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PROJECT MANAGEMENT: NETWORK BASED MANAGEMENT SYSTEM WITH THE SUPPORT OF FUZZY LOGIC

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1. INTRODUCTION

In dealing with uncertainty, previous network planning techniques are based on stochastic models. Artificial intelligence (especially FL) has brought a new dimension in networking. Theoretically, fuzzy models are closer to reality but not well established rightly so in project construction. The impact of a stochastic and fuzzy version of PERT is illustrated via a numerical example to justify a more practical and realistic network schedule.

2. APPROACH AND METHODOLOGY

A recently completed project was selected as a case study. Two principle areas were studied upon. Firstly, the activity duration and later the resource allocation aspect. Fig.1 shows the flowchart of research. Fig.2 and Fig.3 illustrate the Gantt chart of the whole network and small network (selected activity) respectively. Initially, simulation was done to the small network as shown in Fig.4 (i.e. transforming Gantt chart to network). Positive results warrants further application to the whole network.

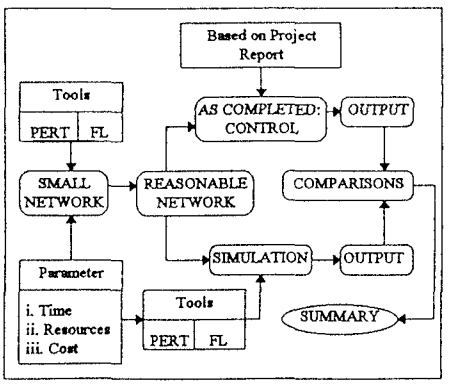

Fig.1 : Research flowchart

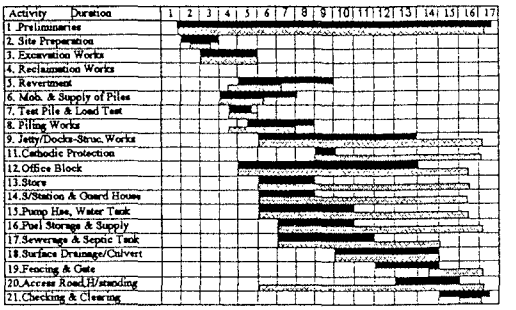

Fig.2: Gantt chart for whole network

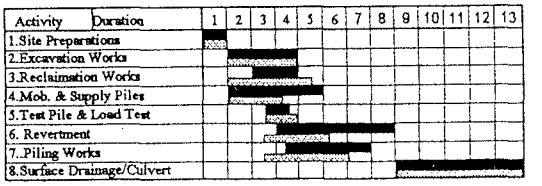

Fig.3: Gantt chart for small network

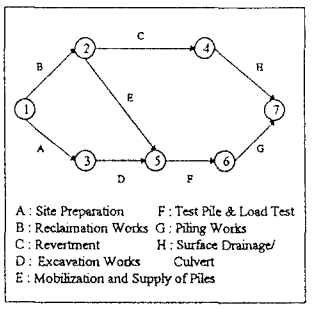

Fig.4: Network for small network

2.1 *Activity duration*

PERT stochastic variable modelled activity duration as beta distribution (optimistic-a, the most likely-m, pessimistic duration-b) and a simple method to calculate expectation and variance of activity times have been proposed. This fuzzy

version is based on fuzzy activity duration with triangular membership function as shown in Fig.5, with [a,b] as the basis and a top value of 1 at m.

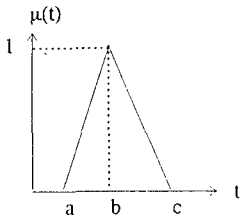

Fig.5: Triangular fuzzy number

By using fuzzy numbers and operators, algorithm becomes progressively difficult since the membership function does not keep the simple triangular form. Thus, the discrete max. and min. are adopted when performing the forward and backword pass.a, m, and b will in turn be refered as the lower value *L(d)*, the modal value *M(d)*, and the upper value *U(d)* respectively. For earliest time by using the relationship:

$$\tilde{t}_j = \max_{i \in B_j} (\tilde{t}_i + \tilde{d}_{ij}) \quad \text{.....Eq.1}$$

The lower, modal and upper values of maxima can be written as follows and their values can be calculated separately via a longest path algorithm.

$$L(\tilde{t}_j) = \max_{i \in B_j} (L(\tilde{t}_i) + L(\tilde{d}_{ij})) \quad \text{.....Eq. 2}$$

$$M(\tilde{t}_j) = \max_{i \in B_j} (M(\tilde{t}_i) + M(\tilde{d}_{ij})) \quad \text{.....Eq. 3}$$

$$U(\tilde{t}_j) = \max_{i \in B_j} (U(\tilde{t}_i) + U(\tilde{d}_{ij})) \quad \text{.....Eq. 4}$$

For the latest time, fuzzy subtraction is not the inverse of fuzzy addition and also the min. latest time is selected.

3. RESULTS AND DISCUSSION

Tabulated results for implementing the stochastic PERT and fuzzy models is shown in Table 1 and presented graphically in Fig.6 and 7. Generally there is a small improvement of 4% by applying the mentioned FL model as compared to the actual completion of the project. For PERT, modeled as beta distribution to cater for uncertainty in activity duration is theoretically valid and effective if it relies on past experience. By performing the discrete max. and min.approach the complexity of fuzzy algorithm is eleviated and perhaps more practical in order to be widely accepted. The distinct significant of fuzzy model, the triangular membership function is maintained and the fuzzy completion time for node 7 can be given as:

$$\mu_X(t) \begin{cases} \frac{t}{7} - \frac{6}{7}, & 6 \le t \le 13 \\ \frac{t}{13.5} + \frac{26.5}{13.5}, & 13 \le x \le 26.5 \\ 0, & \text{elsewhere} \end{cases}$$

	PERT(Single Estimate)		PERT(3TE)		FL	
	Actual		As Plan		As Plan	
Milestone	ET	LT	ET	LT	ET	LT
1	0	0	0	0	0,0,0	0,0,20.5
2	3.5	3.5	3.5	3.5	1,3,8	0,3,21.5
3	0.5	3.75	1.25	5.25	0.5,1,3	0,6.5,23
4	6.25	6.25	8.75	8.75	4,8,16.5	0,8,24.5
5	5.75	7.25	7.75	8.25	3,7,15.5	0,9.5,24
6	7.25	8.75	9.25	9.75	3.5,8,20	0,10.5,24.5
7	11.25	11.25	13.5	13.5	6,13,26.5	6,13,26.5

Table1: Results of PERT and fuzzy model

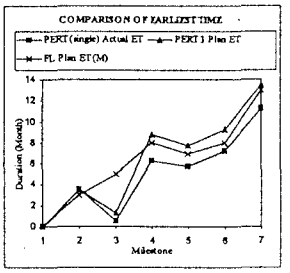

Fig.6: Earliest time comparison

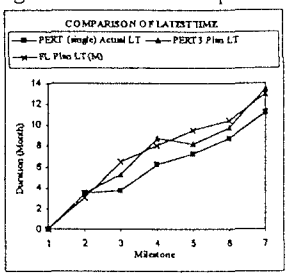

Fig.7: Latest time comparison

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