



**Multi-Project Scheduling with Limited Resources
Management in Construction Industry**

By:

Maher Farok Yousif Al-Lebban

Supervisor:

Prof. Dr. Rami A. Maher

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Faculty of Engineering

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

رَفَعْنَا أَيْدِيَنَا مِنْكُمْ
وَأَبْدِئُ بِالْعِلْمِ دَرَجَاتٍ

صِدْقَ اللَّهِ الْعَظِيمِ

Dedication

I dedicate this work to my country, IRAQ

I dedicate this thesis to my father and mother,

My dear wife,

My son and daughter,

and to my brothers and sisters.

I dedicate this work, first and foremost, to all the people who contributed towards the success of this dissertation.

In addition, I would like to thank Hashemite Kingdom of Jordan and their people for their help and for hosting me throughout the duration of my research.

Acknowledgement

Thanks for God

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Maher Farok Al-Lebban

August 2017

Authorization Form

I, Maher Farok Al-Lebban, authorized Isra University to supply copies of my thesis to libraries or establishments or individuals on request, according to the Isra University regulations.

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Committee Decision

This thesis titled, “**Multi-Project Scheduling with Limited Resources Management in Construction Industry**” was successfully defended and

approved by:

Examination Committee

Signature

Prof. Dr. Rami A. Maher (Supervisor)

*Dean of Faculty of Graduate Studies
and Scientific Research
Isra University*

Asst. Prof. Dr. Ibrahim A. Mohammed

*Department of Civil Engineering
Faculty of Engineering
Isra University*

Prof. Dr. Ghaleb J. Sweis

*Faculty of Graduate Studies
The University of Jordan*

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List of Abbreviations

Abbreviations	Means
A.L.	After Leveling
AOA	Activity on Arrow
AON	Activity on node
B.L.	Before Leveling
CPM	Critical Path Method
CTP	Completion Time Project
EST	Earliest Start Time
ETV	Earliest Time Vector
F.F.	Free Float
GA	Genetic Algorithm
LCT	Latest Computing Time
MAXTWC	Maximum Total Work Content
MINLFT	Minimum Latest Finish Time
<i>MR</i>	Maximum Resource Value
PERT	Program Evaluation and Review Technique
PSA	Parallel Scheduling Algorithm
P.A.	Precedent Activity
RDP	Resource Dedication Problem
<i>RIC</i>	Resource Improvement Coefficient
RV	Resource Accumulating Vector
<i>RR</i>	Resources Rate
T.F.	Total Float
TV	Time Period Vector

Abstract

Multi-Project Scheduling with Limited Resources Management in Construction Industry

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The scheduling of the multi-project consists of two or more projects, and the project is defined as a collection of activities that consume resources or a set of events. Therefore, the scheduling of a project is the assignment of a start and finish time for each activity so that the precedence and resource requirements are satisfied. This becomes a difficult problem in multi-project environments with limited resource.

Three choices for scheduling the projects are usually considered. The first is when the project is very large-scale. Therefore, the project should be divided into several large to medium-scale project so that each project can be easily scheduled. The second choice is when there are several small projects, which have nearly converged completion time, then the treating them separately may lead to lose in efforts, time and to inefficient management and improper control. Therefore, the solution is scheduling these projects in multi-project management environments. The third one is the dealing of several medium-scaled projects, which can be managed separately with easy scheduling and high flexibility.

In this thesis, the second choice is considered by taking five different construction projects in terms of their resources quantity and of the almost equal number of activities from a real construction company. However, their completion times are un-similar. Several approaches of scheduling these projects as a single multi-project will be presented and discussed. A genetic algorithm is used to develop a program that assists to

solve the optimization scheduling process. Two different alternatives of scheduling will be proposed. The first alternative is merging the separate projects in one project by considered seven different merging configurations. The second alternative is re-planning activities of these projects in a single multi-project. For selecting the optimum trade-off between these scheduling alternatives, a multi-criterion is properly used.

At first place, the thesis provides a general approach to scheduling several projects in the multi-project environments, and shows how to choose the best alternative of scheduling. Considering the case study, a general finding is although one optimal scheduling alternative (optimal merging) is found; however, this may not be the best scheduling or best merging for another case study. Consequently, managers have to determine their own multi-criterion for the case at his or her hands.

The found optimal scheduling alternative (optimal merging) offers the best resource improvement coefficient RIC , maximum resource rate RR , and minimum resource maximal use MR , and the risk considerations. Furthermore, the alternative of seven merged configurations is compared to the alternative of re-planning the activities of all projects in a single multi-project. It is found that, besides the need of manager experiences and skills to reduction the number of total activities for an alternative of re-planning the activities of all projects in a single multi-project; the results are either similar or less optimal.