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Developing Decision Support System for Supplier Relationship Management: A Case Study of a Research Organization

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Abstract

This article studied the partnering relationship between supplier and employer, and then developed a decision support system for supplier relationship management. The mentioned system for a research organization determined two samples of relationship management variables such as supplier and employer, the level of supervision on supplier's performance and the amount of allowed delay. The approach that used for extending the system was a fuzzy inference system which created the ability for exports to express appropriate laws in establishing the system with linguistic concepts. Definitions of some fuzzy inference systems were inevitable by considering the discrete type of some affective characteristics. However, at the end, all the established systems formed in a united inference fuzzy system in order to consider better application through utilizing fuzzy values with low dispersal.

Keywords: Partnering, Decision support system, Supplier relationship management, level of supervision, Allowed delays, Fuzzy inference system

Introduction

Recently, partnering has been known as an important approach in project management which imposed improvement of project performance through improving work relation [1, 2]. Partnering is a type of relation between customer and supplier or supplier and employer which may be used in project management and coordinated its objects such as improvement of mutual relations, increasing long-term solidarity, vice versa [3]. Partnering leads to mutual reliance for each sideline and eradication of tension by opening relation frontiers. And also

concentrates endeavors on solving common problem and better output [4]. In addition, partnering introduced as an innovative and nonaggressive relation based on procurement of manufacturing projects [5].

Extensive study has provided for recognition of main criteria to cooperate well. The best introduced criteria are: commitment, credence (trust), and honesty, mutual goals, partnering process or implement. There are also some indices for evaluating the partnering performance which are uncertain given need and the project's output. Lie et al. noted some prominent points such as commitment, continual evaluation, equal rights, mutual objects, appropriative sensitiveness, credence and execution [6]. Cheung et al. demonstrated credence as an attitudinal-pivot factor [7]. Yeung et al. qualified time, cost, commitment, quality, credence, effective relation, innovation and improvement as key indices for measuring partnering performance in projects [5]. Time, cost, quality, a claimed sum of money, accidence, disagreement, pollution and personnel's viewpoint were accounted for affective indices in partnering projects by Chan et al [8]. According to mentioned indices, measuring partnering indices are variable due to need and project's output.

This present study addresses to the evaluation of partnering relation between supplier and employer performed by a research center in Iran. The purpose of evaluation of developing the decision support system is to determine the amount of both the level of supervision on the supplier's performance and negligible delays due to the employer. Therefore, the expert at this center determined to specify the amount of both the level of supervision on the employer and negligible delays as the most affected indices. To answer this issue, in next sections, fuzzy inference systems are totally utilized. In the section 2, a summary of fuzzy inference systems are presented, and then section 3 defines the problem and its indices. By using the data from a research center as a sample, section 4 shows the executive capability of this center. Conclusions are added in the last section.

Fuzzy Inference Systems

Zadeh represented the logic of fuzzy and used it in different scopes of science [10]. The fuzzy expert system is the type of this application uses fuzzy soft computing in expert systems region. Five customary steps in developing fuzzy expert systems are definition of verbal variables, fuzzy sets and member function, determination of fuzzy laws, coding fuzzy inference and system arrangement. Fuzzy inference systems also can control the verbal comprehend and either can provide nonlinear mapping between inputs and outputs as a universal approximation [11].
For this reason, fuzzy expert systems are utilized to answer this article issue.

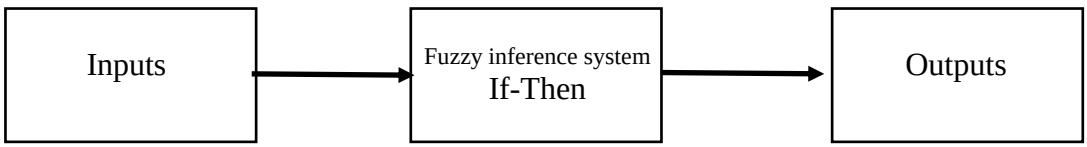


Figure 1: The framework of a fuzzy inference system

Fuzzy inference system, with a set of laws, converts a set of inputs to a set of outputs. The mechanism is based on if-then laws. Expert's knowledge or learning from data resulted in existence of these laws. Figure 1 expresses the mechanism of the fuzzy inference systems.

The techniques used in fuzzy inference systems are the type of Mamadani or Tagaki-sugeno systems. Intuitive, extensive acceptable range and appropriate perception [12, 13] are features for the Mamadani's systems which can be used to form fuzzy inference system.

Problem Statement

This article provides two considerable variables dealing with partnering between supplier and employer in projects of the research center in Iran. The purpose is to develop a decision support system for relation management with employer through in which two "The amount of the level of supervision on supplier's performance" and "The amount of negligible delays due to employer" are defined considering as the outputs of fuzzy inference systems with deferent indices as the inputs. After importing opinions of experts and acceding on mentioned instances, three indices demonstrate as input to recognize indices including 1) type of project, 2) cost of project 3) scale of credence on supplier performance. Usually instead of considering such these variables as inputs of fuzzy inference system, they are used as a distinction of several fuzzy inference systems. This means for each discrete value, it forms a distinctive fuzzy inference system with continual value inputs. According to this explanations, three required fuzzy inference systems defines for dealing with a type of research projects, application and national. In the next, some efforts are made to be synthesized for increasing applicability by means of a guideline.

First, for more transparently, every output, the amount of the level of supervision on employer and the amount of negligible delays, is considered separable hence overall, six fuzzy inference systems has made. Therefore, six types of questionnaire have designed to extract the laws of fuzzy inference systems after filled out by experts.

If Type of Project is	Research	And the Quality of Credence is	Low	And the Cost of Project is	Low	Then How Should the Level of Supervision on Supplier's performance be?	Low ☐ Medium ☐ High ■
					Medium		Low ☐ Medium ☐ High ■
					High		Low ☐ Medium ☐ High ■
			Medium		Low		Low ☐ Medium ■ High ☐
					Medium		Low ☐ Medium ■ High ☐
					High		Low ☐ Medium ☐ High ■
			High		Low		Low ■ Medium ☐ High ☐
					Medium		Low ■ Medium ☐ High ☐
					High		Low ☐ Medium ■ High ☐

Figure 2: A sample of filled questionnaire by experts

The range of input and output variables is divided into three parts, Low, medium, and high, due to expert's opinion which gives the ability of variation of numerical values to the orals. Figure 3 illustrates triangle fuzzy values for the mentioned parts. The fulfilled questionnaire by experts shows that there are five laws for the research projects with output variable, the amount of the level of supervision on supplier. For instance, some laws are mentioned at the following:

- Law 1: For research projects, if the level of credence on supplier's performance is low, then by ignoring the cost of project, the level of supervision on supplier's performance should be high.

- Law 2: For research projects, if the level of credence on supplier's performance is medium, then by considering low cost of project, the level of supervision on supplier's performance should be medium.

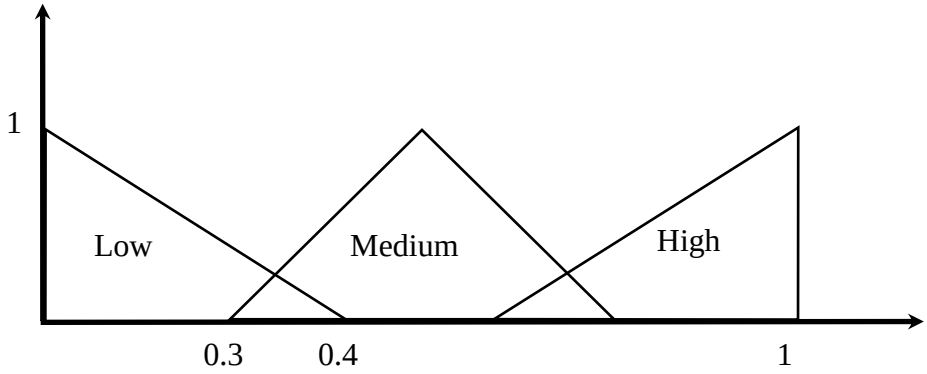


Figure 3: The triangle fuzzy values for the determined parts in input values

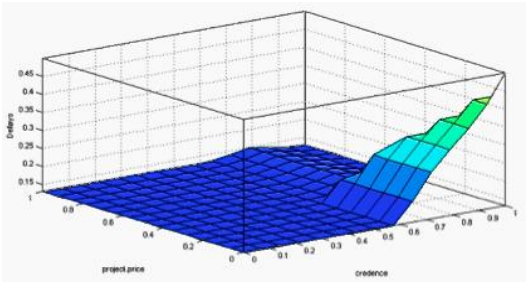
Figure 4 shows a set of laws used in three dimensions (3D) space. In each figure, x and y axes express in order cost of project and the level of credence on supplier's performance. And also z axis points out to the output variable. For instance, if the level of credence on supplier's performance is low, then by ignoring the cost of project, the level of supervision on supplier's performance should be high.

The Aggregation of the Fuzzy Inference Systems

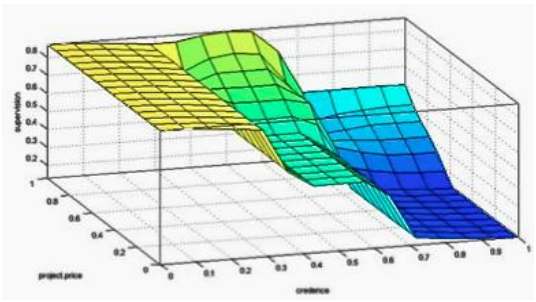
At the end, six fuzzy inference systems are integrated to a united fuzzy inference system to prevent user from confusing in applicable of these systems. Three triangle fuzzy values without enveloping with each other are imposed to insert "type of project" into the inputs. At this point and for determining the inputs, it is just enough to insert the average of each triangle fuzzy values for type of project. Triangle fuzzy values are detected for research projects (0, 0.15, 0.3), applicable projects (0.35, 0.5, 0.65) and national projects (0.7, 0.85, 1).

For instance, if the value 0.15 is an input for "type of project" variable, recognizes the project as a research one. From the other aspect, two outputs simultaneously are defined for the systems by Aggregation for all laws. With his variation, six fuzzy inference systems are integrated to a

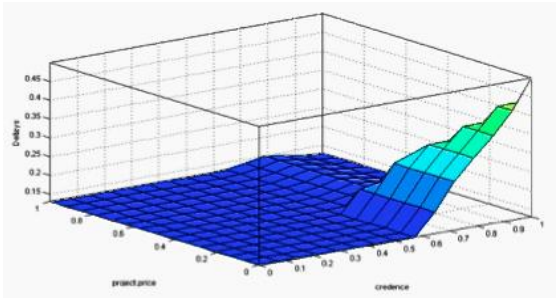
system including three input values and two output values. The rules governing the variables are shown in figure 5.



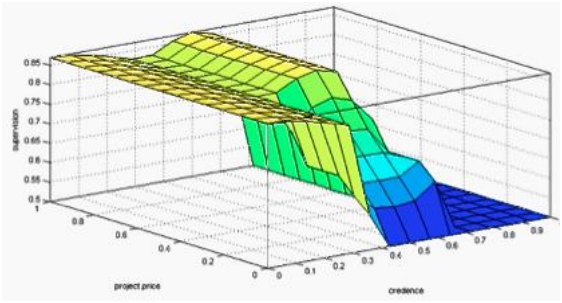
a) Amount of allowed delays in national projects



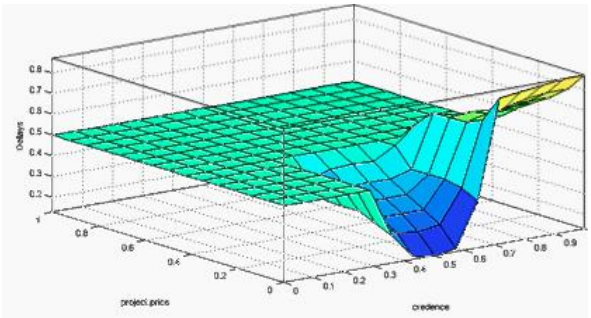
b) Level of supervision on national projects



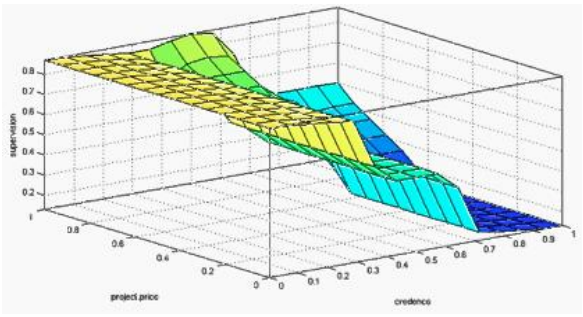
c) Amount of allowed delays in applicable projects



d) Level of supervision on applicable projects



e) Amount of allowed delays in research projects



f) Level of supervision on research projects

Figure 4: The processes in each fuzzy inference systems.

- If the type of project is research and the level of credence on supplier's performance is low, then the level of supervision on supplier's performance is high and the amount of supplier's negligible delays is medium.
- ▪ If the type of project is research and the level of credence on supplier's performance is medium and the cost of project is low, then the level of supervision on supplier's performance is medium and the amount of supplier's negligible delays is low.
- If the type of project is research and the level of credence on supplier's performance is medium and the cost of project is medium, then the level of supervision on supplier's performance is medium and the amount of supplier's negligible delays is medium.
- If the type of project is research and the level of credence on supplier's performance is medium and the cost of project is high, then the level of supervision on supplier's performance is high and the amount of supplier's negligible delays is medium.
- If the type of project is research and the level of credence on supplier's performance is high and the cost of project is low, then the level of supervision on supplier's performance is low and the amount of supplier's negligible delays is high.
- If the type of project is research and the level of credence on supplier's performance is high and the cost of project is medium, then the level of supervision on supplier's performance is low and the amount of supplier's negligible delays is medium.
- If the type of project is research and the level of credence on supplier's performance is high and the cost of project is high, then the level of supervision on supplier's performance is medium and the amount of supplier's negligible delays is medium.
- If the type of project is application and the level of credence on supplier's performance is low, then the level of supervision on supplier's performance is high and the amount of supplier's negligible delays is low.
- If the type of project is application and the level of credence on supplier's performance is medium and the cost of project is low, then the level of supervision on supplier's performance is medium and the amount of supplier's negligible delays is low.
- If the type of project is application and the level of credence on supplier's performance is medium and the cost of project is medium or high, then the level of supervision on supplier's performance is high and the amount of supplier's negligible delays is low.
- If the type of project is application and the level of credence on supplier's performance is high and the cost of project is low, then the level of supervision on supplier's performance is medium and the amount of supplier's negligible delays is medium.
- If the type of project is application and the level of credence on supplier's performance is high and the cost of project is medium or high, then the level of supervision on supplier's performance is medium and the amount of supplier's negligible delays is low.
- If the type of project is national and the level of credence on supplier's performance is low and the cost of project is medium, then the level of supervision on supplier's performance is high and the amount of supplier's negligible delays is low.
- If the type of project is national and the level of credence on supplier's performance is high and the cost of project is low, then the level of supervision on supplier's performance is medium and the amount of supplier's negligible delays is medium.
- If the type of project is national and the level of credence on supplier's performance is high and the cost of project is medium or high, then the level of supervision on supplier's performance is high and the amount of supplier's negligible delays is low.

Figure 5: the aggregation of all laws in a fuzzy inference system

5. Validation of established system

Owing to the fact that all laws for the established system are determined by an expert, there is no need further for validation. However, for increasing intuitive point of view, data of three sample of project from the research center are inserted into the system and the result created.

Project code	Type of project	Cost of Project	Quality of credence on supplier's performance	Level of supervision	Amount of negligible Delays
a	Research	0.253	0.84	0.25	0.71
b	Applicable	0.512	0.58	0.81	0.18
c	National	0.943	0.81	0.78	0.22

Table 1: Data of three samples

By using the real data in fuzzy inference system, the result is gained in follows:

- For project A, the low level of supervision and the high amount of allowed delays is suggested.
- For project B, the high level of supervision and the low amount of allowed delays is suggested.
- For project C, the high level of supervision and the low amount of allowed delays is suggested.

Conclusions

In this paper, decision support system is developed to determine the level of two variables in reliance with partnering between supplier and employer. The aim of establishing the support system is determination of "the level of supervision on supplier's performance" and" the amount of negligible delays due to employer". Considering the exports' opinions and the researched organization's requirements, affective input values in problem consists of "type of project "," cost of project", and "the level of credence on supplier performance" is considered. Distinctive systems for each possible value for the developed variable are extended dealing with discrete type of project. And then, for increasing the applicable of systems, with an approach, all of them have been integrated into a united system. At the end, for increasing intuitive point of view, data of three sample of project from the research center are inserted into the system and the result evaluated which comply with export's opinion.

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