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# *Estimating of Personnel's Variable Productivity Rate Using Fuzzy Sets Theory in Linear-Repetitive Projects and investigating its effect on the Schedule*

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***ABSTRACT***

Linear-repetitive projects are in which one or more group of activities repeat in different parts of project. Because of their special nature and importance of factors such as resource work continuity, personnel's variable productivity rate and effect of learning curve on efficiency of human resources, these projects scheduling is very particular and traditional methods cannot achieve optimum results herein. Personnel's learning phenomenon has been underline in past researches but they have less set to this matter. In present study, an approach for modeling learning rate and considering it in line of balance technique was processed. For this end, fuzzy sets theory has been apply here. After calculating the learning rate, it has been use for estimating amount of required worker-hours, variable productivity rate of labor and expected duration of activities in each unit of project. Based on outputs, it was obvious that effect of learning due to repetition results in reduction of total project duration and scrounging in its total cost.

***KEYWORDS***

Schedule, Linear-repetitive projects, Line of balance technique, Productivity rate, Fuzzy sets

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### *1- INTRODUCTION*

Linear repetitive projects (LRPs) are a particular group of projects in which some activities are repeated in different parts or units of the project consecutively, (such as residential complexes, highways and ...). because of their special nature and importance of factors such as work continuity of personnel, learning phenomenon due to repetition of activities in consecutive units, variable productivity rates of personnel, simultaneous operation of same activities in different units and etc, their scheduling is a different problem and we can't optimize them by common methods. Therefore, various studies have been concentrated on this issue since 1930. Thus, these works resulted in considerable progressions in the scheduling, howewer, not completed.

### *2- METHODOLOGY, DISCUSSION, RESULTS*

In this research using a quantitative method, a new approach based on problem modeling concentrating various aspects of management decisions and key factors involved in this matter is presented for optimum scheduling of LRPs. This model is a comprehensive method to schedule all type of these projects (linear and repetitive projects). Because of complexity of this problem and for attaining optimum schedule, it is necessary to find a powerful method that searches all of solution space without falling in local optimum solutions and in other hand, With respect to special attributes of Genetic Algorithm in optimization, in this study we applied this method for optimization of LRPs scheduling to provide satisfactory result in the minimum time. Also to achieve more realistic outputs, uncertainty conditions have been considered in problem modeling using fuzzy sets theory to provide frequency distribution diagrams of time and cost of project. In order to investigate the potential of the proposed model, a linear project from past researches was presented that has been probed in three different objective functions (minimizing overall project time, minimizing overall costs of project and time-cost trade off). To validate final outputs of proposed model, Final results from first case were compared to minimum duration of project from CPM and final results from second case were compared to minimum overall cost of project from RSM. In both cases, time and cost of project from proposed model are less than results of traditional methods and past researches. Also from the view point of twin time and cost of project, time – cost trade off results of this model are considerable and significant that result in optimum time and cost.

### *3- CONCLUSION*

The most important specifications of LRPs are existence of issues such as movement of resources between units frequently, leaning phenomenon due to repetition of similar activities in consecutive units and parallel performance of some particular activities in different units using various groups of resource (overlapping) if it is allowed. Therefore, in present research we provide a new method based on Fuzzy sets theory and Genetic Algorithm combination to achieve optimum schedule. The mentioned method focuses on resource work continuity and variable personnel productivity rate. In addition, uncertain conditions dominating projects in real world is involved to fulfill a realistic schedule aiming time-cost trade off and its results are presented in form of diagrams. It should be noted that the proposed model investigates the possibility of similar activities overlapping, permits useful interruptions during activities performance and considers various time-cost relationships (such as linear, non-linear, continuous or discrete ones) too. Eventually, suggestions are presented for future studies.

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