

## **Chapter Two**

### **Literature Review**

#### **2.1 Forwarding**

The construction process is a complex undertaking. It involves many different activities and participants from initial planning through execution. The requisite tasks, and the roles and responsibilities of the owner, architect engineers, construction managers, contractors, and subcontractors can be organized in a number of different ways to deliver a construction project. Despite these many options, building a major construction project today without experiencing schedule delays and cost overruns is often the exception. While there are many factors that can contribute to these poor results, there are two key success factors: effectively managing time with resources and change.( 7)

#### **2.2 Theoretical background**

Time, with its associated costs, are vitally important for each participant in the construction process including the lender, owner, architect engineers, contractor, and subcontractors, as well as those who provide bonding and insurance coverage. Effective management and the administration of the contract time and change provisions are central to the avoidance and mitigation extended time and cost overruns. To enhance the odds of a successful project outcome, it is essential for participants in the construction process to have a basic understanding of:

- Critical path scheduling techniques, the associated scheduling specifications, and the software involved.
- Delay and how it occurs.
- The pros and cons of various schedule and delay methodologies being used by project participants and experts.

- The foundational principles for any successful schedule and delay analysis methodology.

Managing the time factor can be expensive, fraught with pressures, and subject to much uncertainty. Key factors having an influence on successful project delivery include the use of overly complex scheduling specifications, construction brokering by the contractor, errors and omissions, differing site conditions, user changes, and inadequate time extensions. These can be compounded by reservation of rights for delay, cumulative impacts, and ignoring possible completion date waivers. Further, there is still uncertainty and misunderstanding that remains in terms of what constitutes acceptable standards of proof for excusable delay and impacts. While computers and scheduling software have greatly increased the potential for enhanced scheduling capabilities, they have also contributed to a variety of user quality problems. The situation is often compounded by failure of both the Owner and Contractor to recognize from the start the need for timely resolution of delays and keeping the schedule up to date by reflecting actual performance and delays as they occur.( 4)

### **2.2.1 Proving and Defending a Delay**

When a specific delay occurs, or is claimed by the contractor, it requires the early attention and timely action of the owner or its representative (PM, CM, or A/E). The owner needs to quickly identify the party responsible for the delay (Owner, A/E or Contractor) and develop and promptly implement a corrective action plan.

This requires the establishment of an effective method of inquiry for preparing a timely and independent assessment of changes and delay issues, and establishing a clear, concise, and persuasive position to be

taken on each one. The pertinent contract requirements need to be followed. Additionally, the owner needs to require that its representative institute the basic principles of delay analysis using a sound methodology, like Time Impact Analysis (TIA) procedures. The owner or its representative also requires a basic working knowledge and understanding of related legal precedence for schedule and delay, as well as addressing any issues with the project completion date. Further, field procedures should be initiated, requiring the identification, isolation and recording of factual data related to the delay and impact costs.(19)

### **2.2.2 Establishing the Necessary Controls and Procedures**

1. Establish contract provisions and project procedures setting forth a clear understanding of the requirements for planning, implementing and controlling the project.

2. A claims avoidance and mitigation system should be established and geared to risk management and aid in prevention, mitigation and timely resolving potential disputes, and particularly those that deal with schedule and cost overruns. A sound claims avoidance and mitigation program entails:

a) A review of the contract documents to identify potential areas of risk and how they can be best managed and resolved; to ensure that critical claims prevention provisions and procedures are a part of the contract documents.

b) Training staff to be familiar with the procedures established and the areas in which claims are likely to arise, to establish early warning systems, to develop consistency in responding to potential claim

impacts, and to recommend techniques to prevent, recognize, analyze, mitigate and successfully resolve claims.

c) A claims surveillance program to periodically assess the efficiency of the avoidance and dispute resolution process.

d) A periodic reporting system to keep the project team and management informed, and to ensure that all parties are in agreement with the approach, actions, timetable, and results being achieved.

e) A periodic management briefing focused on addressing the most important issues on a by-exception basis.

3. Be familiar with the strengths and weaknesses of the project delivery system being used, and the obligations, roles and responsibilities assumed or avoided by the parties involved.

4. Develop an awareness of the key contract provisions that will potentially generate disputes, scheduling delays and cost overruns.

5. Develop and maintain a contemporaneous summary entitlement analysis.(14)

### **2.2.3 Managing and Administering the Time Factor**

Scheduling techniques have made it possible to demonstrate, with reasonable certainty, the delay impact which can occur as a result of issues and unplanned project events. Delays can be identified, isolated, quantified, and concurrent delays accurately segregated. This capability has contributed significantly to the legal importance of the project schedule. While scheduling techniques do not necessarily constitute proof in and of themselves, their application can be of evidential value to

demonstrate liability and causation. In addition, they can provide a legitimate and supportable basis for allocating or apportioning damages, a means preferable to using guess work or the like.

It is important to also understand the basic rights of both the owner and the contractor, which arise from a contractual relationship. For example, the owner has the right to establish the envelope of time for performance. He also has the right to expect timely performance and to contract for liquidated damages for late performance. He may even make agreements to limit contractor remedies.

The contractor also has certain rights. For example, he has the right to expect reasonable access to work areas, timely approvals, and the timely delivery of owner furnished materials and equipment, and to be promptly paid. He also has the right to finish early and to expect extra time and money, depending on the circumstances, for owner caused delays

As participants in the construction arena, it is imperative that we understand not only the techniques of scheduling and how to make them work, but also that a project schedule can serve as a basis to delineate the respective rights, obligations, and warranties flowing from the schedule.  
( 4 ).

#### **2.2.4 Be Proactive – Use Time Impact Procedures**

Plans, estimates, and schedules are bound to change as a result of errors and omissions, owner changes, unforeseen subsurface conditions, strikes, and actual performance variations. These are just a few of the many factors that create the need to change the schedule. Such conditions require that the schedule be kept up to date and revised on a regular basis

to reflect actual performance and the contractor's best, current plans and intentions.

Calculating the extent of delay can best be accomplished through a process called Time Impact Analysis (TIA), which is a time estimating procedure that utilizes networking techniques (dragnets) to demonstrate the effect of specific delays on the project schedule as they occur. A dragnet can be defined as a sequence of new activities and/or network revisions that are proposed to be added to the existing schedule to demonstrate (graphically and mathematically) the effects and the method for incorporating delays as they are encountered. Its objective is to pinpoint, isolate, and quantify the time impact of a specific issue and determine its time relationship to past or current delays. Time Impact Analysis procedures can be used in a prospective or retrospective manner, even on the same project.

The use of Time Impact Analysis (TIA) had its origin in 1960's as a contract requirement on the Apollo Space Program (Launch Complex 39). It is a contemporaneous procedure to be used by both the owner and the contractor for quickly identifying which activities and paths of criticality are impacted. A TIA is best performed by considering the following principles: chronology of delay; responsibility for delay; duration of delay including any allocation; the method to be used to incorporate delay/causation into the schedule; available float; any concurrent delay and how it occurs, and the affect (if any) a delay has on the project completion date.

When both parties use TIA procedures, it provides a disciplined basis for two contractual parties to independently evaluate the impact of a delay event or issue. Employing a common basis to analyze and compare

results facilitates the negotiation and agreement of the parties as to the amount of delay and time impact involved. TIA techniques allow each party to demonstrate its understanding of a specific delay and the scheduling proofs offered versus those required. If no agreement can be reached, the efforts can provide a clear record of any differences which can be documented by records of meetings or negotiations. A TIA can be used contemporaneously during the project as a contract requirement, as well as a key tool in performing an after the fact delay analysis should issues remain unresolved.

Hank Kaiser, founder of Federal Publications summed up the situation stating “construction is big business, big in its physical product, big in money, big in the problems it generates, and big in the potential for claims. Because so much is at stake, those who engage in construction must guard against costly error, must arm themselves with protective knowledge, and must, in short, be educated in their specialties.” Nothing could be truer than in managing the time and change factors under any of the delivery methods.( 4)

### **2.2.5 Managers responsibilities**

Managers have many specific roles that either studied or practically gained, and they must understand well these roles, so in order to control delay in construction project they have to:

#### **1. Get early warning of delays due to the client, main contractor or**

**your people**. Client delays arise because they change their minds, give their instructions too late or are slow in approving drawings etc. They tend to overlook the fact that these delays push back the start for "E&M" contractors and that the contractor is powerless to avoid these delays.

Main contractor delays are usually the result of construction work not

being complete so that later installations such as installing heavy equipment can proceed. In some cases, delays are the result of mismanagement and a lack of coordination. Last but not least, the "E&M" contractor may himself cause delays, for example by under-resourcing the project in the early stages or not completing design drawings and getting them approved in time.

**2. Make sure the client knows when they are the cause of the delay.** Clients have selective memories. When they make design changes, issue late instructions, or are slow in approving designs, they need to realize that there is a knock on effect. Time is indeed money, typically the contractor's money unless it is recognized by the client what the effect of their actions is on the completion of the project stages and the critical path. Use phrases such as "Mr. Client, I am happy to implement these changes, however, I need to point out that we need to reorder equipment and get approvals, both of which will take time" and then get it in writing!

**3. Freeze design changes at a certain point to allow for procurement lead times, approvals etc.** When there is a fixed deadline, for example a sports complex has to be opened on a certain date. There is a "Point of No More Changes". Too often the sub contractor is held accountable as "the Last Man Standing" - don't be caught in this position.

**4. Monitor the work done by the earlier contractor or contractors carefully** - and make sure delays outside your control are recognized and documented. Delays that are outside your control and impact you financially need to be recorded and the financial impact dealt with by



the appropriate responsible person. Remember, you shouldn't bear the cost of other peoples' delays, nor should you be blamed for them!

**5.Keep an eye on what your team are doing that might cause delays** - typical examples include starting late, late submission of drawings, mistakes in your drawings. Where we are at fault, we have to accept the costs and try and make good the delays and recover the costs we incur. Remember; when we are honest about our errors, people will more readily accept our claims when it's not our fault.

**6."Mitigate" the impact of the delays** - accelerate work, use up your "float" and redefine the Critical Path. Whatever the cause of the delay, we must try and recover our position - after all, if a critical date is missed; it may not matter to the client who is at fault.( 5)

### **2.2.6 Issues that should be done before the construction start**

**1.Know the scope and relationships of all parties.** A disproportionate number of project delays are driven by entities that have no direct contractual relationship with project participants but drive schedule milestones, such as permitting agencies and public utilities. Mapping those relationships and tying their scope to key project milestones is an essential risk management step. Active communication with these entities is an overlooked mitigation strategy. Contracts can have built-in remedies to accommodate delays caused by indirect participants.

**2. Understand the contract(s).** Notice provisions should be clearly defined with real consequences for deviations, such as withholding payments. The change management procedures are instrumental in controlling scope growth and addressing cost and schedule impacts. Lessons learned from many project failures have revealed that mismanagement of change was a

root cause for unresolved disputes, leading to a lengthy and costly resolution process.

**3. Analyze the critical path.** Risk assessments of the schedule can identify areas where task durations are not achievable or disconnected (lacking accurate logic) from other dependent tasks. A reliable schedule is a key component of controlling the project timeline during execution and, if necessary, forensically in a dispute. As such, early analysis of a Level 1 schedule can lead to adjustments in the procurement process or timing of critical tasks to minimize risk and identify efficient mitigation options.

**4. Establish risk triggers as an early warning system.** Risk assessment and identification is not effective unless specific action plans are developed for critical risks to the project schedule. Action plans are most effective when tied directly to project controls that are already being monitored by the project team. Once a project control measure that relates to a specific risk is identified, it can be monitored for risk triggers that indicate when a risk is about to materialize and impact the project. Active monitoring and communication of these risk triggers through dashboard reporting allows the entire project team to be aware of the risk status before it materializes. This allows proactive mitigation, as opposed to damage control.

**5. Develop contemporaneous documents to quantify delay and productivity loss.** An adjunct benefit of tying risk action plans to project controls is that delays and productivity loss can be identified and quantified in real time as they occur. This allows potential delay and disruption impacts to be addressed in a change as opposed to a claim. For contractors, this can be accomplished by providing notice of an impact and supporting the costs or extent of the impact with contemporaneous records (timesheets, daily reports, and invoices). For owners, this requires

a reasonable approach in reviewing the contract scope and potential losses incurred (or at least claimed) by the contractor. Either way, reliable contemporaneous documents will at least help support the damage or loss, minimizing the discussions of the dispute to areas of entitlement.

A project-centric approach to risk management relies on input from all project stakeholders. This includes proactive management of delay and disruption risks, which is in part addressed by these strategies. While the strategies proposed above might not completely eliminate delay and disruption claims, in many instances, they can allow for more effective resolution.( 14)

### **2.2.7 Delay management system**

#### **Retrospective Delay Analysis Techniques**

In the Society of Construction Law Delay and Disruption Protocol, four retrospective delay analysis techniques are referred to, to calculate the extra time for the delay ,as follows;

1. As-Planned v As-Built.
2. Impacted As-Planned.
3. Collapsed As-Built.
4. Time Impact Analysis.

A brief analysis of each of these delay analysis techniques is given below.as shown in chart (2.1).

**1.As-Planned v As-Built**

What is the basis of the method?

This method compares the duration of an As-planned activity (or the duration of all As-planned activities) on the original program with the As-built duration for that same activity (or those same activities) on the As-built program.

How is the method used to assess Extension of Time entitlement?

The difference in time between the duration on the As-built program and the duration on the As-planned program is taken as the period of delay to which a Contractor is entitled to an Extension of Time as a result of an excusable delay event (or delay events) (otherwise known as Employer delay events).

What is needed to make this method work effectively?

The activity or activities need to be clearly on the critical path.

The delay event or events need to be clearly identified.

There should be no other delay events to the activities in question that are non-excusable delay events (otherwise known as Contractor delay events).

What are the strengths of this method?

It is inexpensive to use.

It is simple to use and understand.

What are the weaknesses of this method?

Because no detailed analysis is possible it can only be used on the most simple of construction projects.

It cannot deal with (a) the issue of concurrent or parallel delays, (b) the matter of consequential delay or re-sequencing of works, or (c) the effects of mitigation and/or acceleration measures.(20)

### **2.Impacted As-Planned**

What is the basis of the method?

This method adds an identified excusable delay event (or events), either as a separate activity (or activities), or onto the duration of an existing activity (or activities), into the As-planned program. The duration of the activity is derived (where possible) from the resource allowances on the As-planned program.

How is the method used to assess Extension of Time entitlement?

The As-planned program with the delay event (or events) incorporated is then re-run, to show a resultant revised Completion Date on what is then called the Impacted As-planned program.

The period between the Completion Date shown on the As-planned program and that shown on the Impacted As-planned program, is taken as being the period of delay to which a Contractor is entitled to an Extension of Time as a result of an excusable delay event (or events) (otherwise known as Employer delay events).

What is needed to make this method work effectively?

A simple contract or, in the case of more complex projects, delay events that occur only over limited periods or where the As-planned program has been affected by a limited number of delays only.

An accurate and realistic As-planned program.

Sufficient details on the As-planned program, to allow a reasonable estimate to be made of the resources necessary (based upon the allowances included in the As-planned program) to assess the time to be added for the task resulting from the excusable delay event (or events).

What are the strengths of this method?

As-built information is not needed at all.

As the As-planned impacted program rarely bears any relationship to what actually happened on site, it can be used to illustrate areas where the Contractor took acceleration measures (or conversely where the Contractor's actions were deleterious).

What are the weaknesses of this method?

It is a very theoretical method.

It relies heavily on the As-planned program, and can show misleading results if the As-planned program is incorrect (either in terms of durations for activities or in respect of logic linking).

As the As-planned impacted program rarely bears any relationship to what actually happened on site, it is difficult to use the results to ascertain a Contractor's actual extension of time entitlement.

If records are available for an As-built program, then it is unlikely that a tribunal would accept this theoretical method as being a basis for assessing a Contractor's Extension of Time entitlement.(6)

### **3.Collapsed As-Built (also known as 'As-Built But For' method)**

What is the basis of the method?This method involves removing from the As-built program identified excusable delays to show what the Completion Date would have been if those delay events had not occurred.as shown in chart (2.1)

How is the method used to assess Extension of Time entitlement? The period between the Completion Date on the As-built program and the Completion Date on the Collapsed As-built program, is taken as being the period of delay to which a Contractor is entitled to an Extension of Time as a result of an excusable delay event (or events) (otherwise known as Employer delay events).

What is needed to make this method work?

An accurate As-built program.

Clear identification of delay events.

What are the strengths of this method?

As this is based upon the As-built program, there is certainty that the outcome coincides with the events on site.

It is easy to understand.

What are the weaknesses of this method?

The removal of sometimes arbitrarily established delays from the As-built program can conceal the true effect of the Contractor's delays, and cannot allow for (a) the issue of concurrent or parallel delays, (b) the matter of the re-sequencing of the works, or (c) the effects of mitigation and/or acceleration measures.

The re-creation of a critical path following the removal of delay events may not be the same as the critical path that actually existed at the time of the delay event since the process involves the re-construction of the as-built logic.

In respect of both of the above items, criticisms may be made of the subjective approach that must be used.

#### **4. Time Impact Analysis**

Time impact analysis can be considered under two heads, i.e. Window Analysis (also known as Time Slice analysis) and Snapshot analysis.

As Snapshot Analysis is used primarily only in the event of contemporaneous Extension of Time awards, we will not deal with this method in this Article, and we will only deal with the Window Analysis method.

What is the basis of the method?

Window analysis is based on the analysis of the effects of delay events over the entire length of a project by looking at the events which have affected progress within 'windows' of the contract period sequentially.

The duration of each 'window' is not pre-determined, but is frequently taken as being one month.



At the end of each ‘window’ the As-planned program is updated to take account of any delaying inefficiency which is the Contractor’s risk, any necessary logic or duration revisions because of mitigation measures undertaken, together with all excusable and/or compensable events during the period since the last update.

The closing of a window in this way forms an As-built program at the end of that window which effectively becomes the As-planned program for the next window in sequence.

How is the method used to assess Extension of Time entitlement?

At the end of each window a projection is made to the Completion Date. At the end of the last window a final revised Completion Date is provided which, when compared to the original As-planned Completion Date, indicates the Extension of Time entitlement of the Contractor.

What is needed to make this method work effectively? When being used retrospectively, accurate progress information at the time of the windows must be available.

An accurate As-planned program that reflects all of the activities that should have been included within the original program.

What are the strengths of this method?

This method is the method recommended within the Society of Construction Law Delay and Disruption Protocol.

In each window there are relatively few activities to be analyzed (as compared to the over-all program) and therefore the delay analysis is easier.

It is the best technique for determining the amount of Extension of Time that the Contractor should have been granted at the time that an excusable risk occurred.

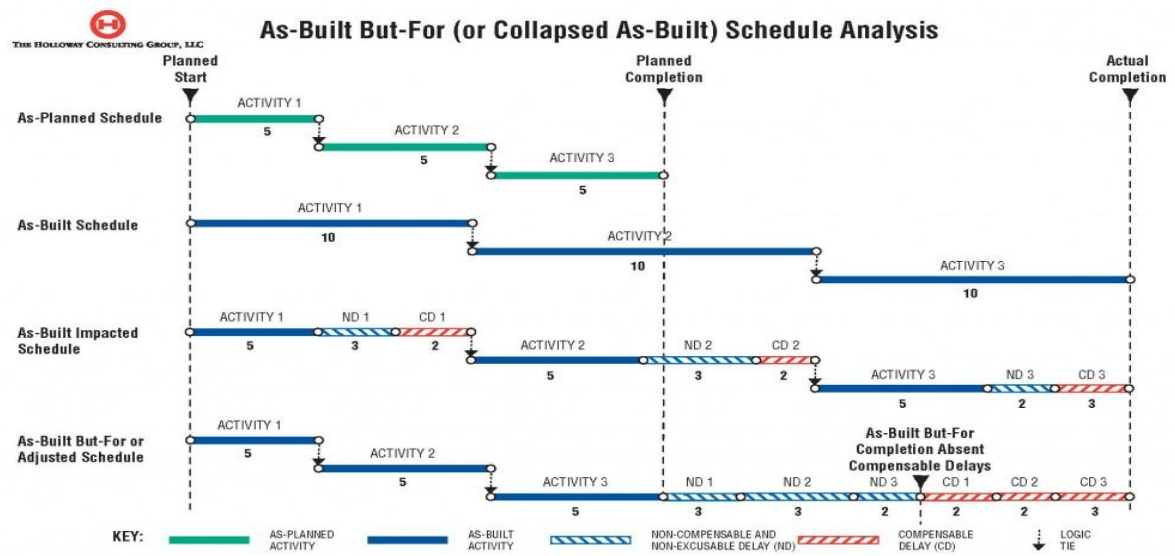
What are the weaknesses of this method?

Accurate progress information at the time of the windows must be available; otherwise the analysis cannot be properly or accurately completed.

The less accurate the program and progress information available is, the more likely that results will be obtained that are clearly inaccurate, that will require to be amended by manipulating any obvious errors in the original As-planned program.

There does seem to be some unnecessary confusion regarding the various delay analysis techniques. They are all relatively simple to understand in principle, but (in some cases) are perhaps rather more difficult to operate in practice.

As noted above, each of the techniques has its own strengths and weaknesses, but in reality the delay analysis that is used is often not dictated by the appropriateness of the technique itself but by factors such as, the relevant conditions of contract, the nature of the causative events, the value of the dispute, the time available, the records available, the program information available, and the programmer's skill level and familiarity with the project.(6)



**Chart (2.1 ) schedule Analysis**

### **2.2.8 Delays management tools and technique**

There are several tools and techniques created to manage the construction projects and avoid the delay as much as possible contractor Scheduling use to identify the coming points:

- Without a Schedule, how does Owner/Contractor determine how a delay affects time?
- Initial Schedule
- Schedule Updates
- Contract completion date
- Contractor's scheduled completion date
- Substantial completion

- Float

Planning tools and techniques:

Arrow diagram	Mass haul diagram
Bar chart or grant chart	Mile stone chart
Critical chain method(CCPM)	Net work analysis
Cascade diagram	Precedence diagram
Critical path analysis (CPA)	Program evaluation and review (PERT)
Histograms	Scatter diagram
Linear-or time change	Theory of constrains
Line of balance	Critical Path Method (CPM)

### CPM Scheduling

Just as network scheduling has become an important tool in managing a project, it has also become an important evidentiary tool in the presentation and defense of delay and disruption claims in litigation. Courts and boards have held that Critical Path Method (CPM) schedules are the most effective model for evaluating construction delays.

CPM is a network-based scheduling technique in which work activities with identified time durations are tied together with logic relationships indicating the flow of work. Once the time durations and logic relationships are identified, a mathematical calculation can be performed on the schedule network to determine the earliest and latest date each activity may be performed within the framework of the contract schedule. The longest path of interrelated activities through the schedule network is defined as *the critical path*. *Float* is the amount of time a specific activity may slip before it affects project completion. Activities on the critical

path have no float. In order to calculate delay damages, it is necessary to determine which work activities and delays were on the project's critical path.(7)

### **2.3 Previous Studies**

Worldwide, many researches have been conducted in the field of Construction Management. After a review of the relevant construction project performance literature, it has been found that different researchers adopted different performance definitions and frameworks based on their own understanding of project performance and research objectives.

#### **2.3.1 Puspasari study (2005)**

Puspasari (2005) studied the identification of factors that causes the poorperformance in construction projects, he showed in his results that there were forty four (44) factors identified where these factors were divided into eight (8) main categories that is (1) project characteristics, (2) client or developer related factors, (3)contractor related factors, (4) labor and material related factors, (5) consultant relatedfactors, (6) contractual related factors,(7) project procurement related factors and (8)external environment related factors. He recommended that to investigate another studyfor a specific type of construction projects, such as housing project, utility projects, highways construction project, dam construction projects, etc. Detail studies can be done to evaluate the involvement and effect of a specific party or resource ofconstruction project to the time overrun in construction projects.

#### **2.3.2 Majid study (2006)**

Majid (2006) stated that the One of the most common problems in the construction project performance is delays in Aceh, Indonesia construction industry, he showed in his study the projects can be delayed due to number of reasons which are due to the client, the contractor, acts

of God, or a third party. He has identified fifty seven (57) factors that may cause delays which grouped into eight groups of causes of delays. He found that the most factors from the groups are (1) contractor-related delays which he ranked it as the most significant groups that cause delays, others group are due to, (2)

Equipment related delay, (3) client related delays, (4) material-related delays, (5)23 finance-related delays, (6) consultant-related delays, (7) external-related delays, and (8)labor related delays. The recommendations were determined by Majid were to improve contractors' managerial skills by work- training program, formulate and execute participatory program for the development of the construction industry through a dedicated national agency, and importance of top management contribution in solving the problems.

### **2.3.3 Sloutman study (2007)**

Sloutman (2007) discussed the influences of execution planning on project performance for construction and mine firms, for reasons of cost overruns, and schedule delays. These cost overruns were the result of a mismanagement of risks that occur due to the size and complexity of the project. In his results, he focused on the workforce planning principles as the best practice to provide higher labor productivity, and better predictability including in six (6) categories which are (1) Tools and Equipment, (2) Human Resources, (3) Engineering and Design, (4) Procedures, (5) Materials, and (6) Environment. The early involvement of contractor ensures better communication which eventually leads to higher constructability of the produced designs. The recommendations of this study were focused on the early involvement of the contractor and the involvement of the owner through the entire process, and to continue the production of FIWP's, and to increase the level of detail one more step.

**2.3.4 Tat study (2009)**

Tat (2009) discussed the factors affecting the preparation of better construction schedule for construction work, he showed that there were thirty-five (35) factors where these factors were divided into four (4) main categories which were project specific factors, project management, working condition and external environment related factors. Tat recommended that to investigate another kind of a specific project, such as highway projects, and to evaluate the effectiveness of the construction work schedule on the particular project in the construction industry.

**2.3.5 Gomaa study (2010)**

Gomaa (2010) studied the different techniques and procedures adopted by the Sudanese Construction firms for the control of construction time and cost and moreover explores the main causes for projects costs overruns, the obtained results confirmed that all construction projects suffer from time overruns ranging between (40-60%) of the pre scheduled time, awareness of engineers with the basics and principles of financial accounting, unavailability system for cost control, and focusing on the wellpreparing of written and balanced contracts to ensure proper and timely projects progress. Gomaa recommended the followings: the project planning, good bid preparation, format contracts, good project management, and accountant work for engineers, apply the statistical applications, and construct units for monitoring and evaluation.

**2.3.6 Bin Hasan study (2010)**

Bin Hasan (2010) studied the problems that facing JKR (name of company) as leading technical department in Malaysia for time estimation to determine the time of the project completion, because the estimation in JKR based on prediction from the experience of completing

past project. The results expressed the factors that contributed to delay in JKR project which has been identified and grouped as, Poor Monitoring (by JKR and Contractors), Lack of Experience (in Monitoring and Scheduling), Bad Management (design changes), and Poor Financial (payment to subcontractor). The recommendations were to determine method to improve time estimation in JKR Projects, and to produce mathematical formula for determining the time of the project.(3)

### **2.3.7Sudanese previous studies**

These are many previous opinions for different engineers in Sudan which were collected from a workshop infrastructure that took place in 29/11/2014.

In this workshop a number of papers were discussed, presented by several engineers. The researcher mentioned only the points that were relevant to this study.

#### **Eng/AbbassMergani:**

- 1- Clarity of contract items.
- 2- Contractor's company profile(previous experiences).
- 3- Realistic time table.
- 4- Economical instability.

#### **Eng/Ashraf SerAlkhtim:**

- 1-BENTIL: Management technique(Integration of construction previous operations with advanced techniques and the latest methods of administration in an integrated system).



- 2- Ideal resources distribution.
- 3- Qualified technical staff.
- 4- Monitor critical activities.
- 5- Lack of coordination between service companies.
- 6- Interference in the decisions of executives with speeding creates geometric defects, and requires replays.

**Eng/SlahAldeenYousif:**

- 1- Dimension transport distance and rugged tracks and traffic jams slow down material import rates.
- 2- Search for resources after tender result.

**Eng/Abbas Yassin:**

- 1- Overlapping decisions.
- 2- Hiring a contractor for several projects at the same time.
- 3- In price change: only the direct cost calculation.
- 4- Not creating new methods to facilitate and reduce the execution of time.
- 5- Delay in the contract procedures and batches submitted.
- 6- Illogic payment which force the contractor to pay from himself.
- 7- Lack of laboratories enabled to reduce the test time.

**E/Mohamed AwadAlradi**

- 1- Poor planning.
- 2- Lack of effective leadership.

- 3- Inadequate management knowledge.
- 4- Lifecycle problems.
- 5- Weak relationship between problems and strategy.
- 6- Weak skills for working team.
- 7- Failure to choose the best way to evaluate the tender.
- 8- Wrong understanding to hold the project in whole or in part.
- 9- Teamwork absence.

**The steps he recommends to avoid delay:**

- Changes planning
- Inspection
- Documentation    (6)