企業環境での作業員配置の最適化に関する研究

A Study of Optimal Workers' Placement in an Industrial Environment

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1. Introduction

This research deals with problems of workers evaluation and worker placement in an industrial environment. The evaluation of workers is the most important for decision-makers to select better workers under various evaluation criteria. The aim of this research is to help the decision-makers make more effective choices among optional candidates. The worker placement is mainly concerned with seeking the optimal matching between workers and jobs within the constraints of available human resourses and jobs. In conventional (non-fuzzy) worker placement approaches, the evaluation of worker suitability tends to use exact values. However, due to the vagueness of job demands as well as the complexity of human attributes, the exact evaluation of personnel suitability is almost impossible. The fuzzy theory developed by Zadeh[1] can be applied to improve the expressions and the assessments in an industrial environment. Liang and Wang[2] applied the concepts of combining the fuzzy set theory and weighted complete bipartite graphs to develop a polynomial time algorithms of solving personnel placement in a fuzzy environment.

This paper develop a new method to determine the optimal workers placement in an industrial environment. In order to get a more convincing and accurate decision-making, the evaluation for relationship between the workers is developed in this paper. The concepts of combining fuzzy numbers and linguistic variables are applied to develop this method of solving worker evaluation problems in an industrial environment.

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2. Fuzzy Set Theory

Fuzzy set theory was introduced by Zadeh to deal with problems in which a source of vagueness is present.

2. 1. Triangular fuzzy numbers

The fuzzy numbers are very useful in promoting the representation and information processing under a fuzzy environment. A fuzzy number A in $\Re$(real line) is a triangular fuzzy number if its membership function $f:\Re\rightarrow[0,1]$ is equal to

$$f(x)=\begin{cases}(x-c)/(a-c), & c\le x\le a,\\ (x-b)/(a-b), & a\le x\le b,\\ 0, & \text{otherwise,}\end{cases}$$

with $-\infty < c \le a \le b < \infty$.[2] The triangular fuzzy number can be denoted by A=(c,a,b). The triangular fuzzy numbers defined on interval [0,1], is used to denote the fuzzy suiabilities of worker and the approximate reasoning of linguistic values.

2. 2. Linguistic variables

A linguistic variable is a variable whose values are words or sentences, in a natural or artificial language. The linguistic values are used to characterize the decision-makers' linguistic assessments about criteria weightings and worker suitability relative to various evaluation criteria.

3. Optimal Workers' Placement Problem

In this section, to efficiently tackle the worker evaluation and worker placement problems the following method is developed. This method can be used to solve workers evaluation and worker placement problems. The computational process of the proposed method as follows:

a: **Problem situation**: Assign importance weights and rating to each criteria

b: **Find a qualified workers**: Based on the condition that have been fixed, the qualified workers will be compute and listed.

c: **Find a possible combination**: Based of the condition that have been fixed, the possible combinations will be compute and listed.

d: **Aggregate the rating for relationship between the workers**: Relationship for the workers will be evaluate only for the possible combination.

e: **Rank the suitability indices**: As a final results, decision-makers will get a list of selected combination with ranking values.

As an example, suppose that we want to find a worker evaluation and also want to find an optimal worker placement for a department that have ten workers and three jobs. Numbers of criteria will be decide by decision-makers.

First Step: Decision-makers need to key in the grade of the linguistic values of workers for a different criteria.

Second Step: Decision-makers need to fix the linguistic weighting scale of a different criteria.

Third Step: Decision-makers need to key in the grade for relationship between the workers.

Based on data *first* to *third* steps by using the methods presented in this paper, the following simple but valuable results can be derived.

- •List of workers in ranking position
- •List of possible combination in ranking position
- •List of selected combination in ranking position

Results for example are shown in Table 1 and Table 2.

Ranking	Job1	Job2	Job3	Ranking Values
1	*(1,3,4)	(2,7,8)	(5,6,9)	75
2	(2,4,9)	(3,7,8)	(1,5,6)	71

Table 1: Suitability Indices and Ranking(without evaluation for relationship)

Ranking	Job1	Job2	Job3	Ranking Values
1	*(2,4,9)	(3,7,8)	(1,5,6)	85
2	(1,3,4)	(2,7,8)	(5,6,9)	78

Table 2: Suitability Indices and Ranking(with evaluation for relationship)

*(workers id,workers id,workers id)

Thus, by using proposed method, the best selection is (2,4,9,),(3,7,8),(1,5,6).

4. Conclusions

In this paper, a new method for the worker evaluation and the worker placement is proposed to solve the problems of worker evaluation and worker placement in an industrial environment: Our method includes the relationship between workers. The computation and the transformation between linguistic values and fuzzy numbers can be executed by our computer program, and the decision-maker interacts with the computer and make the appropriate selection.

This new methods emphasize the generality that each worker can perform all or only a subset of jobs in a fuzzy environment which is different from the classical assignment problems in a non-fuzzy environment. In general, the advantages found in this method include that it can efficiently characterize the variation of worker performance. Hence, the effeciency and effectiveness of the decision making process can be enhanced. The domain of worker evaluation illustrated in this paper is focused on production line, it can also be extended to other condition in an industrial environment.

5. References

[1] E.Takeda, N.Nakajima, H.Ishii, "Fuzzy Theory", Shokabo Tokyo,1994.

[2] G.Liang, M.J.Wang, "Personnel Placement In A Fuzzy Environment", Computers Ops Res., Vol. 19, No. 2, pp. 107-121, 1992.