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MODELLING THE TOUR PLANNING OF THE EMPLOPYEES ON THE CRITICAL TASKS BY GENETIC ALGORITHM

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ABSTRACT
The tour scheduling of the employees is the most crucial problems about the minimization of production costs and satisfying the effectiveness. Generally the long-term tour scheduling problems are NP-hard problem. Especially the tour scheduling of the employees on the critical tasks as nurses, pilots, surgeons, etc. have to constructed effectively. This research consists of the modeling of the quantitative and qualitative tour scheduling of labors on critical tasks in the period that the organization managers decide, by genetic algorithm
Keywords: Manpower planning, Tour Scheduling, Genetic Algorithm

1. INTRODUCTION
The most important advantage achievement of organization to contend with, the essence element of globalization, competition is minimization of the production and service's costs. Labor cost participates in production costs at high rates. Considering service sector, these rates increase. By the way; minimizing labor cost could be defined as a factor for elevate the power to compete. Moreover organizing effectively the employees is the one of the key tasks in the meaning of satisfying the productivity and the organizations have to show concern for property of labors. Especially the activities of employees on critical tasks like pilots, nurses, surgeons, firemen, etc. have to be planned carefully. Therefore man allocation planning isn't just regarded as minimization of cost. The fairness factor in scheduling or tour planning, the duration of watch below, satisfying of labors' demands and operational constraints, the foreseen of labors' capabilities and different skills for assignment are the critical success factors.

In this research, the model is developed to use for tour planning of the employees in critical tasks. This model could be interpretable considering all possible constraints, decision variables and goals. The genetic algorithm is the methodology used in developed model to interpret. **[3]**

2. TOUR PLANNING OF THE CRITICAL TASKS
The researches about optimum tour planning investigate the minimum number of employee and the schedule and the shifts applied to employees along a period to fulfill the requirements like manpower, minimization of costs. The reasons of the multiplicity of the researches in this area are the diversities in the circumstances of problems and consequently the possibilities of different models and algorithms of solution. In this research the employees could be defined the experts on critical and important tasks. The periods of tour planning are chosen as one month or one week planning period. In these researches the number of expert needed through a planning period, the satisfying of the experts' and organization management's demands, the number of expert which minimize the number of unemployed manpower, the assignment of the working day or shift of the experts, the

determination of vacation and watch below are analyzed. The integer linear programming used in tour planning is as following:

$$\text{Min} \quad Z=\sum_{j \in J} X_j \qquad (1)$$

subject to

$$\sum_{j \in J} a_{ij}.X_j \geq G_i \qquad (i \in I)$$

$$X_j \geq 0 \text{ ve integer} \qquad (j \in J)$$

Here; J could be defined as a cluster of all possible tour scheduling; I as a cluster of the planning periods; G_i, as the number of expert needed through planning period I; a_{ij} as one of 1 or 0 according the condition whether there is an assignment in tour schedule j through i planning period or not; X_j as the integer decision variable which represent the number of expert assigned to tour schedule. As mentioned before; there are lots of decision variables and constraints used in tour planning models. Besides there is much researches in which tour planning models are constructed with multiple goal functions. The first part of research plan to represent all of the diversities of these tour planning models and the data which could be used in the models. [5]

3. GENETIC ALGORITHM

Genetic algorithm (GA) is a search technique used in computing to find exact or approximate solutions to optimization and search problems. Genetic algorithms are categorized as global search heuristics. Genetic algorithms are a particular class of evolutionary algorithms that use techniques inspired by evolutionary biology such as inheritance, mutation, selection, and crossover. The basic principles of GA are suggested first in the University of Michigan by John Holland. In 1975, Holland introduced his research in his book "Adaptation in Natural and Artificial Systems". Instead of propos ion of a solution; GA creates the sets of solution consists of different solutions. For optimization problems GA has two important advantages. First; GA doesn't need much knowledge of math to solve and all sort of objective (linear or non linear) and constraints could be define. The second; the operator s of GA make he research more effective to find global optimum. With this type of characteristics, GA is applied to real world problems successfully. [4]

All individuals which show the solution in GA is named as chromosome. The chromosome chosen is evaluated by objective function and takes a fitness value. Then according to the purpose of programming, the chromosomes are ordered. The half of these (by using roulette Wheel or tournament selection) is selected. The population formed is developed by mutation and crossover operators. As a conclusion the new individuals are added to population and ordered again. These operations are repeated until the optimum solution. As a result of last iteration, the chromosome at first place in the population shows the feasible solution and the most available fitness function. By using the optimum solution of the model mentioned before; the assignment algorithm and the application results could be determined. In GA applications, a structure of a chromosome has to be formed. It could vary according to models: the employees assigned could form the genes or the tasks and the number of their need of labor could form a structure of chromosomes. In this research the chromosome consists of the employee who will assign to precise task at precise time. [2]

$S = \{sb1, s_{b2}, s_{b3},..., s_{bi}, s_{bi}, s_{b'1}, s_{b'2}, s_{b'3},\ldots, s_{b'i}, Z\}$, Æb∈ B*, Æb'∈ T_b, I = {1, 2,...,N}, (3)

s_{bi} : the "s" employee working in period "b",

$s_{b'i}$: the "s" employee resting in period "b'",

N : total number of employee

Z: the value of the fitness function of chromosome

The problem we are considering involves multiple criteria. This makes it hard to compute a quantitative value to represent the fitness of an individual. A possible approach to get a quantitative fitness value is to assign a weight wj to each criterion Zj and then use

$$F = W_1C(X) + W_2C_f(X) + W_3C_s(X) \quad (4)$$

as the value of fitness, but the determination of the weights wj in such an approach will be practically very difficult. Considering the hierarchical structure of the three criteria in our model and their relative importance, we propose to use a ranking scheme, which ranks the chromosomes in a population by the three prioritized objectives, and then select parents for generating offspring based on their ranks. The ranking philosophy is as below. We introduce a parameter ej in our ranking conditions, with the consideration that two solutions (chromosomes) are usually regarded, in practice, as almost equally good under an objective if their objective values fall within a small range ej. In such a case, we will further evaluate the chromosomes using the condition at the lower level if the current condition is at level j=1 or 2, or arbitrarily declare one chromosome to have higher rank than the other, if the current level j=3 (this corresponds to the case where the performance of the two chromosomes are basically the same after evaluation under the three criteria). **[3]**

- Choose a probability, q, to select the chromosome of rank 1.
- Determine the probability of selecting the chromosome of rank i according to a Geometric Progression series with a common ratio (1-q), namely, let the probability be $q(1-q)^{i-}$.
- Select parents according to their probabilities.

After all the chromosomes in a population have been ranked, we select parents according to the following approach. The structure of chromosome is formed.

Table 1. Structure of Chromosome

Structure of Chromosome	1	2	L
No's of employee	S_{b1}	S_{b2}	Z

To crossover the chromosomes, one or more point are determined in the chromosome and the genes at those points relocate to each other. During these operations the constraints are observed to determine a non-feasible condition could be arise. If there are; the needed changes on the chromosome is done for adaptation. For mutation; a gene in the chromosome is selected and changed with a random gene newly created. This operation must be controlled also for adaptation.

As a result of iterations, the final optimum value is determined. The tables of assignments according to these results are drawn. This research proposes an opportunity to find the solution in the multi-criteria models which contain diversities of skill of employee. The advantages of GA are choosing the parents according to ranking criteria or objective; moving in the set of solution by crossover; heuristic methodology which eliminate the unfeasible solutions created by crossover or mutation. the research become more interesting as concerning the analyses about tour planning by more different methodologies (taboo search, ant colony, etc.) or the analyses about different operational environments (long-term schedule or different types of shifts, non-linear cost functions, etc.) create different comparative areas.**[1]**

The application area of GA is fairly common in the area of production and design. The results obtained with GA in the production problems; especially scheduling, cell production and design is better than other traditional methodologies. The minimum time spent for these types of problems provide an effective working at design and production planning. Meanwhile time and cost are representing each other in nowadays' world; effective jobs in these crucial departments mean rapid response to the customer. All of these bring to the organization, a competitive advantage.
As a conclusion the genetic algorithm as a data mining method, considering with the other soft computational methodologies will make its own application areas in global rapid change's world.

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