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Using AHP and TOPSIS Methods for Decision Making of Candidates' Selection for Business Accelerator Program

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***Abstract* - The multi-criteria decision-making approach using AHP for weights calculation and TOPSIS evaluating alternatives has been applied to the problem of filtering and selecting correctly and scientifically on two stages the candidate teams for the Business Accelerator (KAUACC) program. Calculations were simple and done in a straightforward way. The results of the weights for both stages are represented and the resulting ranking after applying TOPSIS for both stages is represented.**

Keywords: Multi-criteria, Evaluating Alternatives, Weights, Accelerator, AHP.

I. INTRODUCTION

On 25th of April 2016, Crown Prince Mohammed bin Salman announced the country's new vision, which called as "Vision 2030"[1]. It focuses on changing the economic infrastructure of the whole Country. The new vision's main goal is to diversify the oil income by investing in new projects or businesses to encourage Saudi people to start their own businesses. To be in line with the Saudi vision, Jeddah Community College at King Abdul-Aziz University has set up a Business Accelerator (KAUACC) program to provide assistance, support and educate the entrepreneurs who lack the experience, human and financial resources to transform their projects and ideas into new products and companies that can enter and compete in the markets. Babson Global of Babson College, who is number one entrepreneurship in the world, designed the program. On one hand, the program provides participants with knowledge, skills, consultation, training and supervision that will help them in creating and operating their own businesses. On the other hand, the program also provides participant entrepreneurs with all logistic matters they may need, such as offices, computers, printers and labs. Nevertheless, the program even provides participants with some financial support to help them create prototype models or to market their ideas and services.

The first round of KAUACC program was established in the year 2017. The second round of this Business Accelerator program will be in the year 2018. During the filtration and interview stage, the Business Accelerator members had a hard time to choose between candidates, as there were many good ideas and projects.

In this research study, the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods will be applied to choose the best candidates out of everyone who applied based on multi-decision making criteria in the second round.

II. METHODOLOGY

A combined model between (AHP) and (TOPSIS) will be applied to select the best candidates out of everyone who applied for KAUACC program. The proposed model will be used twice. First, it will be used to select the first candidates' batch. Secondly, the model will be applied to select the candidates who enter the KAUACC program for eight weeks.

The following are step by step description of the proposed combined AHP-TOPSIS model to evaluate and select the candidates for KAUACC program.

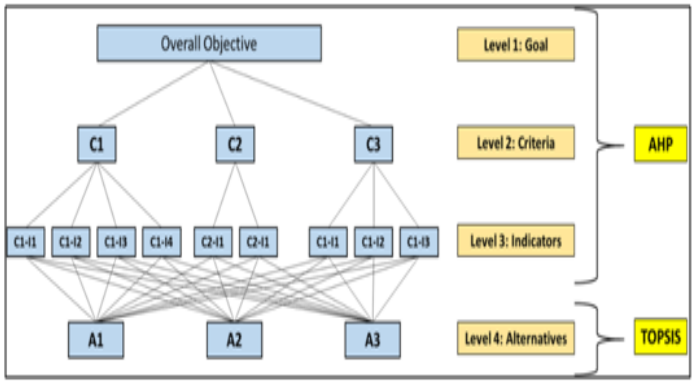

Figure 1: The levels of the proposed AHP-TOPSIS model

Stage #1: Identify the selection criteria:

Step #1-1: Identify the selection committee members who will participate in applying the proposed AHP-TOPSIS model. Those members will be selected carefully by the higher administration of JCC and will be called later as "selecting experts"

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Step #1-2: The case under study is decomposed into a hierarchy of goal, criteria, sub-criteria and alternatives by the selecting experts. Hierarchy indicates a relationship between elements of one level with those of the level immediately below.

Stage #2: Weight the criteria by using AHP:

Step #2-1: Data are collected from the selecting experts corresponding to hierarchic structure, in the pair wise comparison of alternatives on qualitative 1-9 performance scale.

Step #2-2: The pair wise comparisons of various criteria generated at step 2-1 are organized into a square matrix.

Step #2-3: The principal Eigen value and the corresponding normalized right eigenvector of the comparison matrix give the relative importance of the various criteria being compared. The elements of the normalized eigenvector are termed weights with respect to the criteria or sub-criteria and ratings with respect to the alternatives.

Stage #3: Evaluation of candidates with TOPSIS and determination of the final rank:

As, there is two filtration stages in selecting the candidates, two model of TOPSIS (M1-M3) is appropriate for the case under study. The steps of this model are restated here as follows:

M1: The Classical TOPSIS Method for a Single Decision Maker [2]

Step 1: Construct the decision matrix

Let $X = (x_{ij})$ be a decision matrix and

$W = [w_1, w_2, \dots w_n]$ a weight vector and

$w_1 + w_2 + \cdots + w_n = 1$

Step 2: Calculate the normalized decision matrix

Let $n_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$

be the normalized value for $i = 1, \dots, m; j = 1, \dots, n$

Step 3: Calculate the weighted normalized decision matrix

The weighted normalized value v_{ij} is calculated in the following way:

$v_{ij} = w_j n_{ij}$ for $i = 1, \dots, m; j = 1, \dots, n$ where

w_j is the weight of the j-th criterion, $\sum_{j=1}^{n} w_j = 1$

Step 4: Determine the positive ideal and negative ideal solutions

Positive ideal solution A^+ has the form:

$$A^+ = (v_1^+, v_2^+, \dots, v_n^+) = \left(\left(\max_i v_{ij} \mid j \in I\right), \left(\min_i v_{ij} \mid j \in J\right)\right)$$

Positive ideal solution A^- has the form:

$$A^- = (v_1^-, v_2^-, \dots, v_n^-) = \left(\left(\min_i v_{ij} \mid j \in I\right), \left(\max_i v_{ij} \mid j \in J\right)\right)$$

Where I is associated with benefit criteria and J with the cost criteria, $i = 1, \dots, m; j = 1, \dots, n$

Step 5: Calculate the separation measures from the positive ideal solution and the negative ideal solution

The separation of each alternative from the positive ideal solution is given as

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$$d_i^+ = \left(\sum_{j=1}^{n} \left(v_{ij} - v_j^+ \right)^p \right)^{1/p} \quad , i = 1,2, \dots, m$$

The separation of each alternative from the negative ideal solution is given as

$$d_i^- = \left(\sum_{j=1}^{n} \left(v_{ij} - v_j^+ \right)^p \right)^{1/p} \quad , i = 1,2, \dots, m$$

Where $p \geq 1$. The most used traditional n-dimensional Euclidean metric when $p = 2$

Step 6: **Calculate the relative closeness to the positive ideal solution**

The relative closeness of the i^{th} alternative A_i with respect to A^+ is defined as

$$R_i = \frac{d_i^-}{d_i^- + d_i^+}$$

Where $0 \leq R_i \leq 1, i = 1,2, \dots, m$

Step 7: Rank the preference order or select the alternative closest to 1

A set of alternatives now can be ranked by the descending order of the value of R_i

M3: The Classical TOPSIS Method for Group Decision Maker

Step 0: Construct the mean decision matrix and determine the mean weights of criteria for k-decision makers

Let $X = x_{ij} = \frac{\sum_{k=1}^{K} x_{ij}^k}{K}$ be a mean decision matrix and

$W = [w_1, w_2, \dots w_n] = \frac{\sum_{k=1}^{K} w_i^k}{K}$ mean weight vector and

$w_1 + w_2 + \cdots + w_n = 1$

Follow the steps from 1 to 7 of M1

The above three steps can demonstrated graphically by three levels (from 2 to 4) as given in Figure 1.1 below.

III. RESULTS AND DISCUSSION

The following are the result of two filtration stages

3.1 Final ranking for first filtration stages after applying TOPSIS

This stage start with 101 Candidates, 3 main criteria and 12 sub–criteria, Candidates filled online application, then committee was given one excel sheet to give Candidates score out of 10 for each criteria based on the online applicants, The selected applicants from these round is first 25 applicants, The are Candidates for an interview and presentation about their company in front of the selection committee.

3.2 Final ranking for the second filtration stages after applying TOPSIS

This stage start with 25 Candidates, 6 main criteria and 22 sub–criteria, Candidates filled online application, then committee was given four excel sheet to give Candidates score out of 10 for each criteria based on the presentation.

IV. CONCLUSION

To conclude, the main objective of the research was to assist in filtering and selecting candidates for the second round KAUACC in a better way than the first round. The first round selected 10 winners and this round chose 13. But this round was implemented on a quantitative method that is well established in scientific research and more reliable. The

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methods used in this round are now safe to be repeated in any following rounds as it proved mathematical validity.

Overall, the findings and results of this research have revealed that there is a great desire by the participants towered aiding organizations to evaluate their selection and decision methods. Therefore, it is strongly recommended for educational organizations to invest in this advantage to introduce awareness in areas where decision are required under multiple conflicting criteria are present by investing in more comprehensive scientific studies to develop this area of studies which at the end will benefit everyone around this area.

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