Planning, Scheduling, and Delay Analysis of a Commercial Building Using Microsoft Project (MSP): A Case Study

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Abstract

Delay in constructions is one of the common problems in India which usually results in large time overflow and cost increases. This paper examines real-life applicability of planning, scheduling and delay management in commercial buildings projects with the help of Microsoft Project (MSP). Three case studies containing G+4, G+6 and G+7 buildings in Maharashtra, based on elaborate Work Breakdown Structures and base schedules were studied. MSP was used to track progress and Time Impact Analysis (TIA) was used to assess the impacts of delays on project schedules and cost. This analysis showed that the cumulative delay days were 316 and the overall cost incurred due to this delay is ₹1,080,838. among 41 activities. The main delay causes were a shortage of labor, vendor-related problems, and design revision, problems of material procurement, and the environment. Testing comparative results proved that when compared to the manual mode of planning, the dynamic scheduling features of MSP facilitated much better visualization of critical paths as well as loading of resources and modeling of scenarios. The results support the need to incorporate digital tools and proactive delay analysis as key contributors to the efficiency of construction projects, risk management, and decision support within construction projects that are sized in the middle of the spectrum.

Key wards - Delay in construction, Work Breakdown Structures, Time Impact Analysis (TIA), Cost Overrun, Commercial Buildings.

1. Introduction

Construction projects in India are experiencing extensive delays. Due to a dramatic shift in the capacity and volume of the Indian construction industry over the last 10 years, the need of a systematic analysis of the reasons of delays and developing a clear understanding among the industry experts are highly vital. Delays continue to exist because of elaborate stakeholder manifolds, labor fluctuation, weather disruption, materials deficiency, and official snags[1], [2], [3]. In a study focused on Indian commercial construction projects, Doloi et al. [4] found that over 50% of projects suffered critical delays due to improper planning, lack of coordination, and labor inefficiencies. Assaf and Al-Hejji [5], in a larger perspective of large-scale developments, has pointed out that blame has to be put not only on managerial failures, but also on a flawed project design itself.

In developing nations, delays in construction can mostly be linked to contractor factors, delays in purchasing materials and poor integration within the teams. In Malaysia, Alaghbari et al. [6] categorised the major sources of delays into financial restraint, poor management of the site, and poor scheduling. The same pertains to Indian practices where time planning tools suffer either misutilization or are altogether not put into an action plan. Desai et al. [7] compared Microsoft Project (MSP) and Primavera P6, and the conclusion is that MSP offers an uncomplicated and cost-efficient tool that can help perform dynamic scheduling when the project is of middle size. Olawale and Sun [8] they claimed that although budgeting and planning systems have been adopted, they are badly integrated into processes of daily execution hence drastically cutting off the effectiveness of these systems in controlling enterprises.

Quantitative assessments of delay causes, such as Al-Momani [9], have exhibited a common trend of the projects sliding behind the schedule due to shortage of labor, mistakes in designing and mobilization of contractors. Contemporary computer aids (such as MSP) are currently capable of identifying such delays as early as possible with the help of Gantt chart movements and change in the baseline. Muhyi et al. [10] demonstrated MSP's adaptability for forecasting and correcting time slippages in bridge projects. Similarly, Miranda and Helia [11] illustrated MSP's role in ongoing project performance evaluation in high-risk environments. Sepasgozar et al. [12] combined computer applications such as the MSP and BIM to create a solid foundation that would support delay impact modeling settling the dispute on the importance of TIA in the present project delivery models.

Additional research from across contexts supports these findings. For instance, Iyer and Jha[13] discovered that project participant commitment and owner competence play an important role in schedule adherence in the projects in India. Memon et al.[14] emphasized communication and contract management issues as primary contributors to delay in Pakistan. Marzouk and El-Rasas[15] ranked financial delays and poor site supervision as critical in Egypt. Aibinu and Odeyinka [16] pointed to interrelated managerial and systemic flaws in Nigeria. Larsen et al.[17] highlighted project funding issues and consultant errors as major delay contributors. Pourrostam and Ismail [18] identified ineffective planning and late design approvals as root causes in Iran. Agyei[19] showcased how PERT/CPM with linear programming can optimize project timelines when delays are anticipated and The activities underwent crashing of both the time and cost using linear programming, this paved way for the determination of critical path. Next paper illustrates the presence of phantom float in Primavera's P6 and Microsoft's Project schedules and research is being carried out in order to remove phantom float from P6 and Microsoft Project schedules [20]. Another study aim to identify new technologies in construction and suggest for implementation of technologies for speedy construction and report cost-effectiveness of the systems the impact of prefabrication technology on profitability using Primavera p6[21].

2. Research Gap

While extensive research has been conducted on the causes of construction delays across various countries, including India [4], Malaysia [6], Nigeria [16], and Egypt [15], Indonesia [22] Minimal research has been done on the practical application of the dynamic custom scheduling tools used on medium-scale commercial construction projects like a Microsoft Project (MSP) model that closes the gap of substantial research to the practical use of dynamic custom scheduling tools in the commercial construction industry. According to most studies, delays are caused due to lack of planning efficiency [4], [6] [9], [15], [16], yet few delve into real-time delay quantification and control using software-enabled simulations such as Time Impact Analysis (TIA) [12]

Although Desai et al. [7] and Muhyi et al. [10]demonstrate the utility of MSP in scheduling, the literature lacks empirical validation on its forensic application for delay propagation analysis in ongoing Indian construction projects. Additionally, prior research has not sufficiently bridged the gap between theoretical scheduling techniques—like PERT/CPM and linear programming as explored by Agyei[19] and their practical implementation using modern project management software in live project settings.

Furthermore, while studies have examined managerial [5], [8], [13], financial[6], [15], and labor-related [4], [9] contributors to delay, relatively little attention is paid to the interaction of these factors in the critical path of the projects; the factor becomes particularly important when it is affected by modular change such as vendor alteration or regulatory delay. The tools available such as MSP despite its abilities are still underutilized in scenario modeling of predictive situations particularly in emerging economies where there are inhibitive adoption and implementation variances.

This paper has tried to fill in these gaps by applying Time Impact Analysis in Microsoft Project to two live commercial projects and one is manually planned project in Maharashtra, India. It adds a replicable model of quantifying delay events in Gantt-based schedules to combine the academic delay diagnostics and the live site business. This is expected to provide empirical evidence that can be used to improve time management, stakeholder preparation and the general use of dynamic scheduling approaches in the mid-sized Indian construction projects.

3. Methodology

This paper has used case-based analytical approach to analyze planning, scheduling, and of commercial building projects using Microsoft Project (MSP). To simulate the different complexity in the development of commercial and mixed-use buildings three real world construction projects in Kolhapur were chosen G+4 and G+5 along with G+7. The information of the project was obtained by the onsite visits, project documentation, municipal planning and interviews by stakeholders. Work Breakdown Structure (WBS) was constructed in detail with each of the projects which was divided into pre-, construction and post-construction phases. Microsoft Project was also used to develop baseline schedules, determine critical paths and distribute resources. Variance was identified on schedules and prices by monitoring actual progress on the various projects compared to the plans. The delay events have been compartmented and analyzed according to the cause behind them- labour shortages, material delays, regulatory approvals and environmental factors. The method of Time Impact Analysis (TIA) was used to calculate the implications of certain delays on the overall schedule of a project by including and updating the delays in the schedule of the project and then updating the critical path. Comparison analysis was conducted to measure the effect of any delay in terms of lost time and extra costs invested. The capacity of MSP in alleviating these problems has also been evaluated on the basis of its abilities in scenario, resource levelling and real-time updating of the schedule. This systematic paradigm has given a clear picture of how the use of digital project management systems would improve efficiency, accountability, and delay management in construction projects of a commercial nature.

4. Details of Case Study

In order to determine the practical applicability of planning, scheduling and delay analysis in business construction projects, three life cases were conducted in Maharashtra. The projects are of different scale, complexity and functionality encompassing such projects as mid-rise living and high-rise multi-purpose buildings. Such case studies are the basis of the assessment of Microsoft Project (MSP) as a tool that can be used to increase the accuracy of efforts scheduling and reveal the overruns of time and costs.

Case Study 1: G+4 Residential Building

- Project Type: Residential
- Configuration: Ground + 4 Floors (G+4)
- Total Built-up Area: ~1,428.45 m²
- Scope:
  - Ground floor parking
  - Residential flats on 1st–4th floors
- Key Features:
  - Modular kitchens, balconies, and a central lift system
  - Provision for water tanks, fire safety, and ventilation

Case Study 2: G+7 Residential-cum-Commercial Building

- Project Type: Mixed-use (Shops + Residential)
- Configuration: Basement + Ground + 7 Floors (G+7)
- Total Built-up Area: ~2,699.81 m²
- Scope:
  - Basement parking
  - Ground floor shops
  - 1st–7th floors residential flats
- Key Features:
  - Central lift, fire safety measures, and dual access
  - Rainwater harvesting and terrace plumbing

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Case Study 3: G+6 Commercial cum Residential Project

- Project Type: Commercial + Residential + Office
- Configuration: Basement + Lower Ground + Upper Ground + 6 Floors + Terrace
- Total Flats: 25 (20 × 2BHK, 5 × 1BHK)
- Commercial Elements:
  - 7 shops (265 m² total)
  - 8 office units on the 1st floor
- Scope:
  - Service basement and utilities
  - Full vertical integration with elevator and fire safety

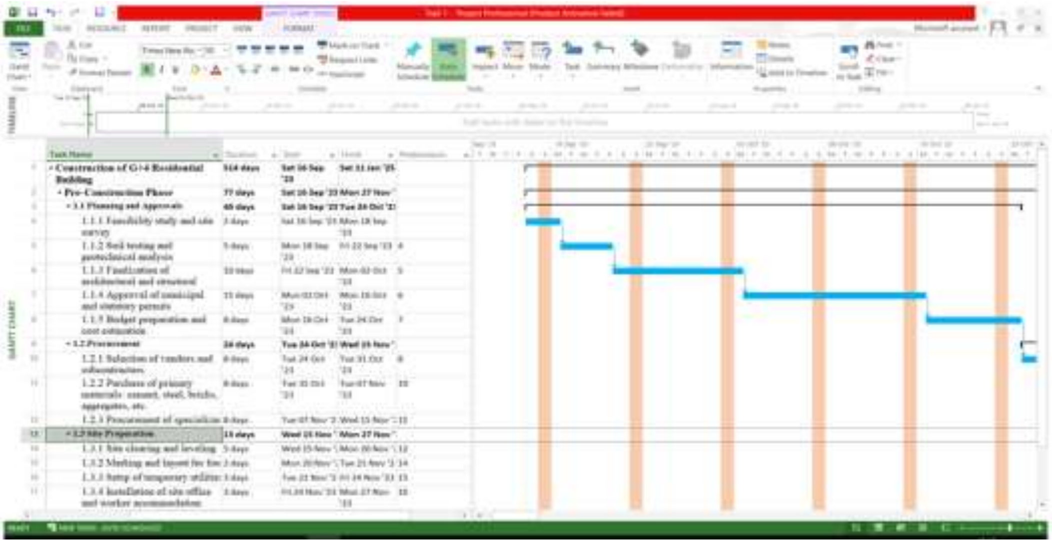

Fig No .1 Case Study 1 (MS Project)

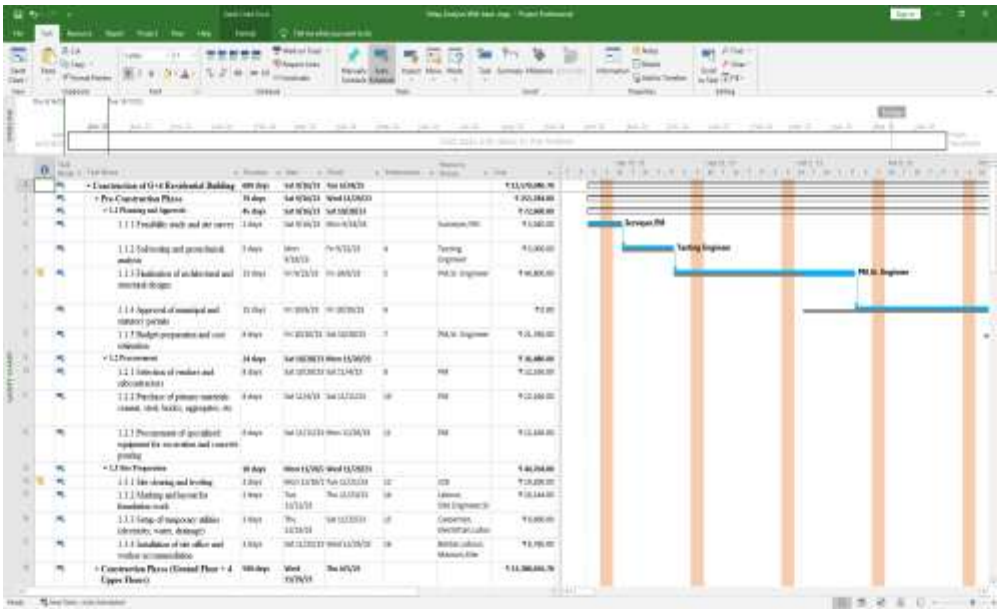

Fig No .2 Case Study 1- Delay Analysis (MS Project)

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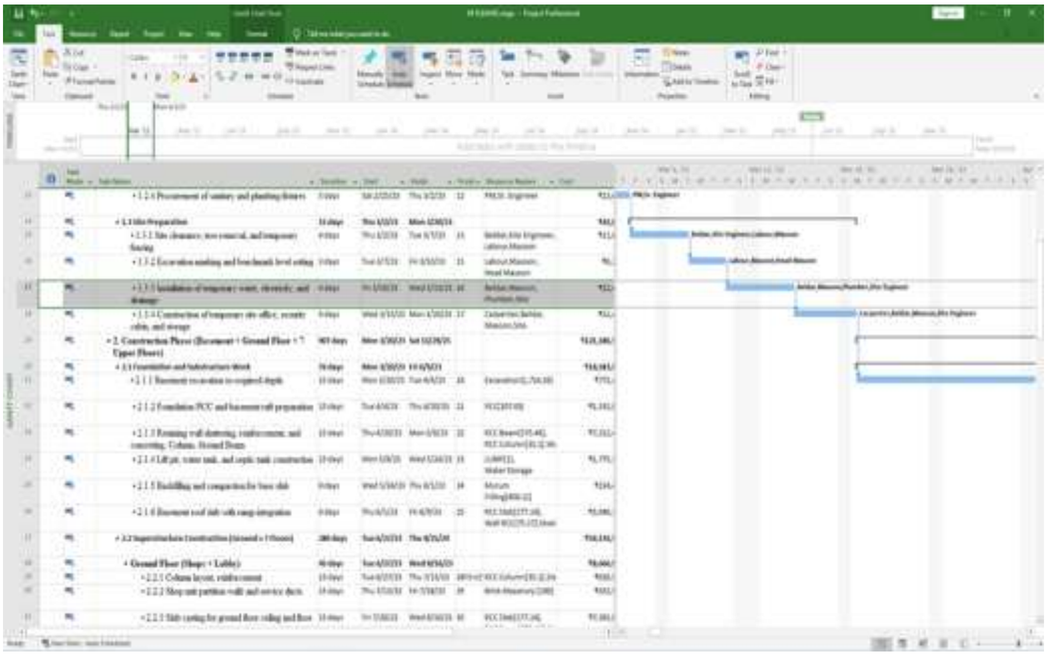

Fig No .3 Case Study 2 (MS Project)

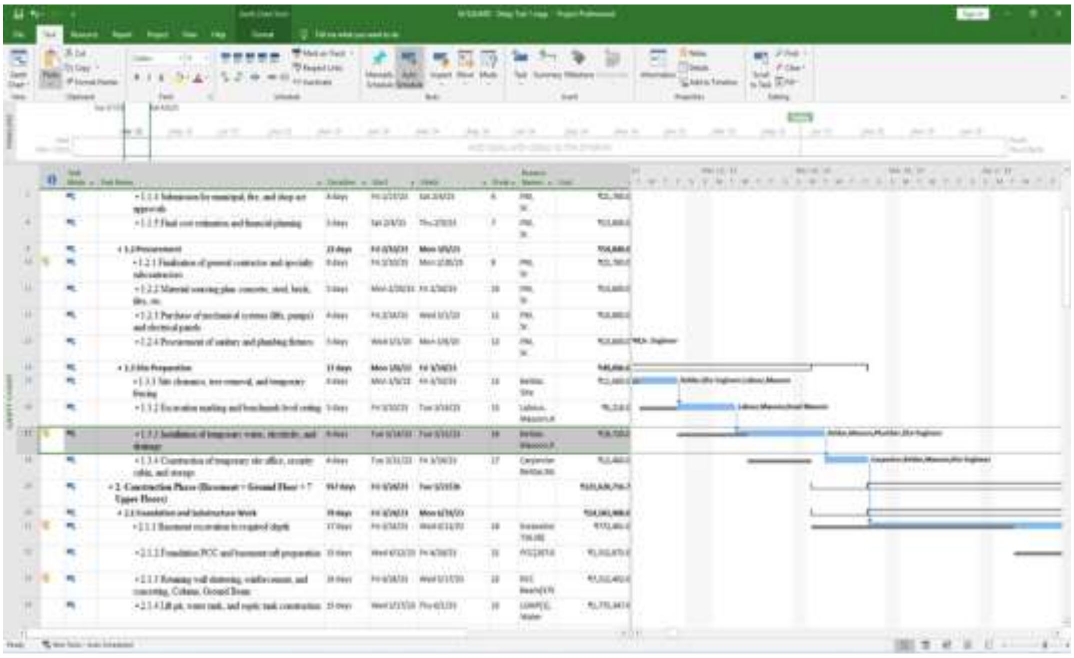

Fig No .4 Case Study 2- Delay Analysis (MS Project)

5. Delay Analysis Methods

There are a number of delay analysis techniques that have been adopted in the face of difficult construction projects. These include:

1. Collapsed As-Built (CAB) Method: The technique is characterized by its high precision but not very effective in providing quick decision making because it is usually time consuming. [23]
2. Windows Analysis Method: This design is a mixture of TIA and CAB, thus providing a fair and reasonable option between efficiency and accuracy. It is especially good in examining contemporaneous delays[24][25].
3. Relative Importance Index (RII): This method helps in identifying the most critical delays and their impact on the project timeline[26] [27].

4. Earned Value-Based Liability Calculation Algorithm: The given algorithm is aimed at assigning the delay obligations to project members and estimating associated costs[28].
5. Time Impact Analysis: The TIA method is particularly effective for prospective analysis, allowing stakeholders to address delays as they occur [26].

6. Effectiveness of Delay Analysis Methods

The successfulness of delay analysis technique largely lies in the GSA capability to precisely indicate delay causes, allocate blame, create a clear idea of financial and time consequences. In the case of prospective analysis, the TIA method is especially helpful as the stakeholders can investigate delays in the course of their occurrence[24], [26]. However, its accuracy can be compromised if the input data is incomplete or inconsistent [23], [25]. Time Impact Analysis (TIA) is a widely recognized method in construction management for assessing the impact of delays on project timelines.

The Windows Analysis method has gained popularity due to its ability to handle concurrent delays and provide a clear, traceable analysis process [24], [25]. This approach is especially applicable in the case of disputes involving more than two parties of a dispute as it is dynamic and systematic in the delay analysis.

The Time Impact Analysis (TIA) approach has been selected as a method used in this paper because it is a structured and activity-oriented tool that perfectly fits dynamic and complex phenomenon of construction projects. TIA takes account of the progress of the works at the time of the delay, mitigation of the delays, concurrent delays. In TIA, the individual delays (in any form due to a vendor problem, revision of design documentation, weather, or lack of resources) can be easily measured in terms of contributing to the planned total project schedule or cost. TIA allows not only prospective but also real-time delay analysis unlike retrospective methods when delay assessment is only done after the completion of the project thus being of special importance when the project is under active monitoring and a dispute is to be prevented. The fact that it bases its decision making on planned vs. actual schedule comparison allows the appropriate identification of critical path interferences and helps in making fair and evidence-based decisions over EOT or contractor liability. Also, the fact that TIA allows the direct connection of time delays with cost implications, it becomes a complete financial analysis and claims supporting tool. Taking into consideration the variety of the delay causes in the three case studies and the necessity of the high quality of documentation related to some hidden aspects of delay, TIA was the most suitable approach to reach out a well-balanced, data-based assessment of time and cost overruns.

6.1 Objectives of the Analysis

- To find and record delays measured at the activities level.

- To measure the delay days per activity and overall delay days.

- To estimate the cost growth due to delays.

- To evaluate the impact of average delay and cost of each activity.

- To obtain practical conclusions that can be applied to the resolution of disagreements, risk handling and schedule development.

6.2 Application of Time Impact Analysis (TIA)

Time Impact Analysis was applied in the following manner:
- Baseline data: Planned start/end dates and cost estimates of all key activities were collected as a baseline information.
- Actual data: Recorded actual durations and final incurred costs.
- Delay measurement: measured delay days using actual and planned duration.

- Cost impact: Calculated difference between the estimated and incurred cost of every activity.

- Root cause analysis: Associated each delay with a particular reason (e.g. vendor problem, lack of labor).

Table No. Result Summary of Case Studies

Metric	Value
Total Activities Analyzed	41
Total Delay (Days)	316 Days
Total Cost Increase	₹1,080,838
Average Delay per Activity	7.71 Days
Average Cost Increase per Activity	₹26,361.90

6.3 Detailed Justification of Each Metric

- Total Activities Analyzed: 41 - Includes all tracked project tasks, enabling detailed delay analysis.
- Total Delay: 316 Days - Aggregated time loss due to activity delays, critical for EOT claims.
- Total Cost Increase: ₹1,080,838 - Reflects financial burden from extended timelines and inefficiencies.
- Average Delay per Activity: 7.71 Days - Indicates a systemic pattern of delays across project tasks.
- Average Cost Increase per Activity: ₹26,361.90 - Useful for risk-adjusted budgeting and penalty assessments.

6.4 Major Causes of Delay Identified

- Vendor Issues / Supply Chain Disruption
- Weather & Environmental
- Labor Shortage
- Design Changes & Approvals
- Machine Breakdown / Technical Issues
- Material Quality Issues
- Site Coordination Conflicts

6.5 Observations and Analysis

Design Phase Delays (5–14 days): Late approvals and revisions.
Procurement Delays (6–10 days): Delivery issues and incorrect materials.
Execution Delays (10–25 days): Coordination and site readiness issues.
Finishing Delays (8–23 days): Vendor conflicts and access restrictions.

7. Results and Discussion

In this study, the scheduling patterns of the three commercial-cum-residential projects that were built were evaluated using both the outdated manual software and Microsoft Project (MSP)-based scheduling. The result of comparative delay analysis showed that in 41 critical construction activities, there was distribution of overall overrun of time of 316 days and escalation of costs of 1, 080, 838.

Project	No. of Delay Activities	Total Delay (Days)	Total Cost Overrun (₹)	Avg. Delay/Activity (Days)	Avg. Cost/Day	Difference
Case Study 1 (G+4)	20	165	₹457,956	8.25	₹2,775.49	Case I Vs II= 39.42%
Case Study 2 (G+7)	13	54	₹209,027	4.15	₹3,870.00	Case II Vs III= 11.40%

Project	No. of Delay Activities	Total Delay (Days)	Total Cost Overrun (₹)	Avg. Delay/Activity (Days)	Avg. Cost/Day	Difference
Case Study 3 (G+6) (Manually Planned)	8	96	₹413,855	12.00	₹4,311.00	Case III Vs I= 55.27%

- Temporal Disruption Patterns

Among the interesting items, which were discovered in all the three projects were the findings that delay was not uniformly spread, but was clustered in some phases mainly in the preliminary groundwork, structure work, and finishing work. The 45-days delay due to the activities related to the foundation of the construction site in Case Study 1 can be summarized as a single cause due to the unexpected presence of black cotton soil which required the situation to be handled by forcing the excavation to be deeper than initially intended to, and costly dewatering steps were to be taken. In another pertinent scenario in Case Study 3 in which the process was held up in the step of design ratification, upstream holdups also caused downstream steps to be stimulated.

Moreover, the case study that had the highest average delay per activity, Case Study 3 (12 days), were due to sequencing and formwork incompatibility and vendor rework, mainly because of the discrepancy in scheduling its critical-path activities. This observation affirms the assertion that construction delay in preconstruction is likely to worsen in the next phases unless the problem is handled as such.

- Cost-Time Correlation

Throughout the cases the relationship between the number of days of delay and incremental cost per activity was quite high and positive. It should be noted that not every delay led to the rise of the direct costs but affects the general cash flow of the project due to the idle time of the resources relevant to the idling resources during the festive season or any season related to material approvals. There were, however, high-cost spikes at structural and MEP phases where slowdowns resulted in formwork, idling or panic purchasing of machinery that was not used until long after. For example:

• The Case Study 2 consisted of a breakdown of only 3-days in column casting caused by unavailability of labor which ended up increasing the total cost by 17550.

• In Case Study 1, the additional costs were of 25 days of excavation overruns: 240,000 (rupees).

This demonstrates that in any resource demanding activity, any time variance can escalate the cost of such activities exponentially especially in situations when the cost thus incurred are to be added with the cost of the weather or design errors

- Role of Microsoft Project in Delay Visualization

Both Gantt charts and the critical path analysis of MSP showed signs of a looming collection of risks that were alarming. To illustrate, in Case Study 1, the critical path was manipulated in the midway of the project where installation of plumbing and electricity systems was being delayed due to disputes by vendors. Within MSP, the change could be traced simply and what it accentuated is the versatility of the dependencies as existed in practice in the real-world construction, a factor that is often given little or no consideration during the first scheduling.

Another benefit of MSP was that it exposed irrigation wastes of invisible overlaps, e.g. when:

• Overlapping of walling and slab casting that leads to congested scaffold.

• Competing access ways that slow the movement of formwork.

Such conflicts were not at the fore-front of schedule based on manuals scheduling but were made clear upon the visual dependency mapping and the tracking of the base lines thus promoting the effectiveness of MSP in dynamic environments.

- Nature and Classification of Delays

The delays experienced could be categorized as:

• Excusable, Non-Compensable: e.g. heavy rainfall (Case Study 1), or dewatering as the result of high-water table (Case Study 3).

• excusable, compensable, e.g., vend differences, late revision of design.

• Non-Excusable e.g. bad coordination, short estimation of curing time or not handling vendor well.

It is worth noting that most of the delays belonged to the excusable-compensable category, meaning that under better contractual forms and active risk communication, much of the overruns would have been predictable or otherwise mitigated.

E The cross case comparison reveals a number of systemic tendencies:

• Vendor-Related Delays in all three cases, but mostly on electrical and plumbing works. In Case Study 2 alone, the issues related to the vendors have negatively impacted on five different tasks.

• Site-Specific Technical Improvements (i.e., soil conditions, shared access, water table levels) were still under-considered when the first planning was made.

• Planning Rigor vs. Field Adaptibility: Although MSP had some flexibility at the micro-level (i.e. a micro-level template and control), its logic (upper level) would fail to adapt to variations in the field- considerably to the extent that there should be a balance between digital controls and ground-level feedback mechanisms

- Insights from Delay Impact Analysis (Time Impact Analysis)

When TIA is applied to delay logs of these case studies it resulted in defensible and measurable allocations of the delays. It enabled:

• Proper association of delays and respectively contributing factors or entities.

• Cascading effect on successor tasks measurement.

• Creating cost-supported claims particularly in instances where the undertakings had an immediate impact on the project milestones.

In Case Study 3, a 14 days slippage in approval of final drawing directly moved procurement schedules 6 days and overhead mobilization at the site took 6 more days with an escalation cost of 55626. This kind of insight, granted by TIA helps in prevention of disputes and fair time extensions.

- Emerging Themes

Based on the evidence collected in each of the three case studies as an aggregation of the different findings, there were a number of themes that were drawn:

• Inefficiencies found in the early stages propagate throughout the time-line particularly when it is concerned with approvals and purchase.

• Cost overruns cannot be linear as they usually increase sharply during the structural and finishing stages during which cost to day ratio is the highest.

• Digital apps such as MSP are essential, however not without themselves, they have to be integrated in a feedback-intensive environment that consists of field data, stakeholder coordination, and adaptive forecasting.

• Delays are multi-causal, multi-connected and only the multi-layered analysis (such as TIA) can differentiate the causes and consequences of delays.

Conclusion

This paper has critically looked at the complex nature of planning, scheduling and delay analysis of the commercial building projects using conventional and innovative methods such as the use of Microsoft project (MSP). With a fair research on three of the real case scenarios we might be well within reason to realize that although delays on constructions are almost inevitable its impacts could be subdued considerably with vigilant planning, methodical assessment and application of technology assisted decision making.

The basic findings were that the slippage of a project cannot be thought of as random event but a systemic impact that is dependent on interactivity of other factors like design poor performance and unreliable suppliers to environmental limitations and unavailability of labor. This showed that the total number of days a project was behind in execution was 316 days thus making the potential cost over run to be more than 1 million rupees. It is anything but clear that the ability to detect through the research how delays at the earlier phase of the project (planning, procurement, etc.) can damp through the most important part of it (the execution itself) derailing the plans and inflating costs is more crucial.

The Time Impact Analysis (TIA) methodology was particularly successful in the situation of the assessment of the delay quantification, the cause attribution and delivery of the delays-related claims. With the advantage of TIA it is not only correct to say that what went amiss is identified but also that there is a modeling of how and when certain interruptions occurred and afflicted the project trail. This makes it a fine problem-solving and a long term improvement tool.

Comparing the average cost delays in each of the three projects per day, it is quite apparent that there is a dramatic rise in the cost of delay to the projects. The delay cost per day was at a higher rate by 39.42 percent in Case Study 2 compared to Case Study 1, and this aspect indicates that delay cost per day is more in larger projects based on increasing complexity (e.g. G + 4 to G + 6), and this aspect might be provided by more specific labour, use of more equipment and increasing costs of materials etc. But Case study 3 being a manually planned project, the greatest cost impact due to delays was 55.27 percent as compared to case study1 and 11.40 percent as compared to Case study 2. Being unplanned, the Case Study 3 was probably accompanied with the lack of project coordination, ineffective allocation of the resources, and reactive decision making that eventually increased cost per day. The trend indicates why it is necessary to plan ahead, analyze risks and delay mitigation strategies particularly on complex and/or high-rise projects. Cost overruns are also most likely to be experienced in projects that are not planned at the beginning but even then, delay activities may be low in number compared to the number of delay activities in other projects. In general, the strategic impositions of an organized project planning, controlling measures to main an active control over the project progress, to ensure the minimization of delays further down, will on average generate a significant slashing of the cost echelons of delays in the future.

More broadly speaking, the research will assist in sketching a critical paradigm in construction management, which is, that the underlying cause of a failure is rarely single when it comes to delays, but a set of dependencies and assumptions that have not been analyzed in detail. The two consequences of the same are the following:

planning should take into account the variability, and the scheduling should be dynamic and responsive throughout the lifecycle of the project.

In conclusion, one should mention that the effective operation of commercial buildings cannot be associated merely with schedule maintenance but with the management of uncertainty. An integrative pro of MSP and TIA is that it forms a brilliant platform when it comes to predicting risks, analysis of performance and also increasing accountability. Last but not least is the fact that, planning as we know it today of being mainly a fixed document ought to be an evolving transforming and new process towards achieving projects on time, at budget and satisfaction of the stakeholders.

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