Integer Programming Technique for Project Scheduling Considering Risk Management for Mega Projects

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This Thesis was Submitted in Partial Fulfillment of the Requirement for Master's Degree of Engineering Project Management

Faculty of Engineering

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January - 2018

Dedication

To My Country, Jordan,

To My Father and Mother,

To My Teachers and Doctors,

To My Colleagues and Friends,

To All Who Cares …

Acknowledgement

After The Name of ALLAH, I wish to express my deepest respect and sincere appreciation to my family for kindness and encouragement throughout my undergraduate and graduate study.

I wish to express my indebtedness and heartfelt gratitude and appreciation to my instructor Prof. Dr. Rami A. Maher, for his precious and continuous help.

A particular note of thanks goes to every member of the academic body of the university to their role in my personal and academic development.

Finally, I would like to express my deep thanks for all my dear friends for their sustain help.

Hamza Hasan AL-Safadi

January 2018

Authorization Form

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Committee Decision

This thesis titled, **" Integer Programming Technique for Project Scheduling Considering Risk Management for Mega Projects"** was successfully defined and approved in January 2018.

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List of Abbreviations

MSIS	Multi Start Iterative Search
TCT	Time Cost Tradeoff
LP	Linear Programming
IP	Integer Programming
PMBOK	Project Management Book of Knowledge
APM	Association of Project Management
EL	Elite list
DTCT	Discrete Time Cost Tradeoff
AOA	Activity on Arrow
AON	Activity on Node
CPM	Critical Path Method
PERT	Program Evaluation and Review Technique
MSPSP	Multi Skills Persons Scheduling
MMRCPSP	Multi Resource Constrained Project Scheduling Problems
NPV	Net Present Value
RPM	Repetitive Project Model
EST	Early Start Time
EFT	Early Finish Time
LST	Late Start Time
LFT	Late Finish Time
TFT	Total Float Time
FFT	Free Float Time

Int.F	Interfering Float
Ind.F	Independent Float
V_m	Maximum Value of Used Resource
RR	Rate of Resource Usage
RIC	Resource Improvement Coefficient
C_c	Crashed Cost
C_n	Normal Cost
T_n	Normal Time
T_c	Crashed Time
C.S	Crashing Slope
ICAP	Increased Critical Activity Percentage

Abstract

Integer Programming Technique for Project Scheduling Considering Risk Management for Mega Project

By: Hamza Hasan Mohammad AL-Safadi

Projects can be classified into small, medium, large and mega. This could be mainly based on several factors such number of activities, the budget of the project or the completion time. This criterions of scaling may be changed from country to another. Increase one or more of these factors, the scale of project increased. The problem of mega project scheduling that is nine out of ten mega projects have cost overrun and benefits shortfall, that are resulted from inadequate scheduling plan.

This thesis develops a methodology for mega projects scheduling using heuristic approach and integer programming approach. This methodology includes three issues; time cost tradeoff, resource leveling and resource allocation. Heuristic approach uses activity on arrow network, therefore, this thesis introduces an algorithm to generate a unique activity on arrow network with minimum number of dummy activities. This developed heuristic algorithm finds the available times to complete the project and crashing cost associated to these times based on crash time for each activity and critical path calculation. A genetic algorithm is used to perform resource leveling and allocation using three indices to determine the optimum scheduling process. It also introduces integer programming model for time cost tradeoff problems using crashing time for each activity and logical relationships between activities.

As a case study, a mega construction project took place in the city of Aqaba, Jordan, is used to explore the application of the proposed methodology. For this case, the proposed methodology finds the available times to complete the project. The heuristic algorithm found that the project can be completed in six different durations and each duration specify amount of crashing for each milestone individually. Furthermore, the genetic algorithm adjust scheduling of these durations based on resource limitation in order to achieve best resource improvement coefficient. The increased cost for these durations was found by integer programming model to guarantee that the increased cost is optimal. Finally, risk consideration offers to project manager to choose one of these durations based on the percentage of increased critical activities.