



Critical Factors Causing Delay in Steel Construction

Projects in Jordan

Prepared by

Sura Imad Al Sarray

Supervised by

Dr. Walid M. Hasan

A Thesis

**Submitted to Faculty of Engineering as a Partial Fulfillment of the
Requirements for Master Degree in Engineering Project Management**

January, 2019

AUTHORIZATION FORM

I'm, Sura Imad Al_ Sarray, authorize Isra University to supply copies of my thesis to libraries or establishments or individuals on request, in accordance to the university regulations.

Signature:

Date:

COMMITTEE DECISION

*This thesis (Critical factors causing delay in steel construction projects in Jordan) was
successfully defended and approved on (10-1-2019)*

Examination Committee

Signature

Dr. Walid M. Hasan (Supervisor)

.....

Al Isra University

Dr. Mohammed S. Al Lami (Assistant Professor)

.....

Al Isra University

Prof. Dr. Ghaleb Swais (External Member)

.....

The University Of Jordan

DEDICATION

This thesis is dedicated to my family, parents, friends and teachers have been a strong and steadfast support in my master journey. They taught me the value of life and faithful love. I can't fully express in words for insightful comments and encouragement that and Dr. Walid Hasan gave me.

ACKNOWLEDGEMENT

My sincere and deepest acknowledgement is to my supervisor Dr. Walid Hasan for his continuous support, fruitful suggestions and constructive criticism during this work. His immeasurable help is highly appreciated and will never be forgotten.

Special thanks are attributed for his patience, help and valuable support during this study. I also extend my thanks to my friends for their help and support.

Most importantly, my deepest gratitude goes to my family for their endless unconditional love, support, patience, prayers. Thanks for their continued motivation and support throughout my master's journey.

Thanks for all who helped me and are not mentioned in this acknowledgement.

ABSTRACT

Throughout the past decades and until this very moment the world trends toward the steel construction infrastructure due to the many benefits that this type of buildings affords; from the flexible and sustainable steel as a building material to the strong and durable facility as a structural steel construction. However, the most significant factors to adopt the steel construction around the world and in the Hashemite kingdom of Jordan as a developing country in particular is the economic benefits that the steel infrastructures afford in contrast with what the ordinary reinforced concrete structures are afford. Yet the delay in such projects leads to overrun the cost.

This study conducted on the most critical reasons behind the delay of steel projects in Jordan, the importance of this research come from the enormous benefits that Jordan as a developing country would gain from improving the steel construction industry; economic durability and sustainability. Nevertheless, as the delay of construction affects all the other aspects of the project, it is essential to study those delay factors in order to provide solutions specially for the cost which considered the most significant factor to decide whether the project management was successful or not.

This study conducted from a Jordanian perspective to identify the most critical barriers to commit to the steel construction projects in Jordan, those barriers related to; (1) owner, (2) contractor, (3) materials, (4) labor, (5) equipment, (6) project, (7) consultant, and (8) extra circumstances. Data collected from specialists of both the private and public sectors, the questionnaire's population includes; Consultants, Contractors, Owners, with experience ranges from 1 to 5 years to more than 16 years. Through the SPSS software the results had been analyzed and studied. The most ten critical factors are determined and accordingly effective recommendations had been proposed to reduce the time overrun in the steel projects in Jordan thus reduce the cost overrun as well.

Table of Contents

AUTHORIZATION FORM	I
COMMITTEE DECISION.....	1
DEDICATION	2
ACKNOWLEDGEMENT.....	3
ABSTRACT.....	4
Table of Contents.....	5
List of tables.....	8
List of figures.....	9
1 Chapter one: Introduction	10
1.1 Background	10
1.2 Consequences of delay in construction projects	13
1.2.1 Time Overrun	14
1.2.2 Cost Overrun	14
1.2.3 Litigation	15
1.2.4 Abandonment	15
1.3 Research Objectives.....	15
1.4 Research Hypothesis.....	16
1.5 Structure of the Thesis.....	16
2 Chapter two: Literature Review.....	17
2.1 Introduction	17
2.2 Types of delay	18
2.2.1 Critical factors	19
2.2.2 Non-critical factors.....	22
2.3 Previous Research on delay in construction projects.....	24
2.4 Previous Research on delay in construction projects in Jordan	26
3 Chapter three: Data Collection methodology.....	31
3.1 Introduction	31
3.2 Research methodology	32
3.3 Questionnaire design.....	33

3.4	Research community	37
3.5	Sample size.....	37
3.6	Data collection	39
3.7	Pilot study	40
3.8	Statistical tests and analysis.....	40
3.8.1	SPSS software.....	40
3.8.2	Reliability test.....	40
3.8.3	Mean score ranking and standard deviation	42
3.8.4	Z-score.....	43
3.8.5	Relative criticality of factors	44
4	CHAPTER FOUR: DATA ANALYSIS AND RESULTS.....	45
4.1	Introduction	45
4.2	Reliability test.....	45
4.3	Determination of the factors' criticality	46
4.3.1	Critical factors related to the owner of the project, and their effect on the steel construction project's schedule in Jordan	46
4.3.2	Factors related to the contractor of the project, and their effect on the steel construction project's schedule in Jordan	48
4.3.3	Factors related to the materials, and their effect on the steel construction project's schedule in Jordan	50
4.3.4	Factors related to the labor, and their effect on the steel construction project's schedule in Jordan	51
4.3.5	Factors related to the equipment, and their effect on the steel construction project's schedule in Jordan	53
4.3.6	Factors related to the steel construction project, and their effect on the steel construction project's schedule in Jordan	54
4.3.7	Factors related to the consultant of the project, and their effect on the steel construction project's schedule in Jordan	55
4.3.8	Factors related to external circumstances, and their effect on the steel construction project's schedule in Jordan	57
4.4	All critical factors that cause delay in the steel construction projects in Jordan	58
4.5	Person correlation between factors	61
4.6	Analyzing the critical factors causing time overrun at steel constructions in Jordan	66

4.6.1	Inability to provide effective solution in critical situations.....	66
4.6.2	Ineffective delaying penalties for the contractor	69
4.6.3	Waste of materials due to fabrication errors	71
4.6.4	Inappropriate construction Methods	74
4.6.5	Poor site management and supervision	77
4.6.6	Inefficient technicians for Maintenance	79
4.6.7	Lack of the project capital flow from the contractor side	82
4.6.8	Work accidents and injuries.....	84
4.6.9	Equipment malfunction and Lack of spare parts & Low productivity and Inefficiency of equipment.....	87
4.6.10	Delay in approving design documents.....	92
5	CHAPTER five: conclusion and recommendation	95
5.1	Introduction	95
5.2	Conclusion.....	95
5.3	Conclusion related to critical factors	96
5.3.1	Inability to provide effective solution in critical situations.....	96
5.3.2	Ineffective delaying penalties for the contractor	97
5.3.3	Waste of materials due to fabrication errors	97
5.3.4	Inappropriate construction Methods	97
5.3.5	Poor site management and supervision	98
5.3.6	Inefficient technicians for Maintenance	
5.3.7	Lack of the project capital flow from the contractor side	98
5.3.8	Work accidents and injuries.....	98
5.3.9	Equipment malfunction and Lack of spare parts & Low productivity and Inefficiency of equipment.....	98
5.3.10	Delay in approving design documents.....	99
5.4	Recommendations	100
	References	101
	Appendix A.....	104
	Appendix B.....	109

List of Tables

Table 3-1List of professors who had arbitrated the questionnaire	34
Table 3-2causes of the delay in the time line of the steel projects (The questionnaire design)	34
Table 3-3consistency according to Cronbach’s Alpha coefficient.....	41
Table 3-4Five level Likert scale and their relative criticality	44
Table 4-1Cronbach's alpha for the study (SPSS)	46
Table 4-2Mean S.D, and Rank of Owner related factors and its effect on delay of steel construction projects time line in Jordan.	47
Table 4-3the statistically significant result - external issues.....	48
Table 4-4Mean S.D, and Rank of Contractor related factors and its effect on delay of steel construction projects time line in Jordan.	49
Table 4-5the statistically significant result - external issues.....	49
Table 4-6Mean S.D, and Rank of materials related factors and its effect on delay of steel construction projects time line in Jordan.	50
Table 4-7the statistically significant result - external issues.....	51
Table 4-8Mean S.D, and Rank of labor related factors and its effect on delay of steel construction projects time line in Jordan.....	52
Table 4-9the statistically significant result - external issues.....	52
Table 4-10Mean S.D, and Rank of equipment related factors and its effect on delay of steel construction projects time line in Jordan.	53
Table 4-11the statistically significant result - external issues.....	53
Table 4-12Mean S.D, and Rank of project related factors and its effect on delay of steel construction projects time line in Jordan.	54
Table 4-13the statistically significant result - external issues.....	55
Table 4-14Mean S.D, Rank and Importance Level of Contractor related factors and its effect on delay of steel constructions projects time line in Jordan.	56
Table 4-15the statistically significant result - external issues.....	56
Table 4-16Mean S.D, and Rank of the external circumstances related factors and its effect on delay of steel construction projects time line in Jordan.	57
Table 4-17the statistically significant result - external issues.....	57
Table 4-18Mean and standard deviation for each question regarding to the descending order	59
Table 4-19Person correlation between factors.....	61
Table 4-20Relevant Importance Index related to occupations- Inability to provide effective solution in critical situations	67
Table 4-21Relevant Importance Index related to years of experience- Inability to provide effective solution in critical situations	68
Table 4-22Relevant Importance Index related to occupations- Ineffective delaying penalties for the contractor	70
Table 4-25Relevant Importance Index related to occupations- Waste of materials due to fabrication errors	

List of Figures

Figure 2-1 types of delay factor's in construction projects (my illustration).....	19
Figure 3-1 survey methodology	33
Figure 3-2 Demographic Characteristics of the Sample due to the occupation (The study population)	39
Figure 3-3 Demographic Characteristics of the Sample due to years of experience (The study population)	39
Figure 3-4 Rejected rejoin not-shaded shown for one tail	43
Figure 4-1 Response percentage according to the factor effect level	67
Figure 4-2 Response percentage for various effect levels according to respondent's years of experience.	68
Figure 4-3 Response percentage according to the factor effect level	69
Figure 4-4 Response percentage for various effect levels according to respondent's years of experience	71
Figure 4-5 Response percentage according to the factor effect level	72
Figure 4-6 Response percentage for various effect levels according to respondent's years of experience.	74
Figure 4-7 Response percentage according to the factor effect level	75
Figure 4-8 Response percentage for various effect levels according to respondent's years of experience.	76
Figure 4-9 Response percentage according to the factor effect level	77
Figure 4-10 Response percentage for various effect levels according to respondent's years of experience.	79
Figure 4-11 Response percentage according to the factor effect level	80
Figure 4-12 Response percentage for various effect levels according to respondent's years of experience.	81
Figure 4-13 Response percentage according to the factor effect level	82
Figure 4-14 Response percentage for various effect levels according to respondent's years of experience.	84
Figure 4-15 Response percentage for various effect levels according to respondent's years of experience. .	
Figure 4-16 Response percentage according to the factor effect level	
Figure 4-17 Response percentage for various effect levels according to respondent's years of experience. ..	
Figure 4-18 Response percentage according to the factor effect level	
Figure 4-19 Response percentage for various effect levels according to respondent's years of experience. ..	

List of Abbreviations

WBS	Work break down structure
CPM	Critical path method
ASEC	American society of civil engineers
CFs	Critical Factors
AIA	American institution architects
SPSS	Statistical Package for Social Sciences
AACE	Association for the Advancement of Cost Engineering
S. D	Standard Deviation
Sig	Significant
RII	Relevant Importance Index