Chapter 1: Introduction

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1.1 Introduction:

The booming of the Egyptian construction industry during the last two decades has been accompanied by an exponential escalation in the number and complexity of construction claims in most projects. As a result of this increase, most construction projects in Egypt were completed either behind schedule or over budget or both.

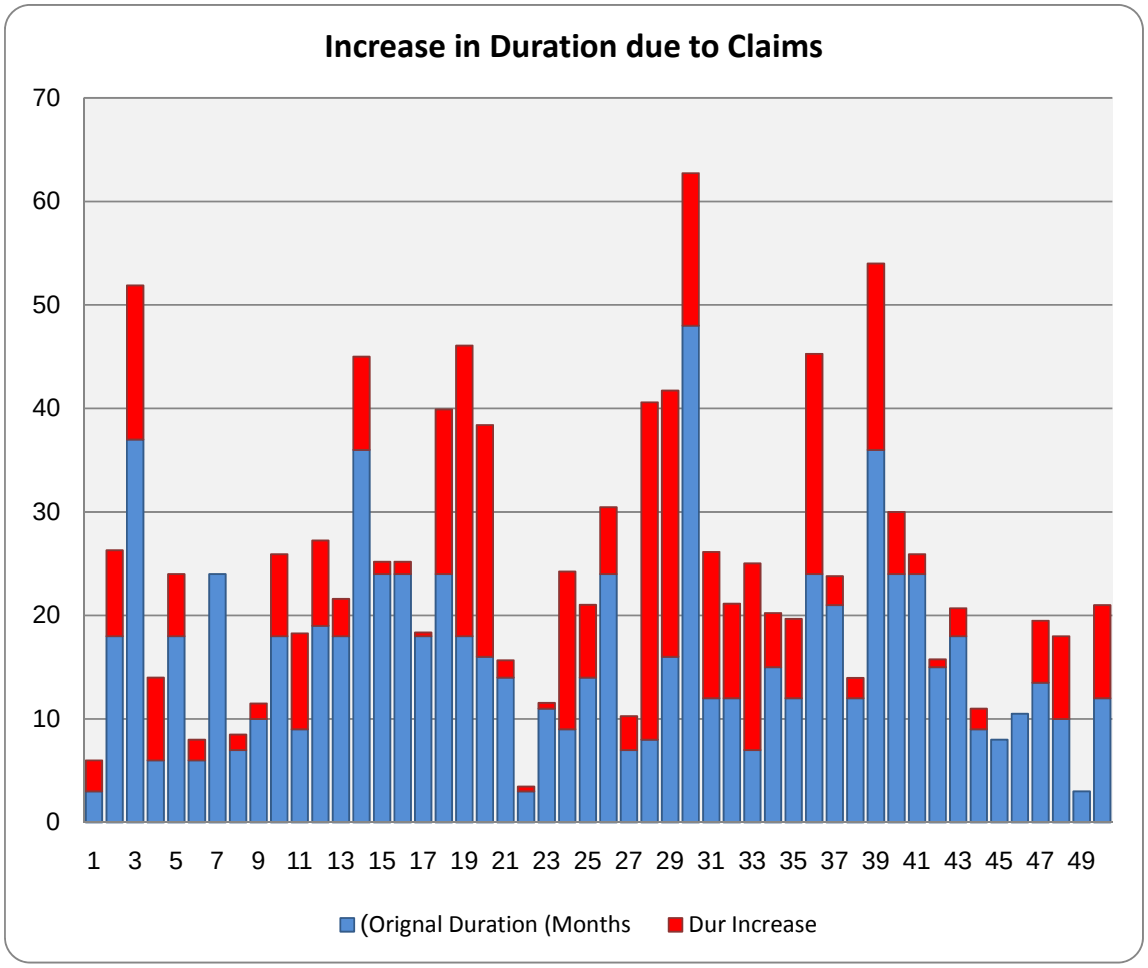

Figure 1 – Increase in Duration due to claims [32]

Figure 1 shows the increase in the duration; of 50 construction projects from different disciplines executed in Egypt during the period from 2000 to 2010 due to claims. It can be noticed that around 8% of the projects finished on time, while 18% of the projects had an increase in the duration of more than 100%. The increase in duration due to claims ranges from 0% to 407.4%.

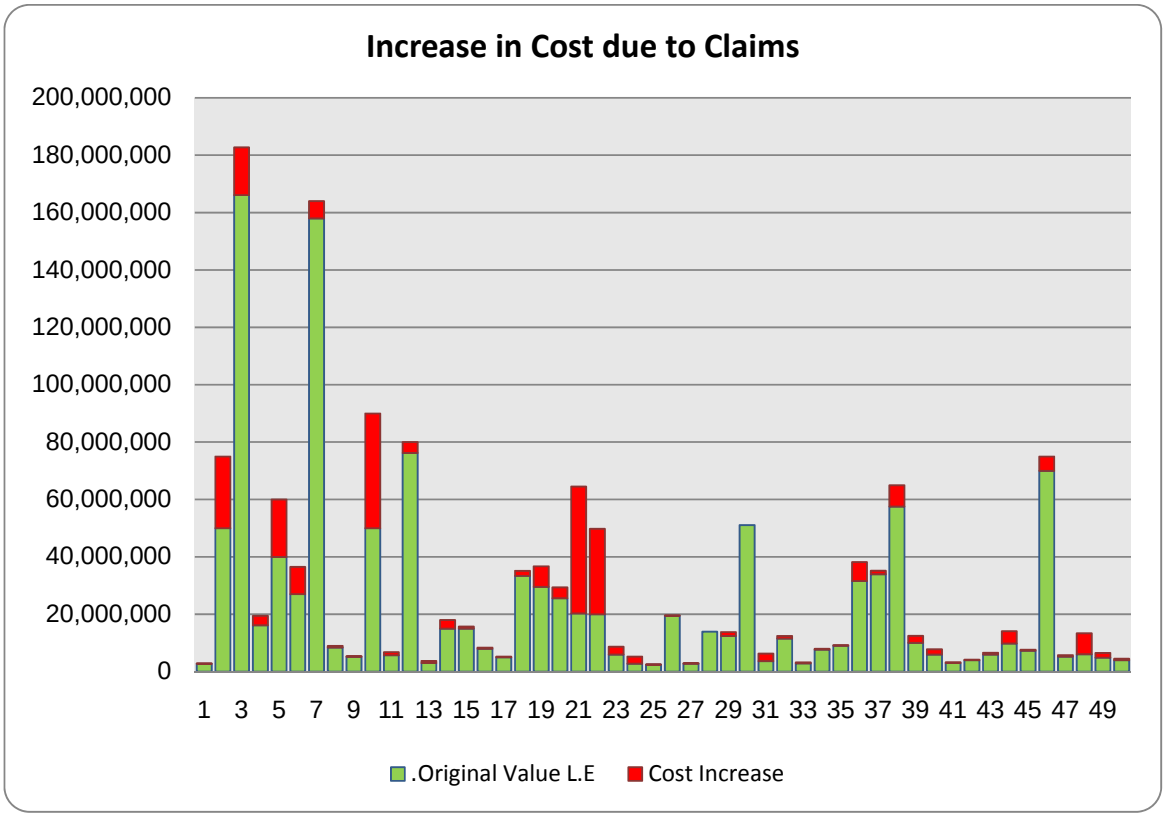

Figure 2 – Increase in cost due to claims [32]

Figure 2 shows the corresponding increase in the cost of the 50 construction projects of Figure 1 due to claims. It can be noted that 4% of the projects finished on budget, while around 12% of the projects had an increase in cost of 50% and more. The increase in the cost due to claims ranges from 0% to 232.2%.

"Construction industry surveys and studies indicate that between one-third and one-half of every project is over budget or behind schedule and that more than one-third of the owners of major new construction projects are involved in arbitration or litigation of construction contract claims." (4)

Enforcing contracts in Egypt represents a very significant problem. The World Bank's *Doing Business Report 2011,* which provides objective measures of business regulations notes that: "Contract enforcement is one of Egypt's worst indicators, where Egypt was ranked at number 143 out of the 183 economies. The report noted that it takes around three years to enforce a contract; the enforcement cost being approximately 26 percent of the value of the claim". [45]

Table 1 – Enforcing Contracts in the Arab Republic of Egypt [45]

Enforcing Contracts data	Doing Business 2009	Doing Business 2010	Doing Business 2011
Rank	154	148	143
Procedures (number)	42	41	41
Time (days)	1010	1010	1010
Cost (% of claim)	26.2	26.2	26.2

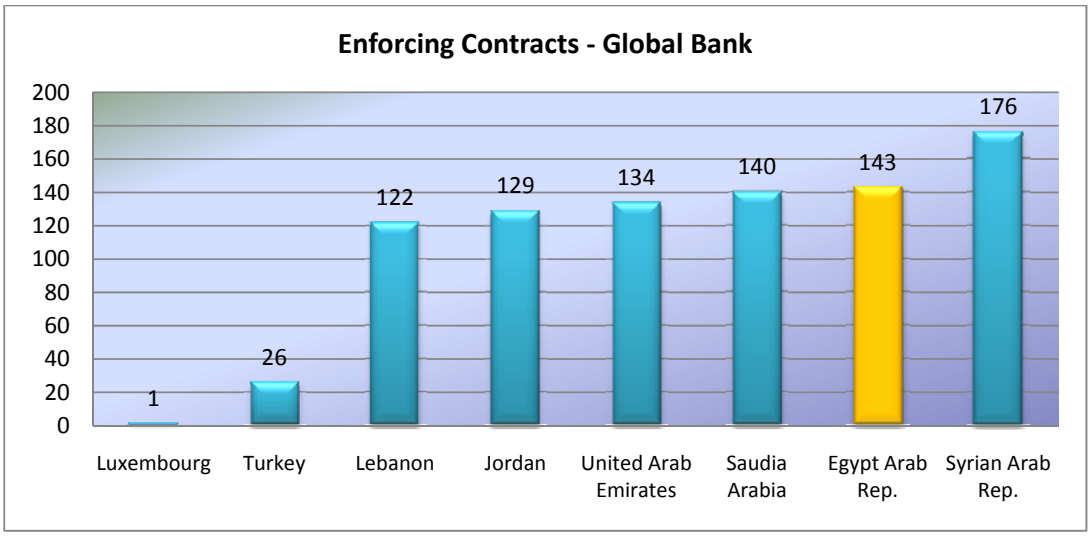

Figure 3 – Ranking of the Arab Republic of Egypt in Enforcing Contracts - Compared to good practice and selected economies [45]

The following figures 4 and 5 shows Enforcing Contracts data for the Arab Republic of Egypt compared to good practice and comparator economies. "Rankings on enforcing contracts are based on 3 sub-indicators:

- **Number of procedures,** which are defined as any interaction between the parties or between them and the judge or court officer. This includes steps to file the case, steps for trial and judgment and steps necessary to enforce the judgment.
- **Time,** which counts the number of calendar days from the moment the Seller files the lawsuit in court until payment is received. This includes both the days on which actions take place and the waiting periods in between.
- **Cost,** which is recorded as a percentage of the claim. Three types of costs are recorded: court costs, enforcement costs and attorney fees. [45]

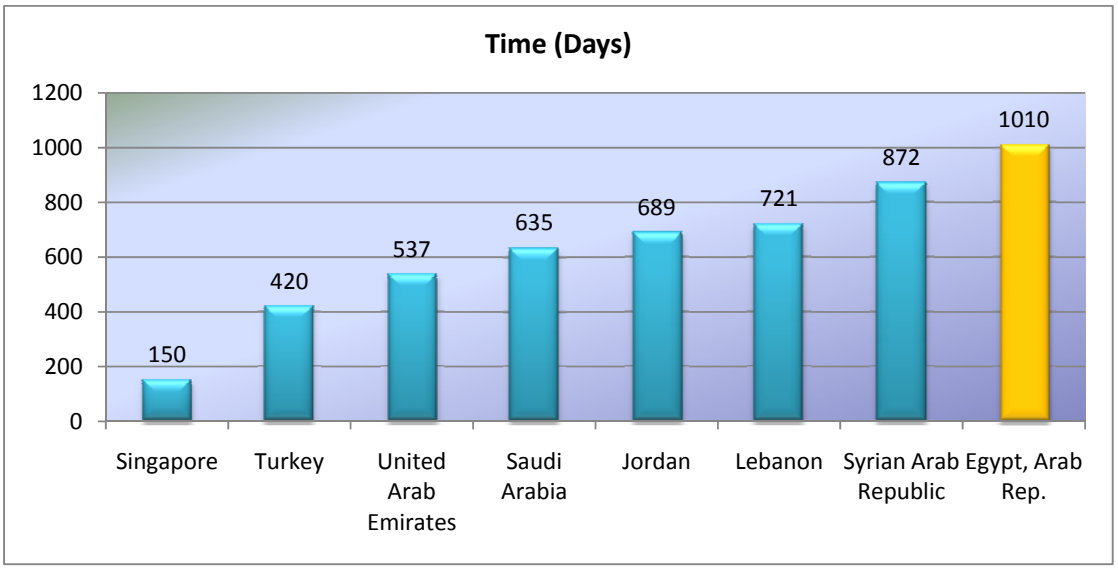

Figure 4 – Ranking of the Arab Republic of Egypt in Time of claim - Compared to good practice and selected economies. [45]

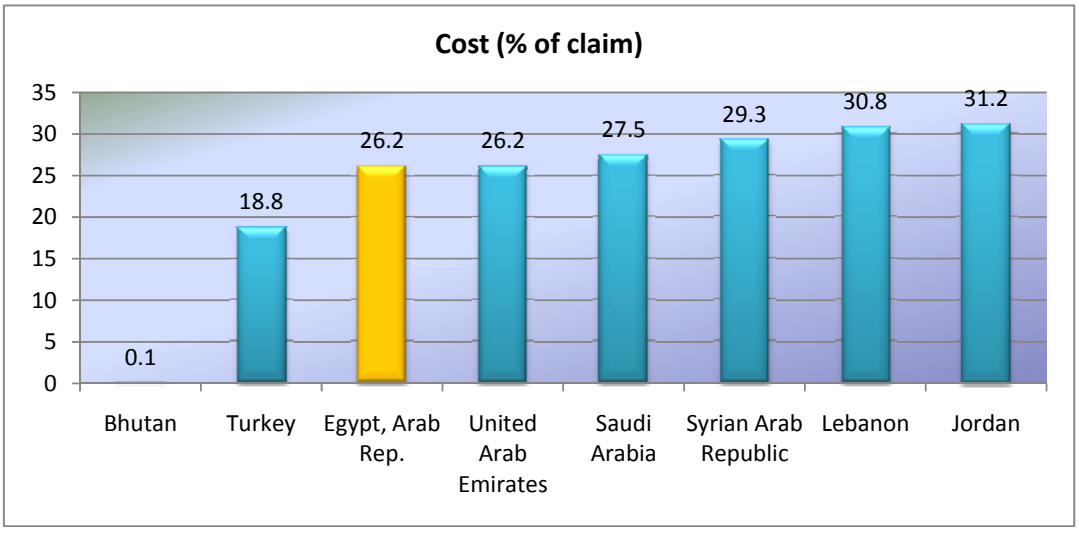

Figure 5 – Ranking of the Arab Republic of Egypt in Cost of Claim - Compared to good practice and selected economies. [45]

Effective claim resolution and prevention is critical to any construction project in light of the foregoing delays and costs. Claims cause major diversion of resources away from the project and the courts and arbitration may not offer a timely resolution of the dispute particularly if the dispute occurs during the course of the works. Also, the increasingly competitive global climate brings a number of tensions and issues which can act as catalysts for disputes. [45]

The construction process has become increasingly a dispute-prone activity. The distribution of risks between the contractor and the owner is tilting in favor of the owner, leaving the contractor with enormous risks, and unforeseen conditions at the construction site. The contracts binding the parties are becoming more complex. The adversarial relationship that has developed between the contractor and the owner over the years, coupled with the increasing complexity and magnitude of the projects, has increased the number and size of disputes. [31]

"At least four relatively unusual characteristics differentiate a construction dispute from other types of disputes:

i. Construction disputes usually involve more parties and more contracts than just the general contractor, the owner and the agreement between the two.
ii. The issues commonly raised are diverse, numerous, complex, and interwoven.
iii. The events leading up to the dispute may take place over months, or even years.
iv. The dispute often arises during, not after, construction, thereby requiring immediate decisions and actions during the heat of battle rather than affording the parties a reasonable period for reflection, study, review and consideration. The failure to act or react promptly may constitute a decision in itself, a decision that can yield disastrous long-term results." [31]

In recent years, all of the participants in the construction process have come increasingly concerned with construction claims. Construction delays are a regular part of the construction process. Although there may be unique aspects of the construction site, construction contract terms, and customs and practices in different parts of the world, for the most part the concept of construction delay is universal to the industry. [4]

1.2 Problem Statement

Analyzing construction delays has become an integral part of the project's construction life. Even with today's technology, and management understanding of project management techniques, construction projects continue to suffer delays and project completion dates still get pushed back. [38]

Despite the existence of a wide range of delay analysis methods such methods suffered from several drawbacks and need to be improved. Most of the existing delay analysis methods are incapable of analyzing concurrent delays, lost productivity and acceleration claims. Meanwhile, they are not in line with the development of advanced planning and scheduling software packages. The lack of uniformity among delay analysis methods can provide widely varying results that complicate the process of settling delay claims.

Delay claim analysis employs two basic parts: the first is the entitlement and determination of extension of time and the second is the computation of the financial damages. Most of delay analysis techniques focus on the first part which is the entitlement and determination of the time extension. This is while the second part of the damages calculations is not integrated in most of the analysis. Both parts are equally important. Without entitlement, damages cannot be recovered. Without obtaining damages the mere establishment of entitlement and time extension means that equitable adjustment is not achieved.

Detailed delay analysis methods are computationally intensive and required a lot of factual data and contemporaneous records. Commercial software provide little support in analyzing delays and the analysis is usually done manually that can lead to inaccurate results.

Extensive research has been conducted on the impact of delay on construction projects. Great efforts were directed to improve and automate the existing methods and to develop new models that expedite the delay analysis processes. However, most of the new proposed models have several limitations that affect the delay analysis:

i. Numbers of activities are limited, suitable only for small and medium projects.
ii. Most of the models are suitable for only finish to start interrelationships.
iii. Concurrent delays are not included in the analysis.
iv. Models are not able to analyze the impact of acceleration on the schedule of works.
v. Limitation of CPM techniques is not addressed.
vi. Most of the models are not integrated with software packages for data exchange and transfer.
vii. Financial delay damages calculations are not integrated in the analysis.

1.3 Objectives:

The main objective of this research is that it proposes a new generic automated model for analyzing delay claims. The proposed model is suitable for small, medium and large-size projects. The model is automated; it uses spreadsheets and databases to be in line with current commercial planning software packages. The model includes both extension of time and financial delay damages calculation. The model is suitable for activities interrelationships Finish to Start, Start to Start and Finish to Finish. The model comprises the analysis of concurrent delay, pacing delay and acceleration. The model is aimed to greatly reduce the analysis time as compared to the conventional delay analysis methods.

1.4 Methodology:

This research objective has been achieved by the fulfillment of a set of integrated phases that ends by the development of the proposed model:

Phase 1:

- Review the literature concerning construction delays and methods of delay analysis.
- Study the pros and cons of the existing delay analysis methods and techniques.
- Study the factors affecting the reliability and accuracy of delay analysis process which includes the Critical Path Method inherited limitations and methods of manipulation of the construction project schedules.
- Study the financial delay damages incurred by project parties as a result of prolongation and extending of construction duration.

Phase 2:

Development of the proposed model for analyzing delay claims which is summarized hereunder in figure 6.

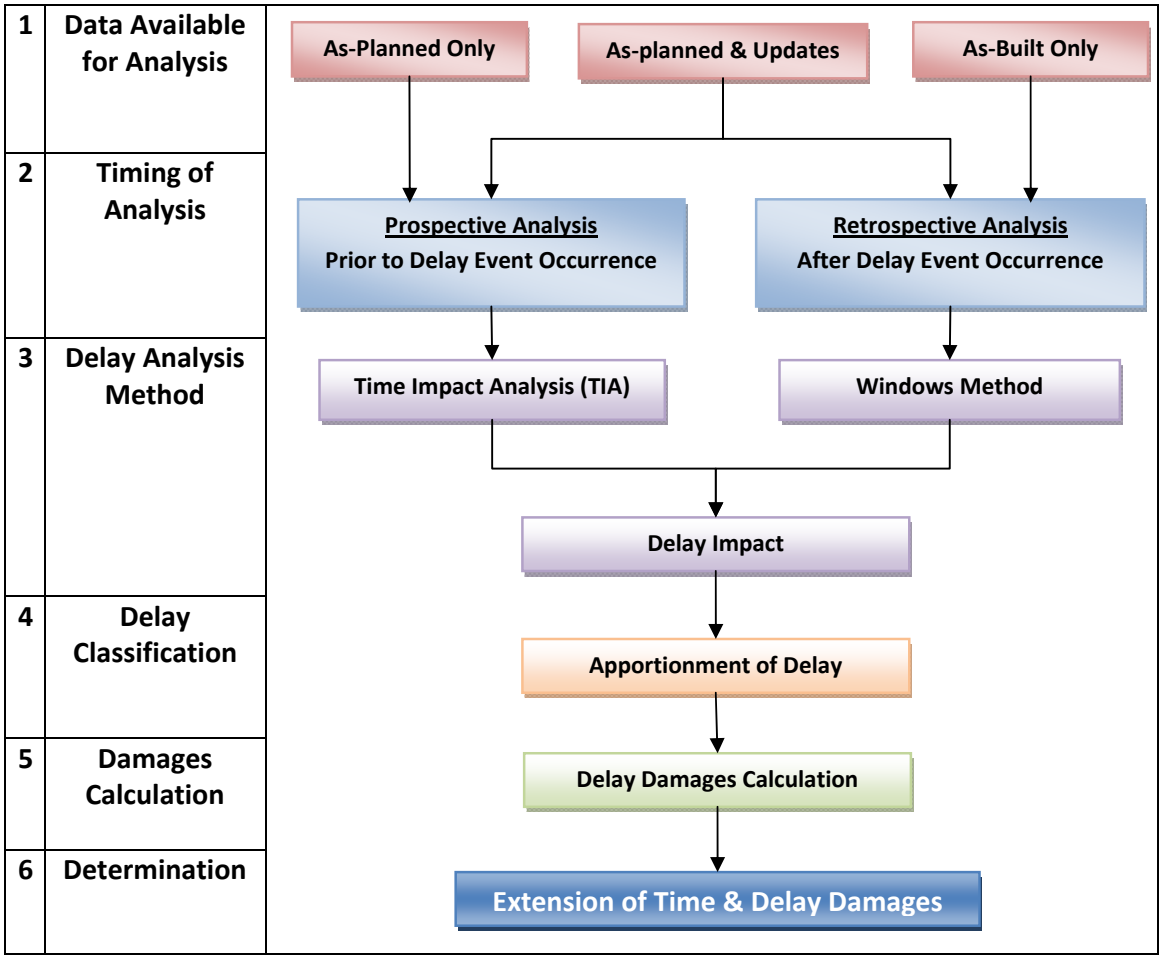

Figure 6 – Proposed Model Flow Chart.

The model comprises six integrated steps for analyzing delay claims and determination of delay damages:

- ***Step 1:*** distinguishes the data available at the time of performing the analysis. This data includes the as-planned, updates and as-built schedules.
- ***Step2:*** distinguishes the timing of when the analysis is performed, consisting of two branches, prospective and retrospective analysis.
- ***Step 3:*** comprises the analysis of delay events for the determination of their impact on the project critical path and finish date. The analysis uses either Time Impact Analysis (TIA) or Windows Method. Time impact analysis is used for prospective analysis while Windows method is used for retrospective analysis.

- ***Step 4:*** comprises the apportionment of critical delays where the liability for each delay event is individually analyzed. The classification is made primarily according to the responsibility for the cause of the delay, but may also consider the contractual risk allocation of the delay event regardless of the party who caused such delay.
- ***Step 5:*** comprises the calculation of delay damages resulted from prolongation and extending of contract duration for either the owner or the contractor.
- ***Step 6:*** involves the determination of the extension of time and delay damages.

Phase 3:

This phase comprises the automation of the delay analysis. The manual analysis requires great effort, much time, and may lead to inaccurate results. Automation is performed by using spreadsheet program MS Excel and database program MS Access.

Phase 4:

This phase comprises the application of the proposed model on two real life projects as a case study. The final results were compared with the actual results and were identical. This case study demonstrates that the proposed method is easy to use, accurate, systematic, speedy and applicable for all types of construction projects using Critical Path Method (CPM).

1.5 Scope:

This research scope is the analysis of delay claims based on time schedules that utilize Critical Path Method (CPM); either these time schedules are as-planned, updates or as-built schedules. The proposed model is suitable for analyzing projects of small, medium and large size; Finish to Start, Finish to Finish and Start to Start activities relationships; and different activity types.

1.6 Thesis Outline

This thesis comprises five chapters, references and appendices:

- ***Chapter 1:***
  includes an introduction for delay analysis and claims showing the role that it plays in construction industry. It also shows the need, objectives, methodology and scope of the research.

- ***Chapter 2:***
  includes the terminology and definitions of delay analysis. This chapter is adopted for listing different terminologies and definitions utilized in the delay analysis processes.

- ***Chapter 3:***
  includes the literature review on delay claims and analysis. This chapter is adopted for reviewing previous delay analysis methods and techniques.

- ***Chapter 4:***
  this chapter is devoted for the detailed description of the proposed model phases, steps and results.

- ***Chapter 5:***
  the objective of this chapter is to investigate the application of the proposed model on real life construction projects. The proposed model is applied on two real life projects and results were analyzed and verified.

- ***Chapter 6:***
  the objective of this chapter is to summarize the research methodology fulfilled in addition to the research conclusions and recommendations for future works.

- ***Appendix (A):***
  Case Study no. 01 data and analysis calculations.

- ***Appendix (B):***
  Case Study no. 02 data and analysis calculations.

- ***Appendix (C):***
  Case Study no. 02 Delay damages calculations.

- ***Appendix (D):***
  This appendix is devoted for describing the software developed for automating the new proposed methodology.

- ***References.***