The Change in Approach of the Higher Education Development Decision Making in Iran from Traditional Method to Systematic Method Based on Information Technology

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ABSTRACT: Currently, there exist plenty of issues and problems in the higher education development in Iran, from which the following items can be indicated: existence of a governmental and centralized structure and not benefiting from the participation management system, lack of long-term and strategic programs in university development, not paying enough attention to observing scientific regulations and criteria in establishment of university majors, not paying any regards to complications, interactions with the surrounding environment and various functions of the university, application of personal and bias tastes, existence of inconsistency in ratifications related to higher education with needs of the country, lack of coordination between quality and quantity development of educational fields in universities, also lack of optimum use of the knowledge of higher education experts and also information technology in this field. Based on conducted studies, benefiting from information technology and systems based on knowledge can overcome a part of the mentioned limitations and problems. The goal of this article is the evaluating and accrediting the higher education development fuzzy expert system and comparing the obtained results from the expert system as a decision making aid system, with factual results obtained from the opinion of experts in the higher education development in Iran. In this article while presenting a short explanation regarding the manner of designing and implementing the higher education development fuzzy expert system in Iran, attention will be paid to the assessment of the system by the output analysis method and also to accrediting by the case study method. The outcome gained from this project manifests the authenticity of the performance of the system and the possibility to apply thereof as a decision making aid system in regard to higher education development in Iran.

Keywords: Higher education development, fuzzy logic, expert system

INTRODUCTION

At the present time higher education development is conducted in a centralized manner at the Ministry of Sciences, Researches and Technology and universities are bound to send their requests along with the required information to this Ministry for the purpose of examination to develop and create a new course location and after going through a kind of long process and by spending a lot of time and high costs, they will be answered. The existing method id based on a traditional approach which was dominating from the very start of the establishment of the Ministry of Sciences, Researches and Technology in 1968. The results of the conducted researches in Iran indicate that the existing approach has some problems along with it which are shortly mentioned as: lack of congruence between the knowledge and skill of the students with the needs of the work market, lack of open and functional information systems and static of programs and also dysfunction of higher education system in on-the-spot, fast and appropriate response to the changing environmental needs, making bias decisions in the state higher
education development, existence of unnecessary bureaucracy in this section, lack of creating a rational and logical balance between the quantitative and qualitative growth of the university, lack of communication, static and lack of required alacrity in higher education development, existence of inconsistency in the ratifications related to higher education with needs of the state (Farastkhah, 2002; Ahmadi Dastjerdi and associates, 2004; Yamani and Arasteh, 2005).

One of the voids of the higher education system is the lack of management information systems on different levels of higher education system which causes decrease in efficiency of the existing facilities, stability of education and project, lack of a comprehensive and functional informing system, lack of a comprehensive observation and evaluation system, the additive development of scientific and technology nick between Iran and other developed countries (Keyzuri and associates, 2009. Therefore, for the purpose of beating a part of the existing problems and obstacles; it is necessary to the innovation of the modern methods, tools, information and communication field based on computer for the aim of programming and decision making in the higher education development by considering the growth of information technology and entering the age of computer.

Due to the fact that one of the important functions of expert systems is in the field of programming (Matthew, 2003); hence, the higher education development expert system will be the result of the compilation of academic sciences, upper hand documents and the knowledge of a high number of assessors and experts of the state higher education development which will manifest by the capabilities f the communicational and information systems. The higher education development expert system in the state in followed by plenty of benefits such as aggregation and organization of specialized topics in the field if higher education development by the assessors and experts of this matter and also benefiting from the vast capacities of information and communicational systems for the purpose of promoting, updating and the fast and accurate transfer of knowledge for the purpose of using the policymakers, programmers and users of the higher education.

For creation of the expert system, first we have to be familiar with its structure.

Any expert system consists of two separate sections:
1- The knowledge base and 2- the inference engine and in Figure number 1 the components of the expert system and manner of its interaction with the system user is shown (Sanders, 2009; Halavati, 2010; Wang, 2010).

![Figure 1. Structure if an expert system (Sanders, 2009)](image)

The existing information in the knowledge rule base of the expert system is provided by interviewing the expert people and also studying the upper hand documents in this field. After organizing the collected information from the experts, the knowledge engineer changes them into understandable rules for the computer as “if- then” known as structure rules (Halavati, 2010) in Figure number 2 the manner of communication and performance of the knowledge engineer in designing and creating an expert system is shown.
The main purpose of this article is to answer to this question that is the higher education development fuzzy expert system able to be a suitable replacement for the existing traditional method of the higher education development in Iran as a decision making aid? The other question of this project is that how is the assessment and accrediting of this system?

In order to answer the questions of this project first the manner of assessment of this system by the system output examination method and its accrediting by applying the case study method should be mentioned by the examination of the implementation and design process of the higher education development fuzzy expert system.

**Steps of Designing the Fuzzy Expert System**

The structure of the higher education development fuzzy expert system in Iran is shown in Figure 3.

For executing and implementing this system in 6 steps, the existing steps in Figure 3 are taken and in the following paragraphs they are discussed briefly.
**Step 1) Determination of the Inputs**

For designing the knowledge base the first step is to determine the inputs which means finding the important and influential variables for higher education development in a university. Due to the fact that making decision in this regard is conducted as centralized at the Ministry of Sciences, Researches and Technology, first a thorough and comprehensive study of the process, laws, regulations and manner of decision making of the higher education system of this Ministry is conducted. With regard to the fact that the considered statistical society consists of 3 groups of teachers of specialized committees and assessors, members of specialized committees and member of the coordination council, the questions regarding the effective variables of development were asked by the brainstorming method. Eventually 18 variables were obtained. By providing a questionnaire, the amount of importance of each of the variables was questioned from the higher education experts. After collecting the data, variables which were of low importance in the point of view of the experts were omitted or mixed with the similar variables. Finally 7 variables were obtained which were: 1- the structural space of the university 2- the number of variables which were of low importance in the point of view of the experts were omitted or mixed with the similar variables.

**Step 2) Fuzzification**

In this step, for each variable, 3 fuzzy states of “good, average and bad” are considered. Applying fuzzy vocabulary is due to lack of certainty in regard to the information being sufficient and uncertainty regarding the inferences being comprehensive. In determining the scope of linguistic variable, the relations between inputs and linguistic variables are described by the use of membership functions. In this step the amount of inputs is changed into the dependence degree of corresponding linguistic variables. Actually the input variables are defined by membership functions and changed unto fuzzy amounts. In the present project triangular membership functions are applied in the manner that any amount of input variable is changed into one of the fuzzy amounts of good, average and bad based on the triangular membership function.

The responsibility of fuzzification is to read the absolute amount of input variables and change them into one of the amounts of fuzzy linguistics which exist in the rules of the fuzzy rule base. Fuzzification should not have a big mass of calculation and it should even have a positive effect in simplifying the calculations related to the inference engine. With regard to the fact that the information of input variables of the higher education development fuzzy expert system is absolute and without rummage; therefore, singleton fuzzifier is applied in it (Fasanghari and Montazer, 2010).

**Step 3) Determination of the Fuzzy Rule Base**

Fuzzy rule base is one of the most important sections of the fuzzy system and from the aspect that other components of the fuzzy system are used effectively and functionally in implementing these rules, it is considered as the heart of the system. In the fuzzy rule base of the higher education development expert system, vague rules as in “if-them”, from the input variables which were determined earlier and are effective in the higher education development, were entered. At first more than 300 rules were written down which after reexaminations and consulting the higher education experts were lowered in number and reached 134 rules. In order to design the fuzzy rule base, composite rules and component “V” were applied.

**Step 4) The Inference Engine**

After obtaining the rules and establishing the fuzzy rule base, we need the inference engine in order to create proper fuzzy outputs by accepting fuzzy inputs based on the rule base. Usually overlap exists in the condition section of fuzzy rules. And so there exists a partial accordance between the input variable membership function with two or three of the membership functions from linguistic variables. Consequently, it is inferable by two or three rules of the rule base. Therefore, competition should exist in the inference engine so that it will be able to create a suitable output. For this purpose, conclusion based on separate rules have been used due to the fact that the aim is to obtain result from all the rules, each of which have the ability to produce fuzzy output. From among the two methods which exist for making deductions, deduction based on separate rules were applied due to the fact that our goal from obtaining the rules is to use the result of all rules, all of which have the ability to produce the considered fuzzy output. All the existing rules in the base of knowledge are summarized as a unique relation as “if-and then”, while all the rules are assumed to be independent and therefore social performance has been applied to combine the rules so that it could be conducted conservatively and all rules could be used in the final conclusion. In
addition, the final membership function has been calculated by applying the Mamadani combination. To sum up, the higher education development fuzzy deduction system is of the Mamadani type and the applied inference engine is of the Mamadani inference engine (MIE).

**Step 5) Defuzzification**

The variables inputting the higher education development fuzzy expert system are non-fuzzy, absolute amounts and numerical. But the amounts obtained by the inference engine of this system are fuzzy and it is necessary for these amounts to be changed into appropriate non-fuzzy amounts. Inputs of the defuzzification section are the output of the inference engine (the results obtained from rules) that has to be mapped at an absolute point (Russ, 2004). In defuzzification, we face a vague set which makes reaching a number difficult. This matter makes the work of this section harder than the defuzzification section. In this research, the center of gravity defuzzifier, which is very functional and it is mentioned as the best defuzzification in the majority of references is applied.

**Step 6) Output of the System**

The output of the expert system will be a number between 0 and 1. In case the amount is between 0 and 0.5, the higher education development will be disagreed with. The closer this number is to zero, it indicates higher power in making decisions in rejecting the request and non-existence of required indexes and circumstances for development and if this number is between 0.5 and 1, it indicates agreement with development and its closeness to the number 1, indicates the registered amounts in the system with more power and confirms the possibility of creating a new course field.

It is worth mentioning that in order to implement the higher education development fuzzy expert system, the MATLAB software fuzzy toolbox and programming in that environment is applied.

**Expert System Assessment**

One of the methods to assess the designed expert system and be informed of its performance accuracy is the output behavior analysis method. In this method, the amount of the two criteria of increase and decrease input are given by fixing the amount of other criteria. For increase and decrease in inputs, the amount of output is calculated by the expert system. The obtained behavior is analyzed. In case the behavior of outputs is confirmed for the changes in the two input criteria based on the review of literature or opinions of the experts, the creditability of the expert system will be confirmed; otherwise, the expert system should be altered.

In this project, this work was conducted for different inputs. The equivalent outputs of each combination were calculated by using MATLAB software. The outputs were analyzed by experts as well as the researcher. The obtained analysis confirmed the accuracy of outputs.

Figure 4 shows one case of these behaviors, in the figure axis X shows the structural space criteria and axis Y shows the criteria of the number of faculty members and the vertical Z axis is the axis of output amounts. The enclosed area between the amounts of 0 to 2 from the first criteria and the amounts of 0 to 8 from the second criteria have an output equal to zero. Also the enclosed area between the amounts of 0 to 10 from the first criteria and amounts of 0 to 2 from the second criteria also have an output equal to zero. This output means that weakness in the amount of required structural space and the number of faculty members causes disagreement with the higher education quantitative development. But the more these two criteria increase simultaneously, the system output will lead further towards 1 which means agreement with the development. Therefore the enclosed area between the amounts of 6 to 10 of the first and second criteria show the maximum amount of output which indicated agreement of the designed fuzzy expert system with the higher education quantitative development. Number of full-time faculty members Extent of the required structural Space to create faculty. For the purpose of assessing the higher education development fuzzy expert, the system output behavior examination method is used. First by examining the two by two graphs of the variables against each other, the behavior of the system output will be analyzed and assessed. In case the behavior of outputs in return of the changes of two input variables, based on the review of literature or the opinions of experts, is confirmed so the validity of the expert system is approved; otherwise, the expert system should be corrected (Bafandeh Zendeh, 2009). Analysis of the system output behavior indicates the correctness in the performance of the higher education development fuzzy expert system.
In order for the accreditation of the system, case study has been applied. In this method, the obtained result from the system is compared and adjusted to the real result. In case the results obtained from the system and the real obtained result are in accordance or have minor differences, the accuracy of the function of the system will be trusted and the accreditation of the system will be approved (Sohrabi and colleagues, 2011). In the case study as well, a couple of requests to create a course location in the supplementary education course which were send from governmental universities to the Ministry of Sciences and were presented at the related specialized committees and votes were taken, was inputted to the system as input variables and the gained output from the system were compared at the specialized committees with the vote and opinion of the higher education experts. In the following parts 16 case studies from the requests of universities by applying the expert system has been examined and the outcome obtained from the system output was compared with the factual opinions of the experts. In all states the gained output from the system was in harmony with the opinion of the experts present at the related specialized committees. The description of the information is shown in table number 1. The obtained result from the system output is completely satisfactory and shows the harmony between system output and the opinion and vote of the specialized committee members because in cases where the system output shows a number lower than 0.5, it indicates the disagreement with the higher education development and the opinion of the experts is consistent with it and in cases that the system output is a number higher than 0.5 it indicates agreement with the higher education development and the opinion of experts also confirms this result. And so the accreditation of the system is approved.

RESULTS OF THE PROJECT

1) Using the fuzzy expert system can be recognized as a turn from the traditional decision making system to a dynamic and systematic decision making system based on information technology in higher education development in Iran.

2) Applying the higher education development fuzzy expert system as a decision making aid in higher education development can help the policymakers and decision makers noticeably in the purposeful development of higher education with an analytic approach and by using information technology tools.

3) Using the fuzzy method in order to make decisions regarding higher education development has better outcome than the absolute state due to the fact that the fuzzy method with multiple rules and lack of
existence of accurate information and uncertainty in making decisions and in uncertain conditions will have a better response.

4) With regard to the functional and appropriate number of development fuzzy variables in establishing the qualitative and quantitative circumstances of the university for higher education development and guiding the state higher education institutes and universities in a higher education development suitable to the required sciences and technology of the country, simplifies decision making in this regard.

5) Applying upper hand documents and opinions of higher education experts in order to determine effective variables causes for decision making in regard to higher education development to be conducted with a higher accuracy and acceptance and far from biasness.

6) Using the higher education development fuzzy expert system leads to having a higher speed in responding and decreasing the related expenses.

Table 1. Case study of the request to create course location, opinion of the specialized committee and result of executing the fuzzy development expert system

<table>
<thead>
<tr>
<th>Case study</th>
<th>Space (m²)</th>
<th>Faculty members</th>
<th>University properties</th>
<th>Comprehensive plan</th>
<th>Ratio of university students to the professors</th>
<th>Ratio of faculty members to the majors</th>
<th>Ratio of infrastructure to the university students</th>
<th>Result (factual)</th>
<th>Result (software)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gilan university (Environme nt MA)</td>
<td>7000</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>23.10</td>
<td>0.83</td>
<td>14</td>
<td>Agree</td>
<td>0.7682</td>
</tr>
<tr>
<td>Tabriz university (ecotourism MA)</td>
<td>8000</td>
<td>6</td>
<td>9</td>
<td>2</td>
<td>21.87</td>
<td>1.22</td>
<td>8</td>
<td>Agree</td>
<td>0.7873</td>
</tr>
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<td>Khalij Fars university (mechanics engineering PhD)</td>
<td>7000</td>
<td>2.5</td>
<td>7</td>
<td>9</td>
<td>26.7</td>
<td>1.34</td>
<td>19</td>
<td>Agree</td>
<td>0.7762</td>
</tr>
<tr>
<td>Zabol university (biology-plant physiology)</td>
<td>6000</td>
<td>3.5</td>
<td>6</td>
<td>2</td>
<td>64.7</td>
<td>6</td>
<td>4.5</td>
<td>Conditional</td>
<td>0.3128</td>
</tr>
<tr>
<td>Golpayega technical engineering (mechanics MA-energy conversion)</td>
<td>3000</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>71</td>
<td>2</td>
<td>16</td>
<td>Conditional</td>
<td>0.2285</td>
</tr>
<tr>
<td>Sisten baluchesta n university (substances engineering PhD)</td>
<td>7000</td>
<td>2.6</td>
<td>7</td>
<td>4</td>
<td>65.1</td>
<td>0.83</td>
<td>4.6</td>
<td>Disagree</td>
<td>0.2543</td>
</tr>
<tr>
<td>Orumieh industrial university (electricity engineering MA-control)</td>
<td>1000</td>
<td>2</td>
<td>8</td>
<td>6</td>
<td>133</td>
<td>1.66</td>
<td>5.62</td>
<td>Disagree</td>
<td>0.3939</td>
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<td>4</td>
<td>8</td>
<td>4</td>
<td>17.2</td>
<td>2.25</td>
<td>2.6</td>
<td>Verdict has not been issued</td>
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<tr>
<td>Orumieh university (plant)</td>
<td>6500</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>32.33</td>
<td>2</td>
<td>20</td>
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<td>Institution</td>
<td>Salary</td>
<td>Total</td>
<td>Total Years</td>
<td>RPM</td>
<td>Agreement</td>
<td>Disagreement</td>
<td>Similarity</td>
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<td>Damghan university (Astrophysics and Astronomy PhD)</td>
<td>6000</td>
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<tr>
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<td>4000</td>
<td>2</td>
<td>8</td>
<td>5</td>
<td>37.3</td>
<td>2.3</td>
<td>3.6</td>
<td>Disagree</td>
<td>0.3362</td>
</tr>
<tr>
<td>Mashhad Ferdosi (English translation PhD)</td>
<td>6600</td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>18.92</td>
<td>2.29</td>
<td>8.6</td>
<td>Agree</td>
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<tr>
<td>Yasooj (agricultural engineering - hydraulic structures Ma)</td>
<td>1000</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>31.5</td>
<td>9</td>
<td>11.2</td>
<td>Conditional agreement 0.5</td>
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<tr>
<td>Tehran university (philosophy - religious philosophy PhD)</td>
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<td>5.5</td>
<td>9</td>
<td>9</td>
<td>22.29</td>
<td>2.42</td>
<td>7.7</td>
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<tr>
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<td>3500</td>
<td>7.5</td>
<td>9</td>
<td>8</td>
<td>18.92</td>
<td>2.29</td>
<td>10</td>
<td>Agree</td>
<td>0.7835</td>
</tr>
</tbody>
</table>

**RESOURCES**

Wang L. 2010. Fuzzy Systems and Fuzzy Control, Translators: Mohammad Tesheh Lab, Nima Safa Pour, Darioush Ahyouni, 6th addition, Khateh Nasir Oxford University, Tehran