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Fuzzy logic computational model for performance evaluation of Sudanese Universities and academic staff

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Abstract The excellence of a Sudanese universities and academic staff member can be effectively classified by systematic and objective design criteria, which participates in developing the learning outcomes in Sudan. In the first phase of this study, we reviewed the literatures, determined and defined the suitable quantitative and qualitative criteria and then designed & exploited pairwise comparison and evaluation forms through a survey to get experts opinions/preference on the evaluation criteria that are used to measure the universities and academic staff performance. This paper presents a fuzzy logic computational model based on this survey to measure and classify the performance of Sudanese universities and academic staff, which includes computation of criteria weights and overall evaluation of Sudanese universities and academic staff using AHP and TOPSIS techniques.

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1. Introduction

Throughout the last three decades, there has been significant growth in the total number of universities and high educational institutes in Sudan. The total number was raised from 11 institutes in 1980s to more than 127 higher education institutes in 1990s & 2000s (Ministry of Higher Education, 2016). Fig. 1 represents the total numbers of different types of institutes and the growth rate of public & private universities with Bar chart and Combo chart respectively.

This considerable increase requires contiguous scientific research in performance assessment to assist the following entities:

- High Education institutes to match up their current qualifications versus the standard requirements and plan for future improvement.
- Applicants & Students' Parents to make out the differences between institutes and figure out the best higher education institutes.

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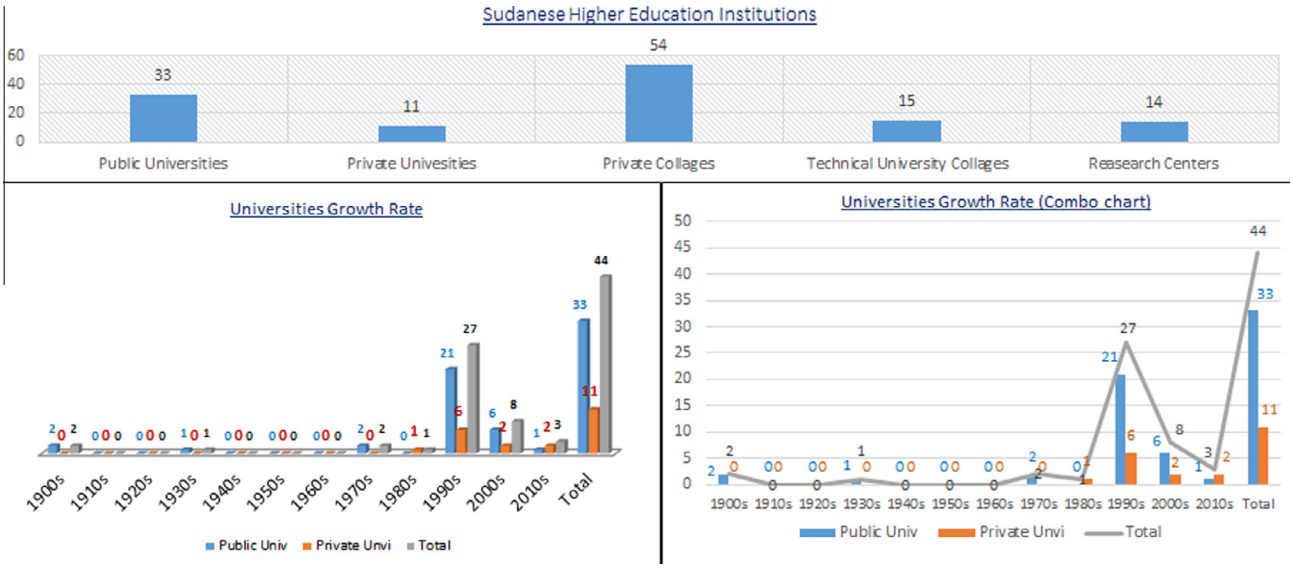

Figure 1 Statistical Info about Sudanese higher education institutions (Institution types and universities growth rate).

- Ministry of higher education in Sudan to observe and keep track of the required standards and maintain future plans.

Currently, organization and funding systems at universities, in general, have considerably changed. The social necessity dominates the classical activities of teaching and research (Etzkowitz, 2003). Getting universities and academic staff evaluation in line with the changes in the university system has become a main concern especially in Sudan and in many other countries around the world.

Decision of quality classification in performance evaluation of Sudanese universities and academic staff is based on quantitative and qualitative criteria which involve not only data but also human judgment. Therefore, performance evaluation and academic staff classification could be considered as a MCDM (Multiple Criteria Decision Making) problem.

There are many fuzzy related appraisal techniques in the literature such as Analytic hierarchy process (AHP). AHP is a quantitative technique for ranking decision alternatives using various criteria (Russell et al., 2003; Shaout and Yousif, 2014). Structuring the alternatives into a hierarchical framework is the AHP technique to resolve complex decisions. However, due to uncertainty in the decision-maker's judgment, pair-wise comparison, a crisp with a traditional AHP may be incompetent to completely get the decision-maker's judgment. Hence, fuzzy logic is introduced into the pair-wise comparison in the AHP to overcome this weakness in the traditional AHP. It is referred to as fuzzy AHP (FAHP) (Ayağ, 2005; Shaout and Yousif, 2014).

Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS) is another technique of the multi-criteria decision making (MCDM) technique that is widely employed to solve MCDM problems (Shaout and Yousif, 2014). TOPSIS technique is based on the concept that the selected alternative is the shortest geometric distance to the positive ideal solution and the longest geometric distance to the negative ideal solution (Akkoç and Vatansever, 2013; Chen, 2000).

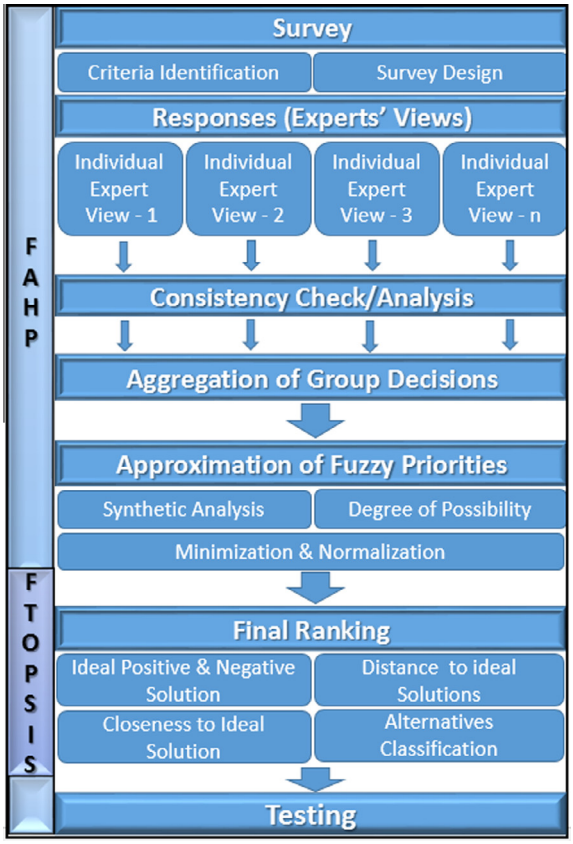

Figure 2 Quality classification model for performance evaluation of Sudanese universities and academic staff.

The multistage fuzzy logic inference has been proposed in order to decrease the number of fuzzy rules for compound systems (Shaout and Trivedi, 2013). Besides input and output variables, intermediate variables are adopted in fuzzy rules to mirror human knowledge. The major benefit of using a multistage structure is that the number of fuzzy rules will only

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