Managing and Controlling Construction Delays using Guild Management Techniques[1, 2]

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ABSTRACT

The construction industry is a noteworthy catalyst to the development of the country's financial advancement. The frequent delay of the substantial construction project has been a wonder and it impacts the execution of the vital planning. This paper introduces the discoveries of study of prevailing reason for delays in construction project in the point of view of project management. The outcome uncovered that the five most huge defer causes as observed by were income and budgetary troubles looked by contractual workers, temporary worker's poor site management, deficient contractual worker encounter, lack of site specialists and inadequate arranging and booking by contract workers. All the causes are gathered into 5 main causes such as 1) project category, which grouped factors related with the project itself; (2)human category, involving the factors affecting the laborers;(3) management or organizational category for those factors referred to planning, management, scheduling and supervising issues; (4) materials and tools category, grouping factors related with the supply or shortage of materials, tools, equipment or machinery; and finally (5) environmental factors category[3]. Ideally, the discoveries of this examination will at any rate shade a few lights to the issues looked by expansive development venture and exertion can be taken to enhance it.

Keywords: Construction, Control, Delay, Planning, Project Management, Time Overrun, Building Information Modeling (BIM)

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[3] Labor Productivity in the Construction Industry -Factors Influencing the Spanish Construction Labor Productivity. (2018). Retrieved from https://waset.org/publications/9999560/labor-productivity

INTRODUCTION

"Construction is one of the major industries worldwide."[4] The construction industry is about to reach an "estimated $10.5 trillion by the next 5 years, and it is forecast to grow at 4.2% from 2018 to 2023.[5]" Although development extends worldwide in developing countries construction industry faces major issues with the delay in construction is one of the significant issues. According to the Guild of Project Controls Compendium and Reference (GPCCAR) "the construction stages, operates through the life span such as 1. Owner practitioner 2. EPCC or Design>Build Contractor and 3. "Design>Bid>Build" or Firm Fixed Price Contractor[6]

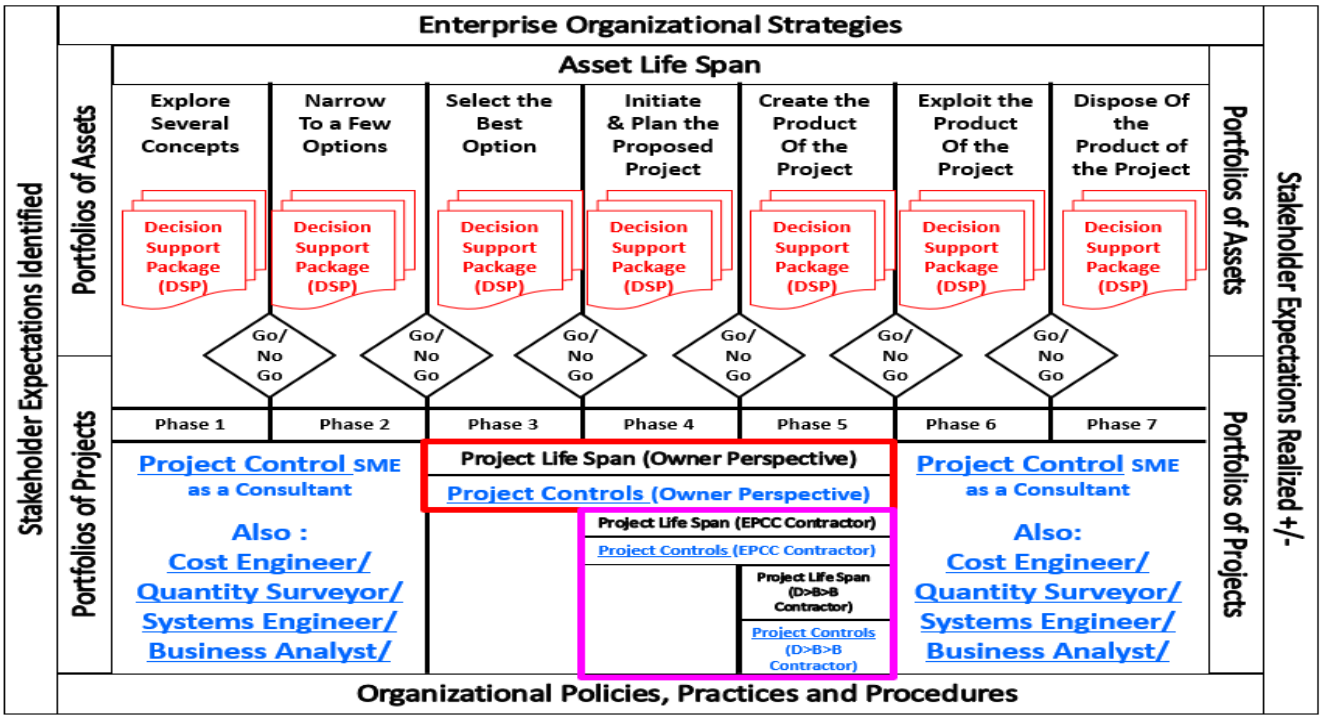

Figure 1. Process grouping in Project life span phases[7]

In this the owner practitioner operates throughout the Asset life cycle. And the contractor practitioner operates in a smaller cycle i.e. within the project life cycle. In figure 1 phases 1, 2, 3, 4, 5, 6, 7 represents the "Asset life cycle" and only three phases represent "Project life cycle".

[4] World Construction Industry | Economy Watch. (2018). Retrieved from http://www.economywatch.com/world-industries/construction/world.htm
[5] Markets, R. (2018). Growth Opportunities for the Global Construction Industry 2018-2023 - A Potential $10.5 Trillion Market. Retrieved from https://www.prnewswire.com/news-releases/growth-opportunities-for-the-global-construction-industry-2018-2023---a-potential-105-trillion-market-300578103.html
[6] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[7] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls

Phase 1 is exploring several concepts i.e. to brainstorm several concepts, ideas and developing the initial schedules, cost estimates and budgets. Phase 2 is doing the feasible analysis on all the best ideas and narrow it to 2 to 3 best suitable options. In phase 3 select the best options that suits the project with all the stakeholders and practitioners. This is the starting of the "project life cycle". Step 4 is the initiation of the project. Refine the project plan, scope, risk, schedule and budget in this phase. Phase 5 is to execute the project as per the plan. The phases 6 and 7 are the "Operate" and "Disposal" phases. Since Project Control specialists can assume two jobs - as Subject Matter Experts (Phases 1, 2, 6 and 7) OR as Key Project Team Members (Phases 3, 4 and 5) our jobs and duties will change and will be characterized by the requirements of the project sponsors and additionally project managers, contingent on the stage we are in. Despite which stage we are in, the essential expectations that we are dependable to create are information and the related examination and projections to empower that Phase to advance.[8]

To be reliable, the core deliverables from each stage which are to be incorporated into the Decision Support Package (DSP) are additionally named after the stage they are related with. The idea for utilizing a stage gated approach is that the delay, time and cost will be continuously explained winding up not so much unclear but rather more solidly characterized after some time. Significant number of projects run late and over-spending means that this procedure is not taken into consideration effectively.

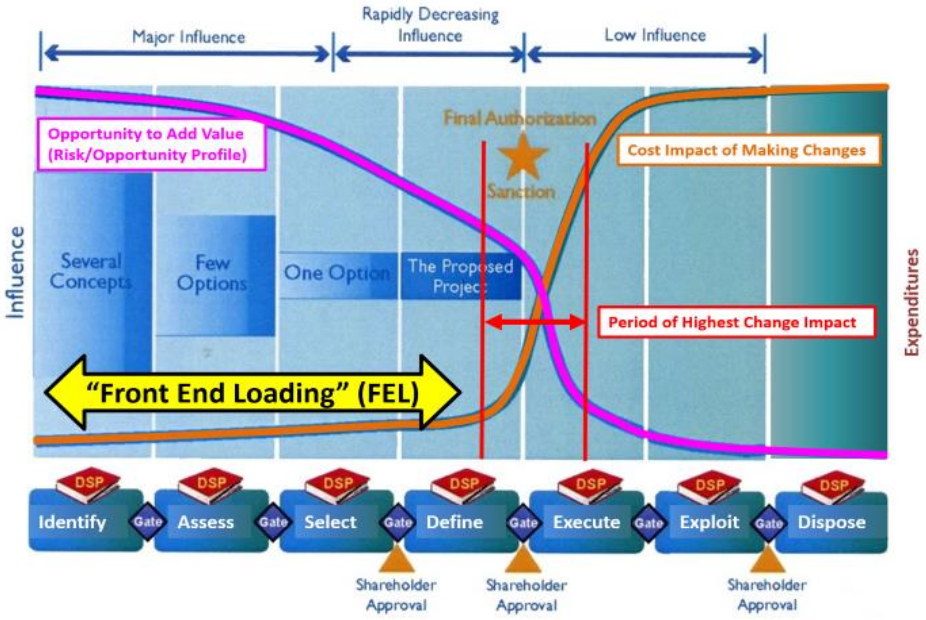

Figure 2. "MacLeamy Curve" of Front End Loading (FEL).[9]

[8] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls

[9] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-change

According to Mcleamy curve (figure 3) "most of the cost variation take place in the define and execution stage of the project."[10] This is the "period of highest impact change". This is because of the change orders. Change orders is an adjustment or alteration requested or coordinated by the owner without issuing a formal change arrange. This is the most widely recognized kind of change order that outcomes in a delay. Front End Loading exhibits that by characterizing extension and solidifying the degree amid the early periods of the benefit life length, when the chance to include esteem is high and the expense to roll out improvements is low, bringing about less downstream effects to either or both time and cost, is the favoured. So, it's important to set a realistic time for the project otherwise it will cause delays in the project. In the worst scenario, quickening the construction will likewise influence the quality of the project which showcases to fail customer's fulfilment.

The root causes can be divided into four parts depending on who is responsible for the delays I.e. from the Project category, Human category, Management category and Environmental factors category . Delays in payment, choosing an incompetent contractor andLevel of Skill and experience, Ability to adapt to changes and new environments , Complexity of the design, Clarity of the drawings and project documents, Project scale, Insufficient supervision of subcontractors category, Improper coordination of subcontractors Unrealistic scheduling . And External factors such as accidents, , Air humidity, High/low temperatures Rain, High winds, Distance between construction sites and cities, economic crisis also leads to delays. The effect is very extreme during the high pinnacle of construction development period. Multiple projects at the same time cause over-loaded to the construction firms also a major cause for delays. Azhar and Farouqui (2008) observed that "Delays on construction projects are a universal phenomenon in which the trend of time and cost overrun is common worldwide, and it is more severe in developing countries". [11]

[10] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-change
[11] Kumar, D. (2018). Causes and Effects of Delays in Indian Construction Projects. Retrieved from https://www.irjet.net/archives/V3/i4/IRJET-V3I4363

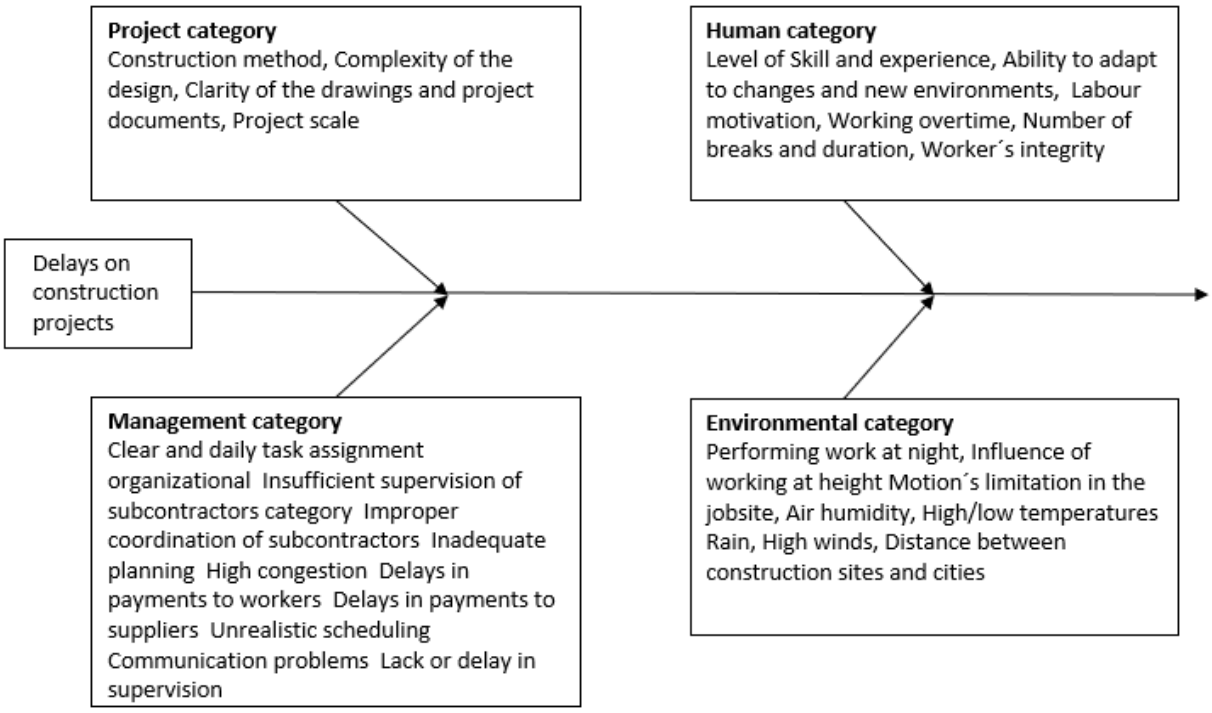

Figure 3: [12]Fish bone diagram of the root causes of delays.

According to Wideman Comparative glossary "[13]Projects are performed by people, constrained by limited resources, and planned, executed, and controlled. A project is a temporary endeavor undertaken to create a unique product or service. Temporary means that every project has a definite beginning and a definite ending". So, construction delays are related to project management as it has all the characteristic of a project managements such as it is performed by people and needs to finish within a limited time and cost. According to Guild "[14]Project control practitioners (Mangers, Engineers, Contractors, planner) all for the most part apply their insight and expertise to what we refer to as Projects." These projects have a more extended life expectancy than the stages they are offered, assemble or developed. As in the same way in Construction everyone operates effectively within time and cost to get the bigger picture. According to Guild "[15]Every project management main objective is to minimize the risk and to maximize the return." In construction everyone has an asset or resources for the project, with

[12] The fish bone diagram is prepared with reference Atout, R. (2018). ROOT CAUSES OF CONSTRUCTION PROJECT DELAYS IN DUBAI. Retrieved from http://www.arcom.ac.uk/-docs/proceedings/ar2008-749-757_Ren_Atout_and_Jones.pdf Kumar, D. (2018).
[13] Wideman Comparative Glossary of Project Management Terms v5.5. (2018). Retrieved from http://www.maxwideman.com/pmglossary/PMG_P12.htm
[14] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[15] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls

the best mix of all assets or resources the project will provide less delays and a profit for all the assets.

The purpose of this paper is to answer the research questions:

1. What are the factors and effects of delay in the construction industry?
2. What are the risks in construction delay?
3. What are the methods to limit delays?

In other words, this paper aims at finding out the causes of delay, investigating effects and risks related to the different types of delay, and identifying the tools to prevent delays from happening.

METHODOLOGY

Step 1 – Summarize

To summarize, the purpose of this paper is to analyze the causes of delays in construction and its effects and give advice on the methods to use to avoid their happenings.

OVERALL RII AND RANKING OF ALL FACTORS SURVEYED

Rank	Code	Factor	Overall RII (%)
1	F25	Shortage or late supply of materials	87.40
2	F3	Clarity of the drawings and project documents	86.41
3	F12	Clear and daily task assignment	85.53
4	F27	Tools or equipment shortages	85.20
5	F5	Level of Skill and experience	83.16
6	F17	Delays in payments to workers	82.47
7	F22	Coordination between crews	82.00
8	F14	Improper coordination of subcontractors	81.59
9	F13	Insufficient supervision of subcontractors	81.03
10	F20	Communication problems	80.88
11	F6	Ability to adapt to changes and new environments	80.84
12	F15	Inadequate planning	78.10
13	F7	Labour motivation	77.47
14	F18	Delays in payments to suppliers	76.99
15	F26	Unsuitability of materials storage location	75.36
16	F19	Unrealistic scheduling	75.07
17	F10	Worker's integrity	75.00
18	F16	High congestion	73.94
19	F24	Rework	73.19
20	F30	Motion's limitation in the jobsite	72.08
21	F21	Reallocation of laborers	70.80
22	F23	Lack or delay in supervision	70.22
23	F11	Incentive policies	69.65
24	F32	High/low temperatures	69.53
25	F28	Performing work at night	67.93
26	F2	Complexity of the design	66.86
27	F1	Construction method	65.49
28	F33	Rain	64.39
29	F29	Influence of working at height	64.36
30	F4	Project scale	64.17
31	F34	High winds	63.25
32	F9	Number of breaks and their duration	62.67
33	F8	Working overtime	59.82
34	F35	Distance between construction sites and cities	54.23
35	F31	Air humidity	53.56

Figure 4: Shows the Leading causes of disputes in Construction.[16]

As shown, there are 35 major factors causing delays in construction. we must apply Pareto Analysis (80:20 rule) to center around those best 11 factors and yet, given the "underlying driver" of numerous cases lies with diminished or affected efficiency, we must in any event every one of the 35 parameters understanding that on a particular project they might be considerably more very positioned. So, it's important to take all factors into consideration.

Step 2 – Feasible Alternatives and Attributes

The technique for assessing the delays to a task is by gaining all the data identified with the task and its prosperity and disappointment. This key information is identified with the planning of the

[16] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls

project. The arrangement that will be accomplished will require assets and money as some portion of the requirements. The strategy received in this exploration is to recognize the key information required for dealing with the issues of delays and use the learning picked up from a portion of the subjects managing the delays in development

The most broadly utilized defer investigation strategies are

- Building Information Modeling (BIM)
- Monte Carlo Simulation
- PERT Formula (Project or Program Evaluation and Review Technique)
- Time Impact Analysis
- Line of Balance (LOB)

Step 3 – Development of feasible alternatives

To understand the alternatives there are in construction to limit the risk of delays, we can have a look on the features of the defer investigation strategies mentioned above

Building Information Modeling (BIM) [17]

Building Information Modeling (BIM) is the way toward creating and overseeing building information during its life cycle. Normally it utilizes three-dimensional, ongoing, powerful building displaying programming to expand efficiency in building plan and development. With BIM it is conceivable to limit a portion of the delays through BIM modelling which can permit joining of different sort of data with 3D demonstrate. Building Information Modeling (BIM) can be taken more remote than just connecting the CPM Schedule to the undertaking structure illustrations to deliver 4D BIM as it tends to be stretched out to 5D BIM by coordinating the Cost Estimating information and now and again much further by incorporating different components, for example, Risk Simulation programming databases to shape 6D BIM and so on.

[17] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-planning-and-scheduling

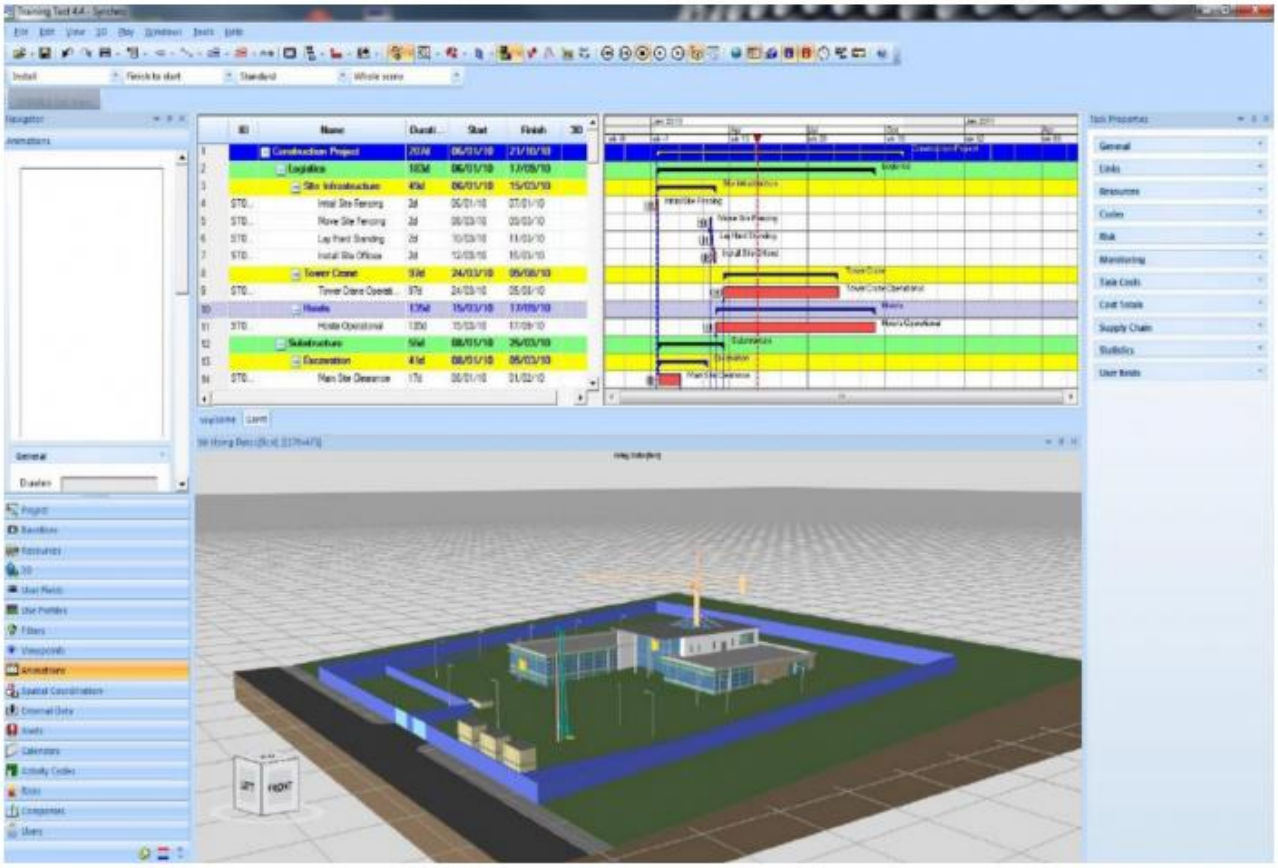

Figure 5: Illustrating 3D BIM linked to CPM Schedule (4D BIM)[18]

Monte Carlo Simulation[19]

The Monte Carlo Simulation is a reproduction technique which is generally utilized for producing arbitrary numbers to a given example, having the irregular impact of probability of event. It is material for simulating diverse kinds of complex issues which principally includes irregular execution. In general, MCS strategies are for the most part used in tackling different scientific issues through the age of arbitrary numbers. Monte Carlo simulation does this hundreds or thousands of times, and the outcome is a likelihood appropriation of conceivable results. Along these lines, Monte Carlo simulation gives a considerably more far reaching perspective of what may occur. It gives data about what could occur and how likely it is to occur.

[18] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-planning-and-scheduling

[19] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/assess-prioritize-and-quantify-risks-opportunities

PERT Formula (Project or Program Evaluation and Review Technique)[20]

The Program Evaluation and Review Technique (PERT) is a hazard examination and administration instrument used to plan, arrange and facilitate tasks inside a project. It is essentially a strategy to break down the task that are associated with finishing a given task, particularly the time expected to finish each task, and to recognize the base time expected to finish the aggregate task. Three cases of activity combined to formulate a PERT formula 1. An optimistic time, which is viewed as the 'best' time given that all related components become alright; 2. A critical time, which is the 'thinking pessimistically' situation, with everything going wrong which could turn out badly; 3. An in all probability term, which is the 'typical' time for the movement, in light of expert judgment, experience or different elements. PERT can be used to analyze cost as well. [21]The PERT COST System gives the adaptability for a contract worker to allocate charge numbers to work bundles and synopsis numbers to end things. The PERT COST System will regroup the assigned worker allocated charge numbers so that condensing up through the work breakdown structure is expert to fulfill the Program Manager's necessities.

Time Impact Analysis (TIA)[22]

Time affect investigation includes the affecting or including of the defect/effect onto the arranged program similarly as the as-arranged affected method. Be that as it may, instead of the delay occasions being embedded into the first arranged program they are embedded into the arranged program which has been refreshed with advancement at a point instantly before the occasion happening. Despite this, affecting of the occasion will demonstrate likely delay/affect and may not really show what in the occasion really happened. Time affect examination is in this way basically a planned system used to learn the conceivable effect of delay/affecting occasions as they happen. his procedure can be utilized reflectively to evaluate the effect of a delay at the time that it happened, anyway as pointed out over the outcomes well speak to the reasonable effect and won't really mirror the occasion as it happened. To have the capacity to utilize this method reflectively will require the accessibility of normal advancement refreshes and a completely arranged program.

[20] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/assess-prioritize-and-quantify-risks-opportunities
[21] DOD and NASA guide: PERT COST systems design., s. (2018). DOD and NASA guide: PERT COST systems design. suppl.. Retrieved from https://babel.hathitrust.org/cgi/pt?id=mdp.39015006057866;view=image
[22] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-planning-and-scheduling

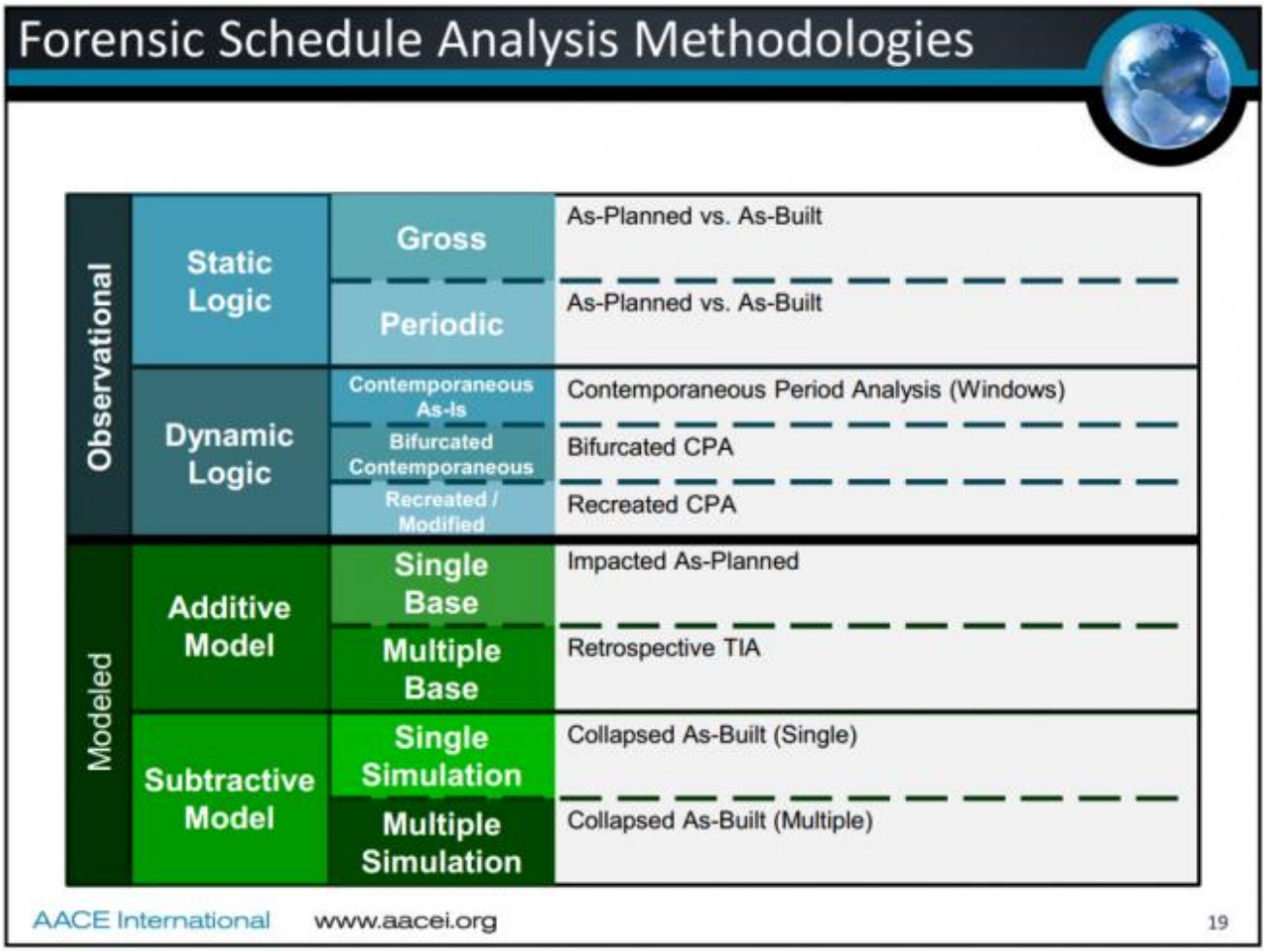

Figure 6: Forensic Analysis Methodologies Summarized [23]

Line of Balance (LOB):[24]

The idea of the Line of Balance (LOB) procedure is to have a more prominent comprehension and control of yields between different exchanges with the end goal that asset levels can be adjusted, and wastage can be kept to a base. It is also called 'lean development' method and is helpful when tedious cycles of exercises are required, for example, tall structure development.

[23] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-planning-and-scheduling
[24] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-planning-and-scheduling

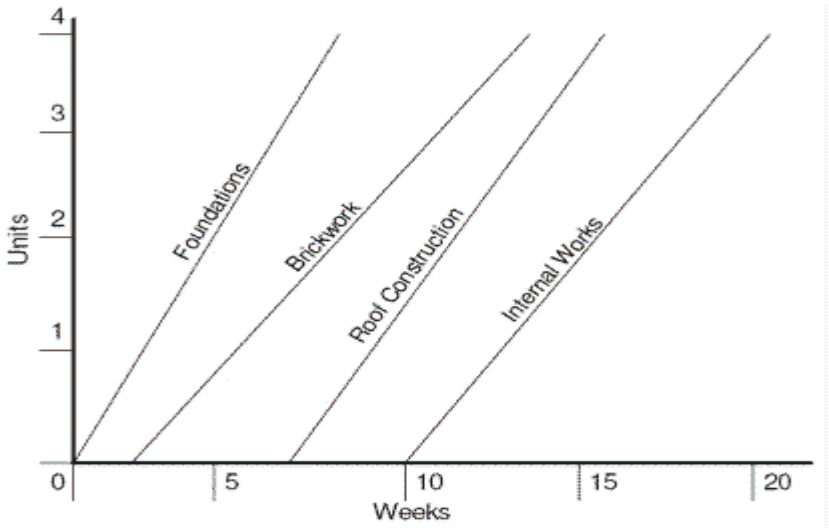

Figure 6: Line of Balance method[25]

In LOB method, the principle is to have a general yield rate of particular work then everyone will adjust its own assets to likewise accomplish the particular work. From figure 6 it can be seen over the generation rate of the brickwork group is marginally lower than that of its antecedent or successor however is yet adjusted adequately inside the two so as not to postpone the general works.

Step 4: Selection of criteria

To access the different feasible attributes available to manage the delays, the Multi-Attribute Decision Making(MADM) technique is used. The idea of the technique is to evaluate all the attributes and to rank them accordingly. [26]The criteria are Time, cost, progress, Cash flow management, Resource allocation, Risk, Project category, Human category, Management category, Measurable, Time based.

Time: Time can be measured in terms of construction time, speed of construction and time overrun. It's an important criterion in determining project success.

Cost: Cost generally refers to the degree of compilation of construction work within the estimated budget. This one is also a major criteria project in construction success.

[25] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-planning-and-scheduling
[26] Criteria for Construction Project Success: A Literature Review. (2018). Retrieved from https://www.researchgate.net/publication/314949396_Criteria_for_Construction_Project_Success_A_Literature_Review

Progress: This is a traditional criterion which means the Progress & quality of a project was commonly defined as meeting technical specifications.

Cash flow management: availability of sufficient assets is undoubtedly a prevalent basic achievement factor that determines performance of any construction project. Based on these criteria's the attributes has compared and to analyze does the alternative significant to minimize delay.

Resource Allocation: Availability of resources is a major criteria as no proper allocation and over use of resources causes delays.

Risk: Risk is also an important criterion as any risks leads to delays in the project.

Project category: which gathered components related with the undertaking itself

Human category: including the variables influencing the workers

Management category: for those variables alluded to arranging, the board, planning and administering issues [27]

Measurable: Know whether the objective is reachable and how far away completion is and discover when you have accomplished your objective

Time based: Enough time to accomplish the objective and Not all that much time, which can influence venture execution[28]

Each alternative will be graded as follows: 0 (low), 1 (medium) and 2 (high) for each given attribute. Then, colors will be added to the matrix to show if it is a positive (green), a neutral (yellow) or a negative (red) aspect. By having a look at the total, we will understand which alternatives can be rejected. The alternatives that do not reach at 4 points will not be accepted as a proper solution.

Factor / Attribue	BIM	Monte Carlo simulation	PERT	Time impact analysis	Line of Balance
Time	**2**	**2**	**2**	**2**	**1**
Cost	**2**	**2**	**1**		**2**

[27] Labor Productivity in the Construction Industry -Factors Influencing the Spanish Construction Labor Productivity. (2018). Retrieved from https://waset.org/publications/9999560/labor-productivity
[28] SMART Goals. (2018). Retrieved from https://www.projectsmart.co.uk/smart-goals.php

Progress	**1**	**1**	**2**	**1**	**1**
Cash flow management	**2**	**1**			
Resource Allocation	**1**	**1**	**2**	**1**	**1**
Risk	**2**	**2**	**1**	**1**	
Project category	**2**	**2**			
Human category	**1**	**1**	**1**	**1**	**1**
Management category	**2**	**2**	**2**	**2**	
Measurable	**1**	**1**	**2**	**1**	**2**
Time based	**2**	**1**	**1**	**2**	**1**
Total	**18**	**16**	**14**	**11**	**9**

Table 2: Attributes vs Criteria and which Alternative support which criteria[29]

In the table above, we see that the total of Time impact analysis is inferior to 10. Thus, this alternative will not be considered proper to manage disputes in construction. [30] Time impact analysis is not a possible option if program has not been updated with advancement simultaneously it might demonstrate hard to re-make reflectively and may contain components

[29] By author this table is created with reference to Multi Attribute Decision Making method to solve problems involving selection from among a finite number of alternatives
[30] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/conduct-the-schedule-analysis

of subjectivity. A graphical comparison only does not provide cause and effect. BIM alternative proved to be the best one among to manage disputes in construction. Other alternatives also prove to be handy in manging delays. And other alternatives are ranked above the least option 10. Thus, for the next step, we will only consider 4 alternatives: Building Information Modeling (BIM), Monte Carlo Simulation, PERT Formula (Project or Program Evaluation and Review Technique), Line of Balance (LOB).

FINDINGS

Step 5 – Analysis and Comparison of the Alternatives

In Table 2, the non-compensatory demonstrate strategy was utilized and the choices were positioned as followed: 1. Building Information Modeling (BIM), 2. Monte Carlo Simulation, 3. PERT Formula (Project or Program Evaluation and Review Technique), 4. Line of Balance(LOB) 5. Time impact analysis. Along these lines we saw that the most exceedingly terrible choice was Time impact analysis and the best one was Building Information Modeling (BIM). The previous was rejected from the elective rundown and four potential alternatives remain. This procedure helped us rank the choices however it doesn't enable us to comprehend their relative score to each other. With the end goal to do as such, we would now be able to look at them by utilizing a compensatory display system: The Non-Dimensional Scaling Technique[31]. This procedure is connected to evaluate the 4 outstanding alternatives by utilizing dimensionless qualities. For the table underneath, the qualities are the equivalent as in Table 2: 0 (low), 1 (medium) and 2 (high). As an update, for the quality "brisk" the best case is 2 and the most pessimistic scenario is 1 since we never again consider – most pessimistic scenario with a score of 0. For this situation, all qualities are desirables.

[31] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/managing-change-the-owners-perspective

	Undesirable= (Worst case - Attribute value) / (Worst case – Best case)		
	desirable= (Attribute value – Worst case) / (Best case – Worst case)		
	Value	Formula	Dimensionless Value
BIM	1. Medium	(1-1)/(2-1)	0
	2. High	(2-1)/(2-1)	1
Monte Carlo	1. Medium	(1-1)/(2-1)	0
	2. High	(2-1)/(2-1)	1
PERT	0. Low	(0-0)/(1-0)	0
	2. High	(2-1)/(2-1)	1
Time Impact Analysis (TIA)	0. Low	(0-0)/(1-0)	0
	2. High	(2-1)/(2-1)	1
Line of Balance(LOB)	0. Low	(0-0)/(1-0)	0
	2. High	(2-1)/(2-1)	1

Table 3.1: Multi-Attribute Decision Making Matrix: Non-Dimensional Scaling Technique[32]

	BIM	Monte Carlo	PERT	Line Of Balance
Time	1	1	1	0
Cost	1	1	0	1
Progress	0	0	1	0
Cash flow managemen	1	0	0	0
Resource management	0	0	1	1
Risk	1	1	0	0
Project category	1	1	0	0
Human category	0	0	0	0
Management category	1	1	1	0
Measurable	0	0	1	1
Time based	1	0	0	0
Total	7	5	5	3

Table 3.2: Multi-Attribute Decision Making Matrix: Non-Dimensional Scaling Technique[33]

From the Non-Dimensional Scaling Technique approach, we can see that Building Information Modeling (BIM), with a score of 4, which equals to 2 times of LOB, 150% greater than Monte Carlo and 1.5 times better than PERT.

Step 6 – Selection of the Preferred Alternative

In Step 5, we saw that BIM is the superior choice to alternate choices by utilizing the Non-Dimensional Scaling Technique. Now we are to apply another technique called "Additive

[32] By Author
[33] By Author

Weighting Technique"[34] . This procedure will enable us to deliver a genuine proportion scale to think about the choices and gives a clearer vision to choose the favored option among the rest.

With the end goal to apply the Additive Weighting Technique, we first need to rank every one of the criteria from 1 to 6 and discover the sum of the ranking- which is 21. To rank the characteristics, Disjunctive Reasoning[35], a non-compensatory display strategy, should be utilized. This procedure encourages us direct a couple shrewd examination and discover which qualities are the most imperative for this paper.

	Time	Cost	Progress	Cash flow manageme	Resource management	Risk	Project category	Human category	Managem ent	Measurabl e	Time based	Total
Time		1	1	1	1	1	1	1	1	1	1	10
Cost	0		1	1	1	1	1	1	1	1	1	9
Progress	0	0		1	1	0	1	1	1	1	1	7
Cash flow	0	0	0		0	0	0	0	0	0	0	0
Resource	0	0	0	0		1	1	1	1	1	1	6
Risk	1	0	1	1	0		1	1	1	1	1	8
Project category	0	0	1	1	0	0		0	0	1	0	3
Human category	0	0	1	0	1	1	1		1	0	1	1
Management	0	0	0	0	0	0	0	1		1	0	2
Measurable	0	0	0	1	1	0	0	1	1		0	4
Time based	1	0	1	1	1	0	0	1	0	0		5

Table 4: Multi-Attribute Decision Making Matrix: Non-Dimensional Scaling Technique[36]

The table above demonstrates to us that the most vital attribute is Building Information Modelling (BIM) and the minimum essential is the Line of Balance(LOB). By normalizing the weights of each characteristic, we will have an ideal score equivalent to or inferior to 1.00, as appeared in the accompanying table

[34] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/managing-change-the-owners-perspective
[35] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (2018). Retrieved from http://www.planningplanet.com/guild/gpccar/managing-change-the-owners-perspective
[36] By Author

	Step 1	Step 2	BIM		Monte Carlo		PERT		Line of Balance	
	Relative Rank	Normaliszd weights(A)	(B)	(A)*(B)	(B)	(A)*(B)	(B)	(A)*(B)	(B)	(A)*(B)
Time	11	11/66=0.167	1	0.167	1	0.167	1	0.167	0	0
Cost	10	10/66=0.152	1	0.152	1	0.152	0	0	1	0.152
Progress	8	8/66=0.121	0	0	0	0	1	0.121	0	0
ash flow managemer	1	1/66=0.015	1	0.015	0	0	0	0	0	0
esource managemen	7	7/66=0.106	1	0.106	0	0	1	0.106	1	0.106
Risk	9	9/66=0.136	1	0.136	1	0.190	0	0	0	0
Project category	4	4/66=0.061	1	0.061	1	0.061	0	0	0	0
Human category	2	2/66=0.030	0	0	0	0	0	0	0	0
Management categor	3	3/66=0.045	1	0.045	1	0.045	1	0.045	0	0
Measurable	5	5/66=0.076	0	0	0	0	1	0.076	1	0.076
Time based	6	6/66=0.091	1	0.091	0	0	0	0	0	0
Total	66	1		0.773		0.615		0.515		0.334

Table 5: Additive Weighting Technique[37]

From the above table the best score is 1 and none of the attributes has a score of 1. But Building Information Modelling (BIM) has a score of 0.773 which is the best among all other attributes. The level of trade-off is very low for this option. The second option would be Monte Carlo. It was a solid alternative at the beginning of the Multi-Attribute Decision Making (MADM) process but it only reached 0.615 at step 6. PERT and Line of Balance score less than 0.55 and can be defined as not proper alternatives. Line of balance is clearly the inferior option for dispute in construction, with a score of 0.334.

From this, BIM is the best attribute among all with a score of 0.773 out of 1. BIM is a useful attribute that is useful in Sequence Your Steps, Model-Based Cost Estimation, Reduced Cost and Mitigated Risk, Improved Scheduling/Sequencing, Stronger Facility Management and Building Handover. We can use this single attribute in managing most of the disputes in construction.

Step 7 – Performance Monitoring and post-evaluation of results

From the report that BIM is the best option, we can have a look at the clauses included in delays in construction. Before starting a project, it is highly recommended to do preconstruction project visualization using BIM. [38]By utilizing BIM, you can design and picture the whole project amid preconstruction. Space-use simulations and 3D perceptions enable customers to encounter what the space will look like offering the capacity to roll out improvements previously construction begin. Having a more noteworthy diagram from the earliest starting point limits cost and tedious changes later.

[37] By Author
[38] Hall, J. (2018). Top 10 Benefits of BIM in Construction. Retrieved from https://connect.bim360.autodesk.com/benefits-of-bim-in-construction

The second thing it helps in work process, sequencing audit, and undertaking site spatial and strategic planning. Gives prompt age of precise building component amount, materials, and cost estimation dependent on components in the model; helps contractual worker in amount and material estimation exactness, and additionally cost control effectiveness.[39]

CONCLUSION/RECOMMENDATIONS

Construction delays claims are unavoidable in many projects in the developing countries. It is infrequently observed that a task finished with no alteration on the planned time. Concurrent delays claims are the most questioned issue in the business. Results demonstrate that delays are a piece of the everyday schedule during construction project execution. In this paper we defined the 5 alternatives disputes responses available to deal with delays in construction and we managed to find out the best option for minimizing delays is using BIM. This alternative remained the first option from the beginning to the end of the Multi-Attribute Decision Making (MADM) process

It can be concluded by, more consideration ought to be paid to the procedures that are taking part before construction progress, for example, creating satisfactory cost, time estimation and project design and drawing. The after-effects of the displayed research recognize the requirements of the construction industry from the perspective of time and cost management and disputes or delays that happen in activities, and these could be utilized as the standard for the arrangement of rules for effective management in all construction projects.

There is some recommendation to minimize the delays[40]

- Project progress and actual planned pathways ought to be continually checked and refreshed with the end goal to battle with any issues that may emerge and have the capacity to completely control potential consequences.
- Each project should assign a budget for BIM towards the beginning of the designing process, and ought to be considered as a feature of demonstrating staffing and scheduling.
- BIM is for the most part connected with plan and preconstruction, it totally benefits each period of the construction life-cycle. Building Information Modeling enables project to be manufactured for all intents and purposes before they are built physically, dispensing with a considerable lot of the wasteful aspects and issues that emerge during the development process.

[39] Benefit Evaluation of Implementing BIM in Construction Projects. (2018). Retrieved from http://iopscience.iop.org/article/10.1088/1757-899X/245/6/062049/pdf
[40] Benefit Evaluation of Implementing BIM in Construction Projects. (2018). Retrieved from http://iopscience.iop.org/article/10.1088/1757-899X/245/6/062049/pdf

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