Ownership of Generated Total Float

ملكية فترة السماح المتكونة

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Abstract

The ownership of the total float is one of the common disputed subjects in construction projects. With projects varying in terms of nature and complexity, conflicts started arising in projects over the ownership of the total float. This dissertation examines the ownership of total float and the entitlement of the contractor to be compensated once the employer may want to utilize the generated total float.

A conclusion was reached after reviewing the available literature. The conclusion has been enhanced through interviewing two experts in the field of construction law. Moreover, the research includes two case studies which are taken from the construction field so as to demonstrate the entitlement of the use of the total float.

The main output of the research is that there is a consensus between the interviewed experts that it is more logical that contractor to own the generated total float. Various factors for deciding who owns the total float are identified; the main defined factor was the contract terms and conditions.

Keywords: Total Float, Extension of Time, Claims, Construction, acceleration.

ملخص

ان ملكية فترة السماح واحدة من أكثر مسببات النزاع شيوعاً في قطاع الانشاءات. مع اختلاف المشاريع من ناحية طبيعة وصعوبة كل المشروع فان الخلافات بدأت تظهر بما يخص ملكية فترة السماح. تبحث هذه الأطروحة موضوع ملكية فترة السماح ومدى أحقية المقاول للتعويض اذا أراد مالك المشروع أن يقوم باستخدام فترة السماح.

تم الوصول الى خلاصة من خلال مراجعة النصوص العلمية المتوفرة. لقد تم تعزيز الخلاصة عن طريق عملية استجواب لخبيرين في مجال قانون الاتشاءات. وكذلك، فان هذه الاطرووحة تحتوي على دراسة لحالتين تم أخذهما من قطاع الانشاءات لكي نستطيع اظهار الأحقية لاستعمال فترة السماح.

النتيجة الرئيسية لهذه الأطروحة هي أنه هنالك اجماع ما بين الخبراء الذين تم استجوابهم بأنه من المنطقي أن يكون المقاول هو الجهة المالكة لفترة السماح المتكونة خلال المشروع. وانه هنالك العديد من العوامل التي تؤثر على أخذ القرار بما يخص ملكية فترة السماح، العامل الرئيسي الذي تم ايجاده هو شروط العقد.

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Dedication

I would like to dedicate this dissertation work and the success behind it to my beloved wife **Suhaila** for her endless support, patience and love and to my daughter **Katrina**; There is no doubt in my mind that without their continued support I could not have completed this degree.

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1 Chapter One: Introduction

1.1 Background and Statement of the Problem

Construction projects are considered as a significant part of the development undertaken by both public and private sectors in any country, such projects are including and not limited to buildings, infrastructure and energy. The level of complexity of any project depends on the size and the nature of the project, the size of the project depends on the physical scope of work which is needed to be accomplished and the nature of the project depends on various factors such as the location and special knowledge needed in order to perform the works.

Scheduling was found to be an essential element in planning and controlling various types of projects. Scheduling is an old model which was used in the old ages, various researches proved that the ancient people used the scheduling techniques to plan their developments and to control their projects such as and not limited to the ancient Egyptians when they built the pyramids.

Total float plays enormous role in the scheduling process[1], and it is considered as a ground of disputes between the contracting parties; disputes related to Total Float start with who has the right to utilize the Total Float and ends with the impact of the Total Float on the liability of delays and consequently the impacts of the delays.

Various reports and publications discussed the ownership of the total float allocated on the non-critical activities which have positive value of total float. This research is examining the ownership of the total float generated during the programme updates.

This research includes analysis of two case studies only from the Construction field. Hence, the research's outputs are limited to similar type of projects only. Moreover, the interviews are all coming from claims and construction law

[1] Jesus M. De La Garza, Michael C. Vorster and Cordell M. Parvin, 'Total Float Traded As Commodity' (1991) 117 Journal of Construction Engineering and Management.

prospective which usually represent contractors; this may limit the use of the outputs when it comes to employers.

1.2 Aims and Objectives

The aim of this paper is to investigate the ownership of the Total Float in the construction projects at the specific circumstance when total float is generated due to performing activity(s) by the Contractor ahead of the planned date(s) and whether the Employer should compensate the Contractor for utilizing the generated Total Float or not.

1.3 Scope of the Research

This research is meant to create a basis that can be utilized as guidance for the decision makers in relation to the use if the generated total float during the programme updates in construction projects in addition to the compensability of utilizing the generated Total Float by the Employer. The intention is to conduct qualitative research by developing a theoretical basis through investigating the reviewed literature in conjunction with the input of two field's experts.

The examined case studies are live examples of projects from the construction industry, projects were disputed and one of the main reasons behind the disputes is the ownership of the generated total float and the right to consume it by any of the parties.

1.4 Research Questions

The research questions are designed to serve as part of the theoretical basis for the total float ownership. Both questions were not directly questioned during the sessions of the interviews. However, the conversation with the field experts concentrated on the merits of both questions.

- In the circumstance when the Contractor performs activity prior to the planned dates, total float will be generated on such activity, who owns the newly generated float and can it be reserved to the contractor to use it later?

- If the Employer caused a delay event, can he benefit from the new generated float by the Contractor free of cost and without any compensation to the Contractor?

1.5 Research Structure

This paper includes six main chapters. Chapter one is giving an introduction to the scope of the research, research questions and the overall research aims and objectives. Chapter two includes the literature review; mainly, this part of the paper includes the particulars of the literature and specifying various sights and thoughts of researchers on the topic of the ownership of the generated Total Float in Construction Projects. Chapter three describes the nature of this research and the methodology. The research will follow the qualitative mean of research due to the fact that the core source of information will be gathered via dialogues with construction delay analysts. Chapter Four includes the conducted interviews with the field's experts. Chapter six includes case studies. Chapter seven covers the conclusions and recommendations.

2 Chapter Two: Literature Review

2.1 What is the Total Float

In the science of project management, the total float[2] is the period of time in which an activity can be delayed without causing any delay to the successor activity and the project completion date. The value of the total float is not constant and it may change during the project, the comparison is usually made between the total float in the baseline programme and the updated programmes or between various revisions of the updated programmes in order to track the total float changes and consequently any changes to the critical path. The change in the value of the total float is the result of introducing the actual progress data of the project to the baseline programme which allows the network to re-calculate new values of the total float for each activity and each path.

2.2 Critical Path Method[3] ('CPM') in scheduling projects

2.2.1 Critical Path Method Overview

The Critical Path Method is a scheduling technique[4] adopted by the construction projects in order to optimize the duration of the project and to determine the flexibility on the networks within the program. The Critical path method (CPM) may be considered as most preferred scheduling method for construction projects at the current days. This is due to the fact that the Critical path method added a significant value to the scheduling process through grouping the schedule activities into paths, these paths are driven by the links which reflects the dependencies between the activities, and these dependencies are a result of the sequence of work.

The longest path which pass through both of the commencement and completion milestone is called the critical path of the project, any day of delay

[2] Jay S Newitt, *Construction Scheduling* (Prentice Hall 2009).
[3] Peter Stelth, 'Projects' Analysis Through CPM (Critical Path Method)' (MSc, Isles Internationale Université (European Union) 2009).
[4] *A Guide To The Project Management Body Of Knowledge (PMBOK Guide)* (Project Management Institute 2004).

on the activities of the critical path will cause a delay on the completion milestone of the entire project. The Total Float of the activities which are sitting on the critical path should be zero, which means that any delay to the critical path activities will impact the overall project completion date. Activities which are sitting on other paths other than the critical path may have higher number of Total Float than zero, as an example, the activity which has a Total Float of one day may be delayed for one day without impacting the completion of the overall project.

The Critical Path Method depends on six major components:

- Early Start Date: The earliest date when the activity may start.
- Early Finish Date: The earliest date when the activity may finish.
- Late Start Date: The latest date when the activity may start.
- Late Finish Date: The Latest date when the activity may finish.
- Activity Duration: The total number of work periods required to complete the activity.
- Total Float: The amount of time that an activity can be delayed without causing a delay to the successor activity or the project completion.

The Critical Path Method calculates the early and late dates for each activity based on the activity's duration, predecessor and successor. The process used by the Critical Path Method for the calculations is called the Forward and Backward Path Calculations.

2.2.2 Critical Path Calculations (Forward and Backward passes)

The Forward and Backward Path Calculations process[5] is used for the purpose of calculating the activity's early start, early finish, late start, late finish and the total float. The process calculates the early dates using the forward path and the late dates using the backward path.

In the network, each activity is illustrated by an activity node which includes all the information about the specific activity including the activity name, activity

[5] A. T Armstrong-Wright, *Critical Path Method* (Longmans 1969).

duration, total float, early start, early finish, late start and late finish. Figure 1: [Activity node sample] below shows activity node sample.

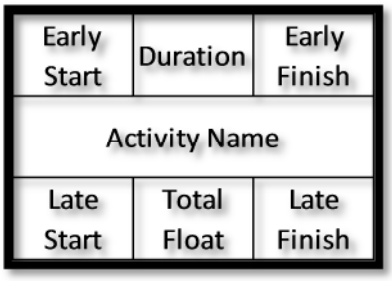

Figure 1: [Activity node sample]

In the example shown in in Figure 2: [Network sample] below, Four activities are identified which are activity A, activity B, activity C, activity D. The sequence of the work assigned is based on the dependencies between the activities, so activity A will be the first to start, and then both activities B and C require activity A to finish prior to the start of both activities B and C. Then activity D requires the completion of both activities B and C in order to start. Activity D is the last activity to be done.

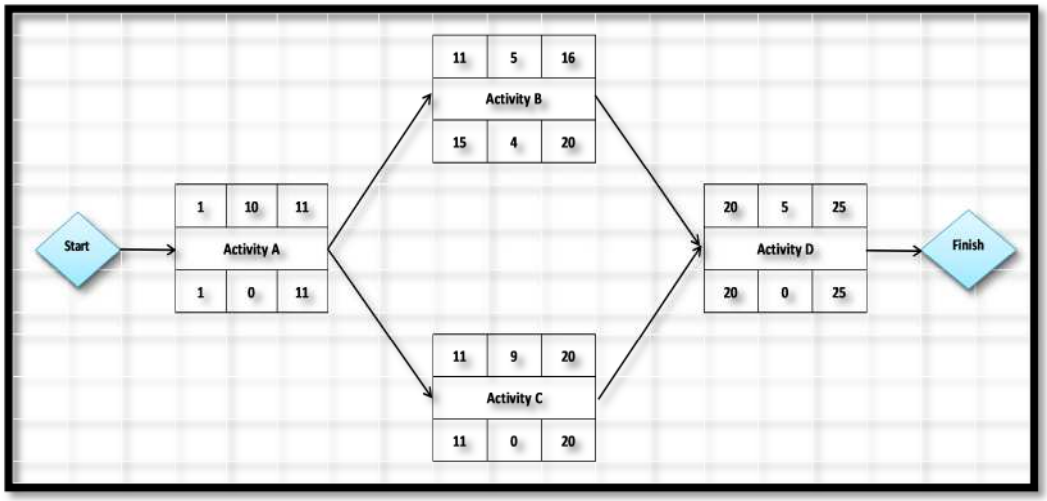

Figure 2: [Network sample]

As shown in Table 1: [Forward Pass] below, the forward path starts with assigning the date of the early start on activity A, for the purpose of this discussion, the early start is considered as day one, the early finish date of activity A equals to the summation of the early start and the duration of the activity which equals to 11. Due to the fact that activity A is the predecessor of

activity B, then the early start date of activity B equals to the early finish date of activity A which is 11, the early finish date of activity B equals to the summation of the early start and the duration of the activity which equals to 16. As activity A is the predecessor of activity C, then the early start date of activity C equals to the early finish date of activity A which is 11, the early finish date of activity C equals to the summation of the early start and the duration of the activity which equals to 20. As activity D has two predecessors which are activity B and activity C, then the early start date of activity D equals to higher early finish date between both predecessors, the early finish date of activity D is 20 which is the early finish date of activity C, the early finish date of activity D equals to the summation of the early start and the duration of the activity which equals to 20.

Activity Name	Early Start	Duration	Early Finish
A	1	10	11
B	11	5	16
C	11	9	20
D	20	5	25

Table 1: [Forward Pass]

As shown in Table 2: [Backward pass] below, the backward path starts with the last activity in the network which is activity D, due to the fact that activity D is the last activity to be performed in the network, then the late dates should equals to the early dates, as a result the late finish date of activity D is 25 and the late start date is 20. As activity D is the successor of activity C, then the late finish of activity C equals to the late start date of activity D which is 20, the late start date of activity C equals to the subtraction of the activity duration from the late finish date which equals to 11. As activity D is the successor of activity B, then the late finish of activity B equals to the late start date of activity D which is 20, the late start date of activity B equals to the subtraction of the activity duration from the late finish date which equals to 15. Due to the fact that activity A has two successors which are activity B and activity C, then the late finish date of activity A equals to lower late start date between both successors, the late finish of activity A equals to the late start date of activity C which is 11, the late start date of activity A equals to the subtraction of the activity duration from the late finish date which equals to 1.

Activity Name	Early Start	Duration	Early Finish
D	20	5	25
C	11	9	20
B	15	5	20
A	1	10	11

Table 2: [Backward pass]

The Total Float calculations can be made through one of the following equations:

- Total Float = Late Start – Early Start; Or
- Total Float = Late Finish – Early Finish

As shown in Table 3: [Total Float Calculations] below, the value of the Total Float is calculated to be zero for activities A, C and D; moreover, it is calculated to be 4 for activity B.

Activity Name	Duration	Early Start	Late Start	Early Finish	Late Finish	Total Float
A	10	1	1	11	11	0
B	5	11	15	16	20	4
C	9	11	11	20	20	0
D	5	20	20	25	25	0

Table 3: [Total Float Calculations]

The final step is to identify the critical path for the network. The critical path is passing through the activities which hold a total float value of zero, which means that, the critical path for the network shown in Figure 2: [Network sample] is passing through activities A, C and D.

The value of the Total Float can be positive, negative or zero. Positive value of the Total Float describes the time by which the activity can be delayed before adversely impacting the completion date. The negative value of the Total Float identifies how much late an activity is at specific time and consequently the project. The Total Float becomes negative when the early date of the activity is later than the late date. Total Float helps identifying the criticality of the activities and which are the most critical activities. Subsequently, Total float is a mean of early warning of probable delays. Moreover, Total Float is used to identify which activities are critical and which may activities may be delayed

without impacting the completion date which helps in the process of leveling the resources so as to avoid significant fluctuations in the monthly resources allocation.

2.3 Factors affecting the calculation of float[6]

2.3.1 Activity Durations

Activity duration illustrates the time period required to perform the scope of work associated with certain activity. Various factors are affecting[7] the estimation of activity durations; these factors include the amount of work to be performed, the availability of resources which can be utilized to perform the work associated with the activity, the working hours, the working conditions and the weather conditions.

2.3.2 Activities Relationships

Activities relationships may be defined as the links inserted between the activities in order to identify how the dependent activities are going to interface with each other. Identifying the type of relation between the different activities is a very important process as it is simply affecting the calculations of the activities dates and consequently the total float calculations. The dependencies between the activities can be illustrated in four models:

- Finish to Start: This model of dependencies is used when the predecessor activity should be completely finished before starting the successor activity. This is the common used logic dependency in scheduling.
- Start to Start: This model of dependencies is used when the successor activity should start on or after the start date of the predecessor activity.
- Finish to Finish: This model of dependencies is used when the successor activity should finish on or after the finish date of the predecessor activity.

[6] Rita Mulcahy, *PMP Exam Prep*.
[7] P. J Keane and Anthony F Caletka, Delay Analysis In Construction Contracts, 2Nd Edition (John Wiley & Sons 2015).

- Start to finish: This model of dependencies is used when the successor activity should finish on or after the start date of the predecessor activity. This model is rarely used.

2.3.3 Project calendars

Calendars are illustrating the working time of the project team, multi calendars can be used in the same project such as calendar for office based works such as engineering is different than construction site working calendar. It is essential to identify the project's calendars and to assign calendars to the project's activities. The calculation of the activities dates and consequently the total float depends on the calendars assigned on the activities. The calendar includes the number of working days per week after identifying the weekends, the working hours per shift and the number of shifts per day.

2.3.4 Constraints

When calculating the activities dates and total float, special consideration should be given when constraints are exist. Planner may use the constraints to represent contractual milestones, interim milestones, dates of material delivery in addition to many other valued uses. Although constraints are with high value in scheduling, they should never be used to substitute the logic between the activities, using the constraints as a substitute to the activities may affect the network's ability to calculate a reliable critical path to the project's completion.

Table 4: [Types of Constraints] below identifies the types of used constraints:

Constraint	**Purpose**
Start on	Activity to start on specific date
Start on or after	Activity to start on or after specific date
Start on or before	Activity to start on or before specific date
Finish on	Activity to Finish on specific date
Finish on or after	Activity to Finish on or after specific date
Finish on or before	Activity to Finish on or before specific date
Must finish by	Entire project to Finish on specific date

As late as possible	Activity to Finish on the latest date without impacting the successor
Mandatory start	Early and late start date to equal specific date
Mandatory finish	Early and late finish date to equal specific date
Zero total float	Early date to equal the late date.

Table 4: [Types of Constraints]

2.4 Total Float consumption[8]

2.4.1 Total Float consumption by the Employer

This includes the use of total float by the Employer and/or the Employer's representatives. The Employer usually attempts to consume the Total Float of the activities which are not falling on the critical path. The Employer's consumption of the Total Float may have adverse impact on the Contractor's operations as the Contractor will be left with lower contingency which may force the contractor to significantly increase the resources which may lead to having a working area congested with the resources, may force the contractor to diverse resources between the activities which adversely impacts the supervision skills and cause disruption[9]. Commonly, the Employer consumes the Total Float through one of the following[10]:

- The Employer not to execute its obligations as planned. Such as not granting site accesses to the Contractor, not obtaining authority permits, not approving shop drawings or submittals as planned, not delivering free issue material as planned, not performing proper interface management practice between various main Contractors.
- The Employer's representatives such as the Engineer not to execute its obligations as planned which consumes the Total Float.
- Generally, Employer's changes to the scope of the project are happening due to the fact that the Employer gains more visibility of the final product

[8] Zafer I. Sakka and Sameh M. El-Sayegh, 'Float Consumption Impact On Cost And Schedule In The Construction Industry' (2007) 133 Journal of Construction Engineering and Management.
[9] William Ibbs and Long D. Nguyen, 'Schedule Analysis Under The Effect Of Resource Allocation' (2007) 133 Journal of Construction Engineering and Management.
[10] Vezina (1991) and Householder and Rutland (1990)

as the work progress. Variations may increase the durations of the associated activities which may adversely impact the project completion date. Even if variations do not impact the completion date of the project, variations are usually consuming the Total Float of the activities which are not located on the critical path.

- It is the Employer's duty to manage the Contractor(s) and to do proper interface management practice to make sure that all of the contractors working on the project are doing their works in harmony. The issue starts when the Employer starts interfering with others such as subcontractors which causes disruptions to the works due to changes by the Employer, verbal instructions and micromanagement.
- Contractual terms are another mean that the Employer opts to consume Total Float, this is about including terms in contracts allowing the Employer to use or to own the Total Float.

2.4.2 Total Float consumption by the Contractor

It is the Contractor's obligation to plan and perform the scope associated with the project. Contractor usually plans to use the Total Float as contingency so as to deal with issues happening through the course of the project or to level the resources in order to decrease expenditures. Contractors have several ways[11] in consuming the Total Float of activities which are not located on the critical path:

- The Contractor not to execute its obligations as planned such as:
    - not performing its responsibilities as planned in terms of timing and sequencing;
    - not managing the interfaces between the Employer and the Employer's representatives from one side and the Subcontractors and vendors from the other side;
    - lack of experience in specific project's type which adversely impacts the performance and causes reworks;
    - lack of adequate project management team; or

[11] Householder and Rutland (1990), Vezina (1991), and Hulett (1995)

- lack of interface between the Contractor's schedule and the Subcontractor's schedule which causes gaps

- Subcontractors or vendors not to execute its obligations as planned such as and not limited to delayed or unfinished engineering drawings, manufacturing deficiencies and logistics delays.
- In many cases, it is well noticed that the contractor prepared unworkable schedules in order to show that the Contractor is able to match the contractual completion date; such schedules usually presents misleading figures of Total Float.
- The Contractor usually intends to obtain an extension of time, as a result, the Contractor abuses its rights under the contract to exaggerate any of the Employer's delays for the purpose of maximize the impact of this delay to be significantly impacting the project completion so as to demonstrate and entitlement for extension of time.
- The Contractor occasionally tries to tie activity(s) to certain date(s), this process happens by imposing constraints on the activities, such constraints may be Start on, Finish on, Start on or after, Start on or before, Finish on or after, Finish on or before and As Late As Possible. The utilization of such constraints is one of the major reasons setting behind unworkable schedule[12]. Such constraints can be utilized to allocate and control Total Float to individual activity or path.
- It is common to see both leads and lags in the Contractor's schedules. The purpose of using leads and lags is to impose a logic on how a set of activities are going to be performed and may be used to control the outcome of the scheduling process through getting already identified dates. The impact on the Total Float is adverse, the leads and lags are decreasing the value of the Total Float.
- Inserting resources links is another mean used by the contractor to consume and control the Total Float. As a standard practice, Contractor inserts logic links between the activities which illustrates the engineering

[12] Hulett 1995

logic between the set of activities, another type of links is the resources links, this type of links illustrates the movement of the resources around the site, consequently, the activities which will be performed by the same resource will be linked with each other. Adding such links consumes the Total Float as the Contractor's activities become sequenced through the project period instead of having more concurrent activities going on with higher Total Float.

- Contractor using overestimated durations for the activities in the schedule. Various contractors try to consume the Total Float by increasing the activity durations more than the periods required to perform the works in the activities of the network[13]. This will allow the Contractor to present a schedule with slight Total Float. Using such type of schedules, the Employer's delays will always be presented as impacting the Critical Path and the Contractor will be entitled for extension of time.
- Invalid updated programs. Throughout the course of the project, the Contractor is supposed to frequently update the schedule to show the progress of the project and to reflect a realistic completion. Updating the program wrongly through entering wrong actual data will lead to consuming the Total Float.

2.5 Project Programmes

2.5.1 The baseline program[14]

The expression "Baseline" is meant to describe scope, time and cost. Identifying a baseline is considered as assigning a benchmark for any of these three components which assists the project to identify any deviation from the initial benchmark and allow further analysis to be made to analyze the impact of such deviation. The baseline program includes the scope of work in the shape of sequenced activities loaded with quantities and resources, time zoning for the

[13] Zack 1992

[14] Christian Merrett, *The Importance Of An Integrated Project Master Baseline Programme* (1st edn, 2015) <http://www.driver-group.com> accessed 7 August 2016.

activities and the cost allocated on each activity. The critical path is previously defined in this paper, the critical path of the baseline programme passes through a chain of activities which are linked to each other and distributed over the time zones per the project's initial plan.

The total float of the critical path activities in the baseline programme should equal to zero, which means that the critical path passes through the entire project's duration from the start milestone up to the completion milestone.

2.5.2 The updated program (As Built Programme)[15]

Updating the baseline programme is an essential practice which is usually undertaken by the contractor throughout the project's period of performance. The contractor is updating the baseline programme for several purposes which include measuring the progress of the project and compare the progress at certain point of time with the plan in the baseline programme, identifying any deviation from the baseline programme such as changes in durations and dates, measuring the impact of the delays or potential risks and recording the performance of the project and forecasting the project completion through scheduling the remaining activities.

In the majority of the standard forms of contracts, updating the baseline programme is a contractual obligation which should be undertaken; moreover, various forms of contracts consider the updated programmes as the mean to determine the contractor's payments. This is to demonstrate the importance of issuing programmes updates for the project's stakeholders, this will allow the project's team to have the required knowledge in relation to the status of the project at various points of time. The project's status reports[16] illustrate the project's status at different points of time which present the project's delays as well and whether such delays are impacting the critical path or simply consuming the total float of the impacted activities. This will allow the

[15] Dean O'Leary, *The Importance Of As-Built Programmes In Construction Disputes* (1st edn, 2015) <http://www.tamimi.com> accessed 7 August 2016.
[16] P. J. Keane & A. F. Calteka [Delay analysis in construction contracts 2015]

stakeholders to have the proper time in order to take the needed measures so as to avoid risks or reduce the impacts of the delays.

Technically, preparing the updated programme is a process which includes the baseline programme in addition to the actual status of the project at certain point of time; the updated programme reflects a realistic completion for the project considering the actual circumstances took place. The progress information needed to update the programme includes the actual start and finish dates, the percent complete, the remaining duration, the utilized resources, the spent cost and the logic changes. The values of the total float may change from an updated programme to the another based on the deviations from the plan, the total float of the activities in the updated program may incline under the number of zero in case that the project is delayed, as an example, if the critical path of the updated program passes through activities with a total float of -1, then this reads that the project is delayed by one day. In contrary, if the critical path activities of the updated program passes through activities with a total float of +1, then this reads that the project is ahead by on day. This dissertation investigates the circumstance when the critical path of the updated programme gains total float in comparison with the previous updated programme.

2.6 Early Completion[17]

2.6.1 Obligation to finish the works

Most of the standard forms of contracts require the Contractor to complete the works associated with the scope of work within a specific time period. The nature of the completion milestone may vary from contract to another and it can be mechanical completion, practical completion or substantial completion. FIDIC 1999 Red book[18] provides that "*The Contractor shall complete the whole of*

[17] Andrew Stephenson, *Early Completion And It'S Effect On The Contractor'S Right To An Extension Of Time* (1st edn, 2015) <http://www.navigant.com> accessed 5 August 2016.
[18] Nael G Bunni and Nael G Bunni, *The FIDIC Forms Of Contract* (Blackwell Pub 2005).

the Works, and each Section (if any), within the Time for Completion for the Works or Section (as the case may be), including:

(a) Achieving the passing of the Tests on Completion, and

(b) Completing all work which is stated in the Contract as being required for the Works or Section to be considered to be completed for the purposes of taking over under Sub-Clause 10.1 [Taking Over of the Works and Sections]."

The civil code of UAE provides that the time of completion should be specified in the construction contracts, article 874 of the UAE civil code provides that *"In a muqawala contract, there must be a description of the subject matter of the contract, and particulars must be given of the type and amount thereof, the manner of performance, and the period over which it is to be performed, and the consideration must be specified."*. Moreover, the UAE civil code stipulated that the Contractor should comply with the conditions of the contract and accordingly, to complete the works of the contract within the time period specified in the contract, article 877 of UAE civil code[19] provides that *"The contractor must complete the work in accordance with the conditions of the contract. If it appears that he is carrying out what he has undertaken to do in a defective manner or in a manner in breach of the agreed conditions, the Employer may require that the contract be terminated immediately if it is impossible to make good the work, but if it is possible to make good the work it shall be permissible for the Employer to require the contractor to abide by the conditions of the contract and to repair the work within a reasonable period. If such period expires without the reparation being performed, the Employer may apply to the judge for the cancellation of the contract or for leave to himself to engage another contractor to complete the work at the expense of the first contractor."*

The Common law consented with the principles of the civil law, In the case of Multiplex v Honeywell[20] which was raised at the Royal Courts of Justice and

[19] United Arab Emirates, 'Civil Code' (1986).
[20] *Multiplex v Honeywell* [2007] Royal Courts of Justice (Royal Courts of Justice).

heard by Judge Justice Jackson, Judge Jackson stated that *"In the field of construction law, one consequence of the prevention principle is that the Employer cannot hold the contractor to a specified completion date, if the Employer has by act or omission prevented the contractor from completing by that date. Instead, time becomes at large and the obligation to complete by the specified date is replaced by an implied obligation to complete within a reasonable time."*, this means that it is the Contractor's obligation to assure completing all the works related to the scope of work of the contract within specific time and that the Contractor can be relieved from this obligation only if the Contractor is prevented by the Employer to complete the contract scope within the specified time in the contract.

2.6.2 Contractor's right to finish early

Clause 18.2 of FIDIC 1999 provides that "*The Contractor shall complete the whole of the Works, and each Section (if any), within the Time for Completion of the Works or Section (as the case may be) ...'* which means that the Contractor will be entitled to complete 'within' the time for completion as stipulated in the above mentioned clause of FIDIC 1999, therefore, the Contractor will be entitled to prepare the programme of work to show the completion of the works prior to the contractual date of completion. The argument rises when the Contractor plans to complete early whether the Contractor will be obliged to complete the works as of the date of the program rather than the Contractual Completion Date. The argument starts here through clause 8.3 of FIDIC 1999 which provides that 'the Contractor shall proceed in accordance with the programme" which may serve as an evidence that the program is binding to the parties. The same Clause provides that the "Employer's Personnel shall be entitled to rely upon the programme when planning their activities" which means that the Employer, when planning the Employer's activities, should rely on the Programme as a mean of obligation on the Employer's side to complete by the program date. Couple of arguments usually rise when the Contractor updates the baseline programme by introducing the project's actuals to the initial plan, and when the updated programme shows a completion date prior to the contractual

completion date, the first argument is related to the approval of the updated programme and whether the Engineer has the right to approve the updated programme and the other argument is whether the Employer should proceed with early payment to the Contractor corresponding with the updated programme which shows a completion date earlier than the contractual completion date.

Clause 3.1 of FIDIC 1999 provides that the Engineer doesn't have the authority to amend the Contract, however, the same clause provides that the role of the then Engineer is to carry out the duties assigned to him by the Employer in the Contract. Subsequently, the role of the engineer authorizes him to implement the Contract but not to amend the Contract. In implementing the Contract clauses, the Engineer exercises his right to implement clause 8.3 through approving the programmes submitted by the Contractor, this makes approving an updated programme, which has a completion date prior to the contractual completion date, part of the Engineer's authority and binds the Employer to process payments to the Contractor per the updated programme. Engineer's implementation of the contract complies with clause 18.2 of FIDIC 1999 through assuring the completion of the works by the Contractor within the time for completion and without exceeding the contractual completion date. Having said that the approval of the updated programme is an implementation of the Contract clauses, Contractor should be fully compensated for the works at the date of completion approved by the Engineer, the approval of the engineer on the new completion date allows the Contractor to proceed with the new plan to achieve the new completion date and consequently, and delay caused by the Engineer or the Employer should cause entitlement for the Contractor for Extension of Time and associated costs incurred by the Contractor due to such Employer's delay.

In common law jurisdiction, the Court made it clear in *Glenlion Construction Ltd v The Guinness Trust* [21] that the Contractor has the right to complete the scope of

[21] *Glenlion Construction Ltd v The Guinness Trust* [1987] Courts of Justice (Royal Courts of Justice)

work under the Contract earlier than the Contract Completion Date and that the Contractor has the right to proceed with the works to achieve the early completion of the works.

3 Chapter Three: Research Methodology

3.1 Introduction

The purpose of this dissertation is to be used as a research paper to study the subject of the ownership of the generated Total Float in construction projects and to enhance the knowledge using the data obtained through the research. The research was identified[22] to be a systematic approach for increasing the knowledge. This research will commence with reviewing the current knowledge related to the ownership of the Total Float and also by applying enlightenments for the research's outcomes.

After investigating the current knowledge related to the ownership of the Total Float subject through the literature review, this research concentrated on the issues suffered by the practitioners in relation to the ownership of the Total Float in construction projects. This will enhance the value of this paper as the readers would presumably be experts in the construction field who may justify their decisions in relation to the ownership of the Total Float using the outcomes of this paper.

Due to the nature and the topic of this research, the research questions are required to be answered by subject matter experts who should be experienced in the field of construction industry in addition to the requirement of investigative and interpretive analysis of the data collected. For this reason, the qualitative research approach was opted over the quantitative research approach as the latter would most likely give misleading results in this research topic and may not lead to the desired outcome. Following Fellows and Liu (2008), an attempt will be made to develop concepts based on the conducted interviews and the analyzed case studies.

[22] McGrath & Brinberg (1983) and Saunders et al. (2009)

3.2 Research Approach

As discussed earlier, researches may be conducted through two different approaches, qualitative or quantitative[23]. In this research, qualitative approach has been opted due to the fact that the subject requires gathering information from professionals with extensive experience in the field, and then comprehensive interpretational analysis shall be conducted prior to concluding the outcomes.

This research has been designed for the purpose to ensure the gathering of applicable information that is aligned with the subject of the research. It was stated[24] that "not only the research should be properly designed before commencing any research activities, but also noted that the research approach and way of collecting the data should be accurately defined to ensure that all collected data is in line with the desired information". One of the major aims of the research is to assure obtaining finest results. Due to the fact that the subject of this research is specific and require high level of experience, the interviewees have been carefully nominated based on their involvement and awareness in the issues related to the ownership of the generated total float in their daily life practice.

The straightforward research questions in this research are who owns the generated Total Float and whether the Employer is entitled to use the generated Total Float or not. Due to the fact that the answers to the research questions require examination and clarification of the collected information, additional emphasis is given to qualitative approach more than the quantitative approach. It was stated[25] that "such research questions containing the why and what would normally better be researched through qualitative approach". Qualitative approach allows for appropriate examination of the subject through studying and digesting the information gathered from the subject matter experts.

[23] Kothari, 2004
[24] Yin (2003)
[25] Hancock (1998)

3.3 The Interviews Structure

The interviews with the subject matter experts were structured to concentrate on the ownership of the generated Total Float. It was suggested by Yin[26] that "careful attention was given to all interviewees in terms of listening and underrating of their answers and explanations, well preparation and study of the topic before conducting the interviews and proper data management".

The interviews were directed in the shape of a dialogue; each interview lasted for 30 minutes. Three interviewed experts indicated that they are under confidentiality agreement with their Employers and clients and that is the reason why this research does not contain names or project data.

3.4 The Data Collection

As discussed earlier, the data was gathered during the interviews with the subject matter experts who have taken part in discussions and disputes related to the ownership of the Total Float. Table 5: [List of interviewees] provides a list of the interviewees.

Interviewee	Occupation	Company
A	Delay Analyst	Claims Consultancy
B	Delay Analyst	Claims Consultancy

Table 5: [List of interviewees]

The interviewees were nominated based on their involvement and experience. A is a 35 years old Delay Analyst. He's having around 12 years of total experience; 8 years of them are in planning and delay analysis; A is a Civil Engineer with a master degree in project management. B is 39 years old Delay Analyst with 15 years of total experience, 2 years of them in planning and delay analysis; B is an Engineer with master degree in Construction Law.

[26] Yin (2011)

The interviewees were passionate during the discussion due to the fact that the subject under discussion is forming a root cause of disputes which they are involved in as part of their daily work. The goals of the research will be accomplished through the comparison between the reviewed literature and the information gathered from the experts.

All interviews were commenced by asking "When the Contractor updates the programme of works, the Critical Path may change due to inserting actual progress, in the circumstance when the longest path of the updated programme shows an increase on the Total Float of the longest path, Who do you believe owns this Total Float?" Each interview took different theme based on how the interviewee initiated the response to the first answer; accordingly, the conversations were different.

After discussing the ownership of the generated Total Float, the second stage commenced by asking "In case that the Employer utilizes the generated Total Float, is the Contractor entitled to be compensated due to the fact that the Total Float is generated by the Contractor and consumed by the Employer"?

3.5 Validity and Reliability

It is well noticed that the information gathered during the interviews are relative information to the subject under discussion which makes the gather information valid. It is important[27] to have a research strategy that leads the researcher to the sought after outcome and which successfully provides responses to the research questions. Moreover, the interviewees were nominated based on their experience and involvement in discussions and disputes related to the ownership of the generated Total Float which gives validity to their inputs and reliability to the research as this research has been prepared without imposing the researcher's own interpretation or own sights on the topics.

[27] Flick et al., 2004 Lancaster (2005)

4 Chapter Four: Interviews

4.1 Introduction

This chapter includes the results of the gathered information and the conducted interviews in addition to comparison between the results of the interviews and the reviewed literature.

4.2 Interview 1: Delay Analyst

A is a Delay Analyst working for claims consultancy, as a result, the subject matter under discussion by this research is directly related to his experience. The conversation with A started by asking him to explain the changes in the total float of the longest path of the project during the programme update, A clarified that the Total Float of the longest path should be equal or greater than zero in order to make sure that the project is going to complete on or before the planned date and that in case that the Total Float of the longest path declines under zero this means that the project is suffering delays.

A was asked whether the Contractor owns the newly generated Total Float in case that the Total Float of the longest path of the updated programme is greater than zero. A stated that he has experience with some cases while conducting the delay analysis where a Contractor's update shows increased Total Float on the longest path and that this newly generated Total Float is consumed in later updates. A elaborated that, from his point of view, the generated Total Float during the progress updates is normally owned by the Contractor, as he is the one than owns the project schedule.

For example, while conducting delay analysis for a certain project, the increment of the Total Float on the longest path of certain window will be booked to the Contractor in the shape of recovery and in case that the Employer caused delay in the next window then the Contractor should be entitled for Extension of time in case that the delay event of the Employer affected the longest path.

A was asked to elaborate further on the question of the “First comes first serves” rule followed in such cases, A answered that this rule is not applicable in the case, where it is clear or the parties agree that the float is owned by either of them as, for example, it is not for the Contractor to be penalized and to pay LDs for being delayed and not to be able to benefit from his good doing of recovering delays and showing increased Total Float.

A elaborated that the purpose of the Total Float in the programme is for the Contractor to be able to schedule his activities in order to perform the works, when the Contractor works hard during a period of time to increase the value of the Total Float, this is to be used as a contingency in case that the Contractor causes delay or needs to elongate critical activities due to resources leveling, and it will not be logical for the Employer just to consume such contingency.

A stated that in one of the claims for extension of time he prepared, he used window analysis as delay analysis method, the Total Float at the end of the third window was positive 13 days in comparison with the second window where the Total Float in it was zero, A booked the total float as recovery for the benefit of the Contractor and proceeded with the analysis. He was called after a while by the Contractor to review the Employer’s response for the Contractor’s claim for Extension of time, one of the Employer’s comments on the Contractor’s submission was that the generated total float cannot be booked to the benefit of the Contractor as it is owned by the project and not by either party and that the party who comes first serves first. The Employer further explained that the third window was showing a positive float on the programme with a forecasted completion date of 17 March 2016 (Contractual completion date is 30 March 2016), the delay event caused by the Employer during the fourth window impacted the longest path to show a forecasted completion date of 26 March 2016, the Contractor claim shows that the Contractor is entitled to an Extension of Time of nine days in window four, the nine days are coming from the difference between the end of window three which is 17 March 2016 and the impacted programme of window four which is showing 26 March 2016. The Employer stated that it is not possible that the Contractor’s submission shows

entitlement of Extension of time for the Contractor in this case specially that there was float on the programme to be consumed and that the delay event of the Employer affected the longest path but did not affect the completion milestone of the project.

However, the Employer and the Engineer rejected the delay analysis due to the reason that the Contractor utilized the Total Float of the project and that the Total Float is not owned by the Contractor in the Contract and accordingly, the Total Float should be shared between the parties and that it cannot be fully consumed by one party keeping the other party with no buffer. A stated that he believes that the Extension of Time submission was rejected due to the fact that the Engineer and the Employer attempted to weaken the claim in order to reach to a settlement with lower figures in term of both time and associated cost.

A was asked whether the Contractor should be compensated by the Employer in case that the Employer consumes the Total Float generated by the Contractor during the programmes updates, A stated that the Employer cannot utilize the generated Total Float, and as a result, there will be no need for special arrangement for having the Contractor compensated due to utilizing the Total Float by the Employer, because this compensation will be automatically generated through the prolongation cost, A elaborated that when the delay event of the Employer is analyzed and proved that it affects the longest path, then the period of the delay which affected the longest path is identified as excusable compensable delay, and the Contractor will then be entitled to claim additional cost due to the occurrence of the delay event of the Employer.

As a conclusion, A stated that each party should be compensated due to their doings and that no party will accept to pay additional efforts for free, as a result, if the Employer consumes the Contractor's generated Total Float due to failing to perform its obligations as planned, then it is crystal clear that the Contractor should be able to be compensated.

4.3 Interview 2: Delay Analyst

B is a Delay Analyst in the field of construction claims; construction disputes are part of B's daily work. The conversation with B started in the same manner of A's interview, B was asked to explain the changes in the total float of the longest path of the project during the programme update, B started explaining how is the Total Float of the longest path is driven by many factors which are including and not limited to the accuracy of the baseline programme, accuracy of the updates, the Employer's delays and the Contractor's delays. B elaborated that the project's team should maintain the Total Float of the longest path higher than zero all the time in order to make sure that the project will finish on or before the project's contractual completion date and that if the Total Float may incline under zero due to many reasons but this should be avoided as much as possible. B further explained that the problem which the majority of the projects suffer is that the Contractor usually manipulates the programme in order to hide the delays happening and this is by changing durations and logic links, B stated that this is incorrect practice which should be avoided and that delays should be reported to the project's team in order to have the chance to mitigate their impacts, in addition, this reporting should show the changes happen on the Total Float values either for longest path activities or other activities.

B was asked that in case that the Contractor performs a lonest path activity ahead of plan; this should generate Total Float on the longest path of the project, who should own the generated Total Float.

B responded that the There is no clear answer which may define the ownership of the generated Total Float, it depends on the Contract terms and conditions, the various standard forms of contracts adopted various approaches and positions in relation to the ownership of the generated total float. B stated that The NEC standard form of contracts measured the completion against the "forecasted completion date", FIDIC measured the same against the "Time for Completion". The NEC provides that if employer's delay events happen after generating Total Float then the Contractor owns such float and subsequently,

Contractor is entitled for Extension of time as a result of the occurrence of the Employer's delay events, FIDIC kept the ownership of the generated Total Float as a grey area to be debated based on the circumstances.

The NEC allowed the Contractor for Extension of Time due to the occurrence of the employer's delay events and adopted the position that Contractor owns the generated Total Float, however, any cost entitlement should be based on actual damages incurred by the Contractor as a result of the occurrence of the Employer's delay events. FIDIC doesn't talk about dates, FIDIC talks about Time for Completion, although, the argument usually raises by the Contractor is that the Contractor was ready at certain point of time (point of time prior to the contractual completion date) for handing over but the occurrence of the Employer's delay events prevented the Contractor from doing handing over and subsequently the Contractor is entitled for Extension of Time.

As a result, the difference between measuring the entitlement for using the generated total float versus contractual date or versus time for completion should be clearly defined. The Contractor owns the generated Total Float in the case of measuring the entitlement against time for completion, in contrary, the project owns the generated Total Float in the case of measuring against the Contractual Completion Dates.

Moreover, B stated that the applicable law and the jurisdiction will say the final word in relation to the ownership of the generated Total Float. Most law jurisdictions require the Contractor to show mitigation of the project's delays, this requirement will need the Contractor to use the generated Total Float in order to apply the mitigation measures, and moreover, it is not logical that the Contractor start with mitigating the Employer's delays using the available/generated Total Float leaving the Contractor delays at risk, so it is fair that the Contract owns the generated Total Float which should be used in order to mitigate the delays of the project starting with the Contractor's delays.

Contractor has the right to raise a claim for the costs associated with the Employer's delay events, but it is crucial that the Contractor claim to be based

on actual damages suffered by the Contractor due to the occurrence of the Employer's delay events.

B was asked that in case that the Employer wants to use the generated Total Float, do you believe that the Contractor should be compensated? B responded that the Contractor should be compensated in case that the Employer wants to use the generated Total Float to mitigate Employer's delays, as an example, if the time for completion in the contract is 100 days, and the forecasted time for completion by the contractor at certain point of time is 90 days, then if the employer caused delays which caused adverse impact on the project completion and in case that the Employer still want the Contractor to finish per the forecasted schedule, then the Contractor should be able to claim acceleration cost as the Employer want to use the generated Total Float and mitigate its own delays using such generated Total Float and at the same time Employer is requesting the Contractor to finish per the forecasted completion date which will require the Contractor to accelerate the works. Contractor should raise the acceleration claim based on the increased number of resources required to complete the works.

5 Chapter Five: Case Study

5.1 Case Study 1

5.1.1 Introduction

The Employer is a government body which awarded a mega petrochemical plant project to the contractor. The Contractor's scope is to do the Engineering, Procurement, Construction and Commissioning for an ethylene Cracker Furnaces in addition to tying the new facility with the existing plant. The period of performance was assigned in the Contract to be two years starting from 12 August 2013 and to complete by 11 August 2015. The Contractor submitted the baseline programme and got it approved per the Contract's terms and conditions; the critical path of the baseline programme passes through the Engineering works, Procurement of the furnaces and the piping system, Construction of the new furnaces and then construction of the piping system and ties it to the existing pipe rack. Afterward, the Contractor updated the updated Programme on bi-monthly basis and submitted the updates to the Employer for approval. The project went as planned during the first year, but then, the project suffered various delays which affected the completion milestone of the project and it became apparent that the contractual completion date of 11 August 2015 will not be made. The delays which occurred through the project period were caused by both of the Contractor and the Employer; the Contractor made some efforts to mitigate some of the delays but could not make the contractual completion date.

Table 6: [Case Study 1 – Updated Programmes] below is showing the submitted updated programmes, the date of each updated programme and the forecasted completion date of each programme.

Month	Completion Date	Variance	Total Float on the Critical Path
Oct-13	11-Aug-15	0	0
Dec-13	11-Aug-15	0	0
Feb-14	11-Aug-15	0	0
Apr-14	11-Aug-15	0	0

Jun-14	11-Aug-15	0	0
Aug-14	11-Aug-15	0	0
Oct-14	28-Aug-15	17	-17
Dec-14	18-Sep-15	21	-38
Feb-15	6-Sep-15	-12	-26
Apr-15	19-Sep-15	13	-39
Jun-15	30-Sep-15	11	-50
Aug-15	23-Oct-15	23	-73
Oct-15	31-Oct-15	8	-81

Table 6: [Case Study 1 – Updated Programmes]

The numbers of the total float of the critical path are showing the value of the Total Float recorded at each stage of the project through the bi-monthly updated prepared by the Contractor. The Total Float numbers are showing the Contractor was able to maintain a zero value of the Total Float from the beginning of the project till the month of August 2014, after August 2014, the project's completion date started to slip till the project completed by 31 October 2015 with total delay of 81 days.

The Contractor's caused three major delays the first one is the delay in procuring the furnaces, the second one is the delay in procuring the piping system and the delay in commencing the piping work due to the lack of manpower.

The Employer caused four major delays which are the late hand over of the existing area to the Contractor, No work permits Issued to the Contractor due to emergency shutdown on existing plant, Lack of site access due to change of security system by the Employer and lack of site access due to Employer changing routing plans.

5.1.2 Analysis

Month	Completion Date	Total Float on the Critical Path	EDE	CDE
Oct-13	11-Aug-15	0	0	0
Dec-13	11-Aug-15	0	0	0
Feb-14	11-Aug-15	0	0	0
Apr-14	11-Aug-15	0	0	0
Jun-14	11-Aug-15	0	0	0
Aug-14	11-Aug-15	0	0	0
Oct-14	28-Aug-15	-17	17	0
Dec-14	18-Sep-15	-38	0	21

Feb-15	6-Sep-15	-26z	0	-12
Apr-15	19-Sep-15	-39	0	13
Jun-15	30-Sep-15	-50	11	0
Aug-15	23-Oct-15	-73	23	0
Oct-15	31-Oct-15	-81	8	0
		Total	**59**	**22**

Table 7: [Case Study 1 – Analysis]

Per Table 7: [Case Study 1 – Analysis]:

- The project went as planned without any delays from the start date till the end of August 2014.
- During the period from 1 September 2014 till 31 October 2014, the Employer caused a delay event which impacted the project completion date by 17 days. The Total Float of the updated programme dated 31 October 2014 is -17 and the Employer delays are 17 days.
- During the period from 1 November 2014 till 31 December 2014, the Contractor caused a delay event which impacted the project completion date by 21 days. The Total Float of the updated programme dated 1 January 2015 is -38 and the Contractor's delays are 22 days.
- During the period from 31 December 2014 till 28 February 2015, the Contractor caused a delay event which did not have any impact on the Critical Path, during this window, the Contractor increased the rate of the work and was able to recover 12 days of the project's delays, in this update, the Contractor generated 12 days of positive Total Float which makes the Total Float of the updated programme dated 28 February 2015 is -26 and the Contractor's delays are 9 days as the newly generated Total Float by the Contractor is used by the Contractor to recover the Contractor's delays.
- During the period from 1 March 2015 till 30 April 2015, the Contractor caused a delay event which impacted the project completion date by 13 days. The Total Float of the updated programme dated 30 April 2015 is -39 and the Contractor's delays are 22 days.
- During the period from 1 May 2015 till 30 June 2015, the Employer caused a delay event which impacted the project completion date by 11

days. The Total Float of the updated programme dated 30 June 2015 is -50 and the Employer delays are 28 days.

- During the period from 1 July 2015 till 31 August 2015, the Employer caused a delay event which impacted the project completion date by 23 days. The Total Float of the updated programme dated 31 August 2015 is -73 and the Employer delays are 51 days.
- During the period from 1 September 2015 till 30 October 2015, the Employer caused a delay event which impacted the project completion date by 8 days. The Total Float of the updated programme dated 30 October 2015 is -81 and the Employer delays are 59 days.

5.1.3 Summary

In this project, the parties postponed any argument related to the Extension of time till later stages of the project, when the Contractor prepared its submission for Extension of Time, the Contractor booked the gains/losses for the benefit of the Contractor, and consequently, the Contractor used the generated Total Float in order to recover its own delays.

5.2 Case Study 2

5.2.1 Introduction

The Employer is a semi government body which awarded a signature residential high rise building project to the contractor. The Contract is a FIDIC 1999 Contract, and the design is by the Employer but the Contractor is in charge of the procurement and construction activities. The period of performance in the Contract is 30 months starting from 14 June 2014 and to complete by 13 December 2016. The Contractor submitted the baseline programme and got it approved per the Contract's terms and conditions, the critical path of the baseline programme passes through the shop drawings for the earth works, the excavation works for the foundations, the substructure, the super structure and the finishes works including the MEP. Afterward, the Contractor updated the approved Programme on monthly basis and submitted the updates to the

Employer for approval. The project suffered various delays from the beginning which affected the completion milestone and it became apparent that the contractual completion date of 13 December 2016 will not be made. The delays which occurred through the project period were caused by both of the Contractor and the Employer; the Contractor made some efforts to mitigate some of the delays but could not make the contractual completion date.

This paper will only study the first 6 months of the project as this is the period when the Contractor was able to generate Total Float. Table 8: [Case Study 2 – Updated Programmes] below is showing the submitted updated programmes of the first 6 months, the date of each updated programme and the forecasted completion date of each programme.

Updated Programme	Completion Date	Variance	Total Float on the Critical Path
UPD01	13-Dec-16	0	0
UPD02	16-Nov-16	-27	27
UPD03	16-Nov-16	0	27
UPD04	8-Dec-16	22	5
UPD05	16-Dec-16	8	-3
UPD06	1-Jan-17	16	-19

Table 8: [Case Study 2 – Updated Programmes]

The numbers of the total float of the critical path are showing the value of the Total Float recorded on monthly basis for the first 6 months of the project. The Total Float numbers are showing that the Contractor was able to maintain a zero value of the Total Float in the first month period, then generated significant value of Total Float during the second month, then the delays started to affect the completion milestone from the third month onward.

The Contractor's caused one major delay event which is the late delivery of the core walls system required to build the high rise building, this delay event starts to take effect on the completion milestone from the 5th update.

The Employer caused two major delays which are the late hand over of Issued for Construction (IFC) drawings needed by the Contractor to prepare the work drawings and commence the works and this delay event started to take effect

from the 4th update. Moreover, the Employer's delay event of, instructing the Contractor to stop all site works due to potential changes in design, affected the completion milestone and started to take effect starting from the 6th update.

5.2.2 Analysis

Month	Completion Date	Total Float on the Critical Path	EDE	CDE
UPD01	13-Dec-16	0	0	0
UPD02	16-Nov-16	27	0	-27
UPD03	16-Nov-16	27	0	0
UPD04	8-Dec-16	5	22	0
UPD05	16-Dec-16	-3	0	8
UPD06	1-Jan-17	-19	16	0
		Total	38	-19

Table 9: [Case Study 2 – Analysis]

Per Table 9: [Case Study 2 – Analysis]:

- The first updated programme shows that the project was going as planned and that the contractual completion date of 13 December 2016 will be made.
- The 2nd updated programme shows that the Contractor generated 27 days of Total Float and the completion date was forecasted to be on 16 November 2016, 27 days ahead of the Contractual completion date. This is due to the fact that the Contractor was able to cut the mobilization period for the tower cranes from 2 months to one month by buying new tower cranes for the project instead of mobilizing other tower cranes from other projects and the latter is the contractor's initial plan. The 27 days of generated Total Float are booked for the benefit of the Contractor to use them to recover Contractor's future delays.
- The 3rd updated programme shows that the forecasted completion date of 16 November 2016 which was reported in the 2nd updated programme is maintained and that no delays by any of the parties occurred at that month.

- The 4th updated programme has a completion date of 8 December 2016 with a delay of 22 days in comparison with the previous window, this is due to the occurrence if an Employer delay event, and the 22 days of delay are booked as an employer delay. This makes the total delays of the Employer 22 days.
- The 5th updated programme has a completion date of 16 December 2016 with a delay of 8 days in comparison with the previous window, this is due to the occurrence if Contractor's delay event, and the 8 days of delay are booked as Contractor's delay. This makes the total delays of the Employer -19 days, which means that the Contractor still has 19 days to use in recovering forthcoming Contractor's delays.
- The 6th updated programme has a completion date of 1 January 2017 with a delay of 16 days in comparison with the previous window, this is due to the occurrence if an Employer delay event, and the 16 days of delay are booked as an employer delay. This makes the total delays of the Employer 38 days.

5.2.3 Summary

The Contractor was able to generate Total Float during the 2nd update; the Contractor used the generated Total Float to recover the Contractor's delay event which occurred at the 5th updated programme.

6 Chapter Six: Conclusion and Recommendations

6.1 Conclusion

It is obvious that the subject of the research is essential as it has direct impact on the contractual and commercial aspects of construction projects; from the perspective of the contractor, the ownership of the total float affects the contractor's entitlement for extension of time and consequently affect the contractor's profit margin and may cause the contractor major losses caused by the elongated period in addition to the delay damages; from the perspective of the employer, the ownership of the total float affects the project's period of performance and consequently causes the employer additional costs in addition to the loss of profit due to the late takeover of the project.

This dissertation has examined the ownership of the generated total float in construction projects and the factors which are deciding the ownership of such total float through reviewing the available literature talking about this subject, conducting interviews with subject matter experts and analyzing two case studies of construction project.

The main finding of the research is that both of the contract terms and the applicable laws have the final say on the ownership of the generated total float, various types of standard contracts behave differently with the ownership of the total float. Moreover, the subject matter experts are in consensus that the Contractor is should be able to use the generated Total Float unless otherwise is forced by the contract and/or the applicable legal jurisdiction, this is due to the obligation of the Contractor under the majority of the standard forms of contracts to mitigate the delays occurring in the projects. This gives the upper hand to the contractor to use the generated the total float to mitigate the project's delays. The experts' opinion is matching with the case studies conducted when the analysis considered the gains to the benefit of the Contractor, on the other hand, the analysis considered the losses which are not caused by the Employer's acts to be contractor's delay events which should be mitigated by the contractor.

In order to properly define the value of the generated total float, proper construction programme frequently and properly updated is needed; any issues with the programme or the updates may mislead the project team and cause disputes.

6.2 Recommendations

As a result of the conclusion above, the research reached to a recommendation which should be used as guidance for decision makers and practitioners to insure the contractual understanding of the ownership of the total float so as to avoid disputes and to be able to understand the project's risks and to consider the contingency to respond to such risks in case of their occurrence. If practitioners follow such recommendations, it is expected that the contracting parties are expected to reach to conclusions in relation to extension of time entitlements with less disputes.

Due to the lack of expressed legislation whether in contracts or applicable laws, it is recommended to include expressed terms in the construction contracts to state the ownership of the total float, this is for the purpose of insuring the parties acknowledgment to their duties and rights in relation to the ownership of the total float under the contract.

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