the AHP was also applied by Tas and Ergin (2012). The authors conducted a study at a private university to identify the criteria employed by Turkish students for selecting universities in the USA to pursue their Master's degree. Eventually, 12 criteria were prioritised by using the AHP and it was indicated that students placed great emphasis on career prospects and job opportunities when selecting universities in the USA. Jayakumar et al. (2010) identified five most popular criteria highlighted by parents and students in their selection of engineering colleges in Tamil Nadu, India. The criteria are location, job placements, teaching faculty, infrastructure and costs. These criteria were then ranked by applying the AHP.

5.7 AHP in other areas of HLIs

Other applications of the AHP in HLIs include marketing strategies as conducted by Ho and Hung (2008) in a Taiwanese University. The authors integrated the AHP, cluster analysis and correspondence analysis to develop effective marketing strategies for universities. Also, in resource allocation, Ho et al. (2006) incorporated the AHP and goal programming to develop a resource allocation model of HLI. Additionally, a study by Uzoka and Ijatuyi (2005) proposed a framework for a decision-making support system for a university library acquisition in Nigeria by utilising the AHP hierarchy.

A study that applied the AHP was also undertaken for a university's procurement and bidding (Dan and Zhiguo, 2012). The study utilised three evaluation index namely price, performance and after sale service for the university to select a company for purchasing

the university's items. In another study carried by Wu et al. (2012), a model was developed by applying the AHP and VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) method to rank 12 private universities in Taiwan. For this purpose, the authors utilised the performance evaluation indices for higher education based on the official performance evaluation structure developed by the Taiwan Assessment and Evaluation Association (TWAEA). The outcome of the model was then compared with the official rankings of the 12 private universities conducted by the government.

Another area involved research award programs in a study performed by Liberatore et al. (1992) and Liberatore and Nydick (1997). In the former study, the AHP enabled the authors to solve problems in research evaluation, namely variation in paper topics and methodology, disagreement on the appropriate set of evaluation criteria as well as dissatisfaction with research methods award evaluation. AHP was applied in the latter study where the authors also utilised four criteria in research evaluation which are clarity of the research objectives, the justification and contribution of the research, appropriateness of its methodology, and research implementation as well as it recommendations and implications.

Finally, a study by Lam et al. (2008) in a leading vocational educational institution in Hong Kong applied the AHP in the area of total quality management (TQM). The study revealed that a positive relationship exists between organisational learning culture and TQM culture. The relationship is exhibited in a multiple linear regression equation. The AHP was then applied to verify the correctness of the equation particularly in prioritising the dimensions of TQM culture.

6 Conclusions

This paper intends to present a thorough literature review on the applications of the AHP in HLIs during the period from 1992 to 2013. Sipahi and Timor (2010) observed that the applications of AHP in HLIs as a decision-making support have increased and this paper augments the claim made by the authors. In the present study, the widespread application of the AHP was shown according to country classification and journal titles where the AHP studies were published as well as the integrated techniques that were simultaneously applied with AHP. Ultimately, the areas where the AHP was used by the HLI decision makers were categorised. In this case, six major domains where AHP was mostly applied are identified, namely measuring quality education of HLIs, faculty evaluation, measuring performance, strategic planning, selection of university major and university selection.

The AHP has been accepted and applied extensively by decision makers in more than 30 diverse areas ranging from medicine, logistics, petroleum pipeline, hospitality, fast food restaurants, accounting and other areas (Shahin and Mahbod, 2007). However, the study observed that the number of papers that applied the AHP in HLIs can be considered low compared with the other areas. As such, efforts should be invested by prominent scholars and practitioners in promoting the AHP as a decision-making tool in HLIs. It is hoped that the findings of the study will act as a reference point to help practitioners and academics to make better decisions by applying the AHP either as a stand-alone tool or in association with other techniques.

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