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Project management model for constructing a renewable energy plant

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Abstract

A project management model is developed for constructing a renewable energy plant in this research. Program evaluation and review technique (PERT) is applied first to find the critical activities when constructing the plant and to calculate the total project cost and total duration time for the project under normal condition. When some activities are crashed, the total duration time can be reduced. The total project cost and the total duration time for crashing various activities are calculated. The fuzzy PERT model is developed by the fuzzy multiple objective linear programming, and the model can devise the project implementation plan to maximize the total degree of satisfaction while minimizing total project cost and total duration time. A case study of a wind turbine construction in Taiwan is presented to show the practicality of the proposed models.

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Keywords: Renewable energy; project management; program evaluation and review technique (PERT); fuzzy.

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1. Introduction

With an enormous investment in time, capital and effort, the development a renewable energy plant is a very complicated task. A good project management for the construction of a plant is necessary. In a large-scale project, the management needs to coordinate numerous activities throughout the organization. Several models, which aim to overcome the disadvantages with critical path method (CPM) and program evaluation and review technique (PERT), have been introduced for the scheduling of construction projects, and some examples are vertical method, linear scheduling method and time scheduling method [1]. PERT, developed in the late 1950's, was first applied for the US Navy to plan and control the Polaris missile program, and its emphasis was to complete the program in the shortest possible time. PERT has the ability to cope with uncertain activity completion times, and it has the potential to reduce both the time and cost required to complete the project [2]. Some recent works on the project scheduling problem include Chrysafis and Papadopoulos [3], Jeang [4], Creemers et al.[5] and Yaghoubi et al.[6].

The rest of this paper is organized as follows. In section 2, two proposed models are introduced: a discrete PERT model and a fuzzy PERT model. In section 3, the proposed models are applied in the construction project of a wind turbine in Taiwan. Some conclusion remarks are made in the last section.

Nomenclature

i	Node number, i =1,2,…,N.
j	Node number, j =1,2,…,N.
(i, j)	Sequence of nodes, j will be processed after i is processed.
TP	Total duration time for the project
TC	Total cost for the project
R	Total crashing cost for the project.
E_i	Start time for activity i.
ST_{ij}	Slack time for node (i, j).
$K_{D_{ij}}$	Direct cost of node (i, j) under normal time.
D_{ij}	Normal duration time for node (i, j).
d_{ij}	Shortest duration time for node (i, j).
T_{ij}	Duration time for node (i, j).
Y_{ij}	Crash time for node (i, j).
$\tilde{s}_{ij}$	Fuzzy crashing cost per unit time for node (i, j).
s_{ij}	Crashing cost per unit time for node (i, j).
$\tilde{l}$	Fuzzy penalty cost per unit time.