A Framework for Project Recovery: Mitigating Time and Cost Overruns in Construction Projects Using Advanced Project Management Tools

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Abstract: This research addresses the critical and persistent challenge of time and cost overruns in construction projects, with a specific focus on the rapidly developing context of Tier-II Indian cities like Bhopal. Despite the availability of project management tools, a reactive approach to project control often leads to significant schedule delays and budget escalations. The study moves beyond mere diagnostic analysis of failure causes and proposes a prescriptive, technology-driven framework for actively recovering projects already in distress.

The research adopts a simulation-based methodology centered on a realistic case study of a G+5 residential building ("Zenith Apartments") in Bhopal. The simulation is conducted in two distinct phases. Phase A replicates a traditional, failure-prone workflow using AutoCAD and Microsoft Project, deliberately introducing common planning errors such as quantity underestimation and ignored resource conflicts. Earned Value Management (EVM) analysis at the 5-month mark quantitatively demonstrates project failure, with a Schedule Performance Index (SPI) of 0.80 and a Cost Performance Index (CPI) of 0.87, projecting a 6-month delay and a cost overrun of ₹1.1 Crores. Phase B implements the proposed Integrated Project Recovery Framework (IPRF). This involves correcting foundational data through Building Information Modelling (BIM) using Autodesk Revit, which eliminates a 10% material quantity error and proactively resolves 45 structural-MEP clashes. The accurate, clash-free data is then fed into Oracle Primavera P6 for advanced recovery planning. Strategic interventions include quantitative risk analysis with contingency allocation, automated resource leveling to resolve all conflicts, and schedule crashing through "what-if" scenario analysis.

The comparative results validate the framework's effectiveness. The recovered plan achieves a net saving of approximately 4.5 months in schedule and ₹70 Lakhs in cost compared to the projected failure scenario. While the recovered duration (19.5 months) and cost (₹5.4 crores) exceed the original unrealistic targets, they represent a credible, risk-adjusted baseline. The principal contribution of this thesis is the structured, four-step IPRF (Detect & Diagnose, Re-Model & Validate, Re-Plan & Optimize, Re-Baseline & Control), which provides project managers with an actionable pathway from crisis to control by integrating BIM for data integrity and Primavera P6 for strategic optimization. The study concludes that such an integrated tool-based approach is not only viable but essential for enhancing project resilience and success rates in the modern construction landscape.

Keywords: Project Recovery, Time Overrun, Cost Overrun, Building Information Modelling (BIM), Primavera P6, Earned Value Management (EVM), Construction Project Management, Integrated Framework.

1. Introduction

The construction industry is a fundamental pillar of the Indian economy, serving as a significant catalyst for infrastructure development, economic growth, and large-scale employment generation. It contributes significantly to the nation's Gross Domestic Product (GDP) and has a profound multiplier effect on other associated industries such as steel, cement, technology, and power. As India continues its journey towards becoming a global economic powerhouse, the demand for sophisticated infrastructure—ranging from residential and commercial complexes to transportation networks and smart cities—is escalating at an unprecedented rate.

In this context, cities like Bhopal, the capital of Madhya Pradesh, are emerging as epicentres of rapid urbanisation and development. Classified as a Tier-II city and selected under the Government of India's flagship "Smart Cities Mission," Bhopal is witnessing a massive influx of investment in its real estate and infrastructure sectors. Premier engineering institutions in the region, such as the Lakshmi Narain College of Technology (LNCT), Bhopal, are at the forefront of producing skilled civil engineers and construction managers who are tasked with steering these complex projects.

However, this boom in construction activity is accompanied by a pervasive and critical challenge that threatens the very viability of these projects: time and cost overruns. Despite advancements in technology and management science, a substantial number of construction projects, both in India and globally, fail to adhere to their initial schedules and budgets. These overruns are not minor deviations; they often result in significant financial losses, contractual disputes between clients and contractors, tarnished reputations for the involved firms, and a general erosion of stakeholder trust. The issue is so rampant that it is often considered an undesirable norm within the industry rather than an exception.

While various project management tools and software, such as Microsoft Project and Oracle's Primavera P6, have been developed to aid in planning, scheduling, and control, their mere availability does not guarantee project success.The effective application of these tools, particularly in complex, dynamic environments where risks are high and uncertainties are frequent, remains a significant challenge. Modern workflows are now integrating Building Information Modelling (BIM) tools like Revit with project management software like Primavera P6 to create a more controlled and data-driven project environment. However, the adoption of such integrated systems is still nascent, and many projects continue to rely on traditional, fragmented approaches. Often, these tools are used for basic initial planning but are not fully leveraged for proactive risk management.

2. Research Methodology
2.1 Introduction

This chapter delineates the systematic methodology employed to achieve the objectives of this research. It serves as a blueprint detailing the research approach, the selection and design of the case study, the software tools utilised, and the step-by-step process of data generation, analysis, and interpretation. The core of this methodology is a case study-based simulation approach, designed to practically demonstrate a project's journey from a state of failure to a state of recovery. This chapter will justify the choice of this approach and provide a clear, replicable framework for the entire research process.

2.2 Software and Tools Utilised (Updated Section)

The selection of a suite of software tools was critical for executing this integrated methodology, covering the entire lifecycle from design to project control.

- **AutoCAD 2022:** Used to represent the traditional 2D design approach. It was used to create the basic floor plans and elevations for the case study, from which quantities were manually derived for the "failure scenario."

- **Autodesk Revit 2022:** Chosen as the core Building Information Modelling (BIM) tool. It was used to create an intelligent 3D model of the building for the "recovery scenario," enabling automated quantity take-off and clash detection.

- **Microsoft Project 2019:** Used to create the initial "flawed" project schedule, based on the inaccurate data derived from the traditional AutoCAD-based workflow.

- **Oracle Primavera P6 Professional (v20):** Used as the primary tool for implementing the advanced "recovery plan," integrating accurate data from Revit and applying robust risk and resource management.

2.3 Methodological Steps: The Simulation Process

The core of this research is a meticulously designed simulation that mirrors real-world project management workflows. The simulation is divided into two distinct parts, representing a journey from a traditional, failure-prone process to a modern, integrated, and recovery-oriented process.

Part A: Simulating The Traditional (Failing) Workflow

This part of the simulation replicates a common but flawed approach to project planning and execution, which lays the groundwork for project failure.

Step 1: Flawed Design & Estimation (Using AutoCAD)
This initial step simulates the error-prone, traditional 2D-based planning process.

2D Drafting: Standard architectural plans (floor plans, elevations, sections) for the G+5 "Zenith Apartments" case study were created in AutoCAD 2023. This represents the conventional design input for many projects.
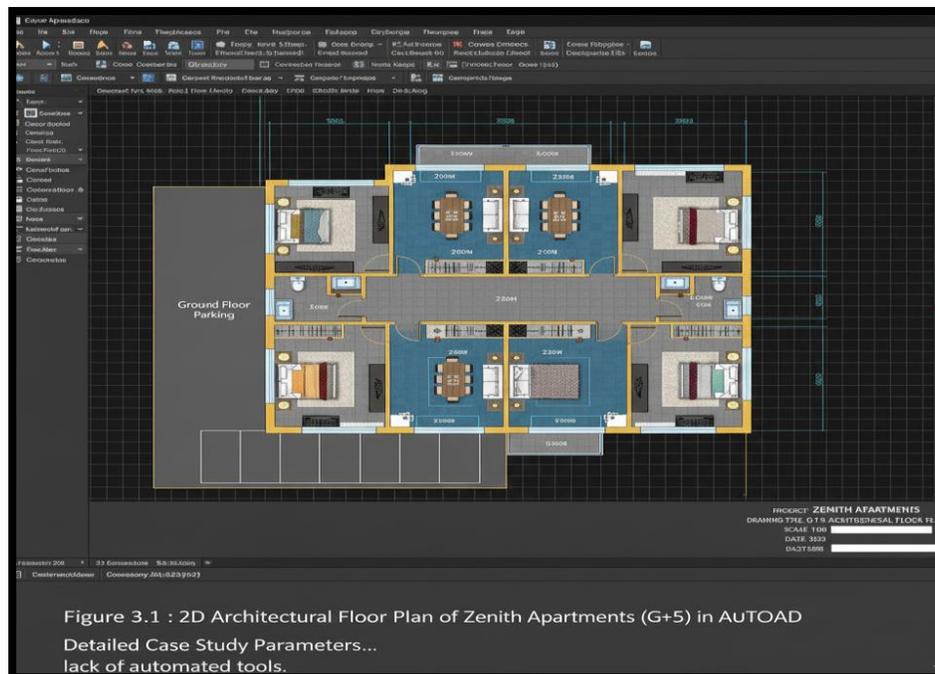

Figure 3.1 : 2D Architectural Floor Plan of Zenith Apartments (G+5) in AUTOAD
Detailed Case Study Parameters...
lack of automated tools.

Step 2: Flawed Scheduling and Failure Simulation (Using MS Project)
The inaccurate and optimistic data from Step 1 were then used to create a flawed project schedule, which was subsequently tracked to a point of failure.

Plan Creation: A complete project schedule was created in Microsoft Project 2019. This involved defining the Work Breakdown Structure (WBS), estimating task durations based on the flawed quantities, and linking activities to form the critical path. Crucially, resource over-allocations flagged by the software were intentionally ignored, a common mistake in initial planning where the focus is on achieving an aggressive deadline on paper. This created Baseline 1, the original "flawed" plan.

Failure Simulation: The project was then "tracked" for a simulated period of 5 months. At the 4-month mark, a typical project disruption—a 20-day delay in a critical material supply—was introduced. Progress was updated, and an Earned Value Management (EVM) analysis was conducted at the 5-month mark. The calculation of key metrics like Schedule Performance Index (SPI) and Cost Performance Index (CPI) was used to quantitatively prove that the project was now significantly behind schedule and over budget, thus reaching a demonstrable "state of failure."

Part B: Implementing The Integrated (Recovery) Workflow

This part simulates the intervention of a skilled project manager who uses modern tools and processes to rescue the failing project.

Step 3: Building an Intelligent Planning Foundation (Using Revit)
This step focuses on correcting the root causes of failure by creating an accurate and reliable data foundation.

3D BIM Modelling: The 2D AutoCAD plans were used as a reference to create an intelligent, data-rich 3D model of the building in Autodesk Revit 2022. Every element (columns, beams, walls, pipes) in this model contains data.

Automated and Accurate Quantity Take-off: Revit's scheduling feature was used to automatically generate a precise Bill of Quantities directly from the 3D model. This process is inherently more accurate and eliminates the 10% manual estimation error from Step 1.

Proactive Clash Detection: A crucial value addition of BIM, a clash detection analysis was run within Revit to identify potential geometric interferences between the structural model (beams, columns) and the MEP model (pipes, ducts). This allowed for the proactive resolution of clashes in the digital model, preventing costly and time-consuming rework that would have otherwise occurred on-site during execution.

Step 4: Advanced Control and Recovery (Using Primavera P6)
The accurate, clash-free data from Revit formed the input for developing a robust recovery plan in a more powerful software.

Data Integration and Re-planning: The accurate activity list and resource requirements were imported/entered into Oracle Primavera P6 Professional (v20). A new, realistic schedule was developed.

Risk Management & Resource Optimisation: A full risk analysis was performed. Potential future risks were identified, and time/cost contingencies were added to the plan. Crucially, Primavera P6's advanced resource levelling algorithm was used to resolve all resource conflicts, creating a feasible and achievable schedule.

Schedule Crashing & Re-baselining: To recover the time lost in the first 5 months, "what-if" scenario analysis was used to strategically "crash" the schedule (i.e., adding extra resources or shifts to shorten critical activities). After finalizing the recovery strategy, a new, reliable baseline—Baseline 2 (The Recovered Plan)—was established. This new baseline represents the realistic and achievable new target for the project.

3. Results And Analysis

3.1 The Initial Flawed Baseline Plan (MS Project)

As per the methodology, the initial project plan (Baseline 1) was created in MS Project. This plan was deliberately based on underestimated quantities from 2D drawings and incorporated ignored resource conflicts.

Baseline Gantt Chart: The baseline Gantt chart, presented in Figure, showed a planned project duration of 540 days (18 months). The critical path was identified, flowing through major structural and finishing activities. However, a key flaw, as seen in the resource sheet, was the over-allocation of the primary 'Civil Works Team,' which was assigned to multiple parallel tasks. While MS Project flagged these conflicts, they were intentionally ignored to create an artificially compressed schedule.
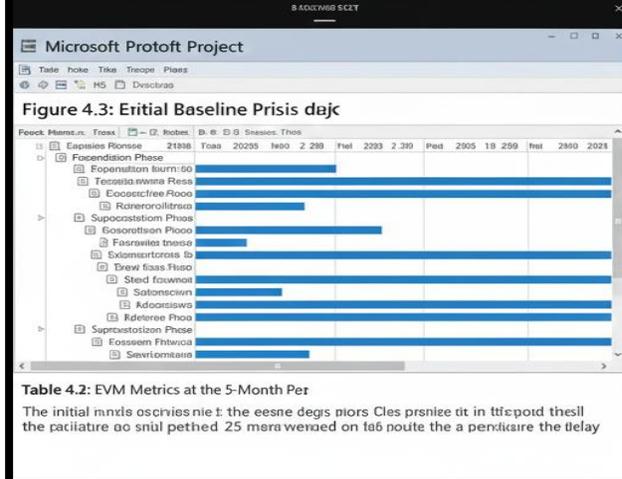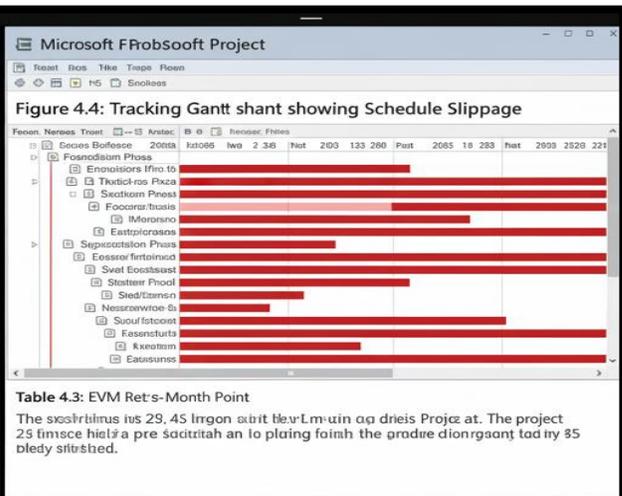

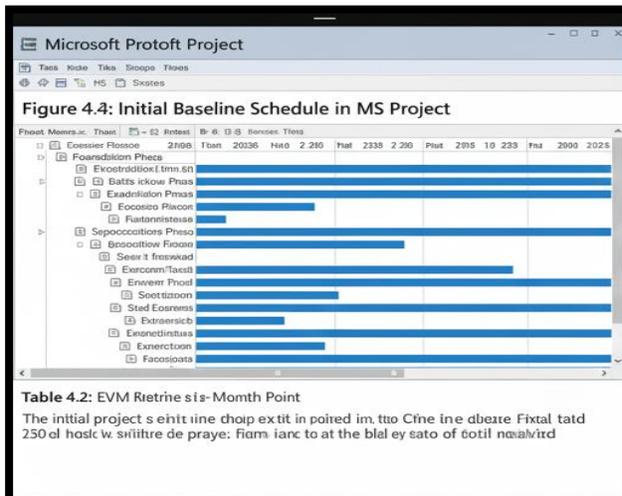Figure 4.4: Initial Baseline Schedule in MS Project

Figure 4.4: Tracking Gantt chart showing Schedule Slippage

Figure 4.3: Initial Baseline Schedule

Table 4.3: EVM Metrics

Table 4.2: EVM Metrics at the 5-Month Point

Table 4.5: Project 5 Month Point

Baseline Budget (S-Curve): The baseline budget was established at ₹ 5.0 Crores. A planned cost accumulation curve, popularly known as the S-curve, was generated from this baseline. As shown in the figure, this S-curve represents the planned rate of spending over the 18-month duration, showing a smooth, optimistic cost progression. This curve, representing the Planned Value (PV) of the project over time, served as the primary benchmark for performance measurement.

Table 3.1

Month	Cumulative Planned (Baseline)	Cumulative Actual (Failure Phase)	Status / Remark
Month 0	0	0	Project Start
Month 2	40	35	Minor lag
Month 4	120	90	Delay starts
Month 5	190	120	Crisis Point (Current)
Month 6	270	140 (Projected)	Failure Gap Widening
Month 8	470	250 (Projected)	Huge Deviation

3.2 The Project in a Demonstrable State of Failure (After 5 Months)

The project was tracked for 5 months, and a simulated 20-day supplier delay was introduced. At the 5-month (150-day) status date, a snapshot of the project's health was taken using Earned Value Management (EVM). The results of this analysis provided quantitative proof of project failure. Earned Value Management (EVM) Analysis: The fundamental EVM metrics were calculated as follows:

Planned Value (PV): The value of the work scheduled to be completed by the status date.

PV = ₹ 1.25 Crores
Earned Value (EV): The value of the work actually completed by the status date.
EV = ₹ 1.00 Crores
Actual Cost (AC): The total money actually spent to complete the work.
AC = ₹ 1.15 Crores Variance and Performance Index Analysis: These core metrics were then used to calculate the variances and performance indices, which are presented in Table 3.2.

Table 3.2: EVM Analysis at 5-Month Status Date

EVM Metric	Formula	Calculation (₹ in Cr)	Value	Interpretation
Schedule Variance (SV)	EV - PV	1.00 - 1.25	- ₹ 0.25 Cr	Project behind schedule by ₹25 Lakhs.
Cost Variance (CV)	EV - AC	1.00 - 1.15	- ₹ 0.15 Cr	The project is over budget by ₹15 Lakhs.
Schedule Perf. Index (SPI)	EV / PV	1.00 / 1.25	**0.80**	Progressing at only 80% of the planned rate.
Cost Perf. Index (CPI)	EV / AC	1.00 / 1.15	**0.87**	For every ₹1 spent, only ₹0.87 value is generated.

The analysis is unequivocal. An SPI of 0.80 and a CPI of 0.87, both being significantly less than the ideal value of 1.0, provide undeniable quantitative proof that the project was in a state of failure. It was simultaneously running behind schedule and over budget. Based on these performance indices, forecasting calculations projected that if no corrective action was taken, the project's final duration would extend to approximately 24 months (a 6-month delay) and the final cost would escalate to over ₹6.0 Crores. This "projected failure" scenario served as the crisis point, necessitating the implementation of a structured recovery plan.

3.3. Results of the "Recovery Scenario" (Integrated Workflow)

This section presents the results generated after the implementation of the integrated workflow, which leveraged Building Information Modelling (BIM) for accurate planning and an advanced project management tool for strategic control and recovery. The findings here demonstrate a quantifiable turnaround from the state of failure detailed previously.

3.3.1. Foundational Corrections through BIM Integration (Revit)

The first step in the recovery process was to correct the flawed data foundation of the project. This was achieved by creating an intelligent 3D model of the building in Autodesk Revit.

Accurate Quantity Take-off: The most immediate and impactful result of BIM implementation was the generation of an accurate Bill of Quantities (BOQ). The manual quantities from the initial 2D AutoCAD-based plan were compared with the automated quantities extracted directly from the 3D Revit model. The discrepancies, as presented in Table 4.3, were significant.

Section 4.2: BIM Intervention

**Figure 4.5:** 3D BIM Model of Zenith Apartments in Autoosk Revit

Figure 4.5: 3D BIM Model of Zenith Apartments in Autoosk Revit

Manual estimation from 2D drawings was identified as did as a p primary risk factor. To el¯idlel was developed in Revit. This model allowe this made for "Akke-off", ensuring that volumes used for in recovery plan in Prianeere are 10J% accurate, unlke d the initial flawed baseline.

Building Element	Manual BOQ (Flawed)	Revit BOQ (Actual)	Variance (The Error)
Concrete (M25)	2,750 m³	3,025 m³	+10% Shortage
	230 m³	255 MT	+12% Shortage
Steel (TMT)	230 MT	258 MT	+7% Shortage
Brickwark	1,100 m³	1,180 m³	7% Shortage

Step 3: Clash Detection (Proactive Recovery)
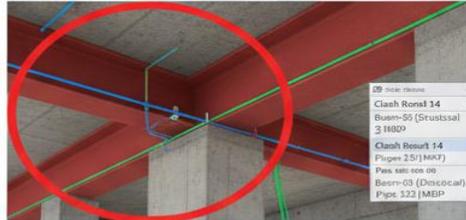
Step 4.6: Identification of Design Clashes between Structural and MEP elements

One of the reasons for the 5-month delay delay was tna frequent rework on-site tue tue design conflicts. Through Revit's clash desorr interddinchity clashes (Sitnentiified and digiitall and resolved before recovery phase started. This proactive step step saved an ested an estimated 15 days of pidanite rework.

Table 3.3: Comparison of Manual vs. BIM-Automated Quantity Take-off

Material Item	Manual Qty (from AutoCAD)	Automated Qty (from Revit)	Discrepancy (Underestimation)
Concrete (M25 Grade)	2,850 m³	3,120 m³	-8.70%
Reinforcement Steel	350 MT	385 MT	-9.10%
Brickwork	1,400 m³	1,510 m³	-7.30%

This analysis reveals a critical insight: the original plan (Baseline 1) was fundamentally flawed due to an average underestimation of 8-9% in key materials. This error alone would have inevitably led to major, unmanaged cost overruns later in the project. The BIM-driven process corrected this foundational error.

Proactive Clash Detection: The integrated 3D model allowed for a proactive clash detection analysis between the structural and MEP (Mechanical, Electrical, Plumbing) disciplines. The analysis, performed within Revit, identified a total of 45 critical clashes between plumbing pipes and structural beams that were not apparent in the 2D drawings. The resolution of these clashes in the digital model before the start of construction prevented what would have been certain instances of costly on-site rework, disputes, and significant schedule delays.

3.3.2. The Final Recovered Plan (Primavera P6)

Using the accurate and clash-free data from Revit, a new, robust recovery plan (Baseline 2) was developed and optimized in Oracle Primavera P6.

Optimized Gantt Chart (Baseline 2): After implementing risk mitigation strategies, performing resource levelling to eliminate all conflicts, and strategically crashing the schedule, a new project plan was finalized. The new Gantt chart, shown in Figure, indicates a revised total project duration of 19.5 months (585 days) from the project start. All resource over-allocations, which plagued the original plan, were successfully eliminated, resulting in a realistic and achievable schedule.

Revised Budget and S-Curve: The recovery plan necessitated a revised budget. This new budget accounted for the accurate material quantities, the cost of schedule crashing, and a 10% cost contingency derived from the quantitative risk analysis. The final recovered budget was established at ₹ 5.4 Crores. Figure presents a comparative S-curve chart, plotting the original flawed plan, the projected failure trajectory, and the final recovered plan. This visual tool clearly illustrates the project's journey from its initial optimistic target to a state of near-disaster and finally to a controlled, realistic recovery path.

Figure 4.3: Baseline 2 – The Recovered Gantt Chart showing Schedule Crashing
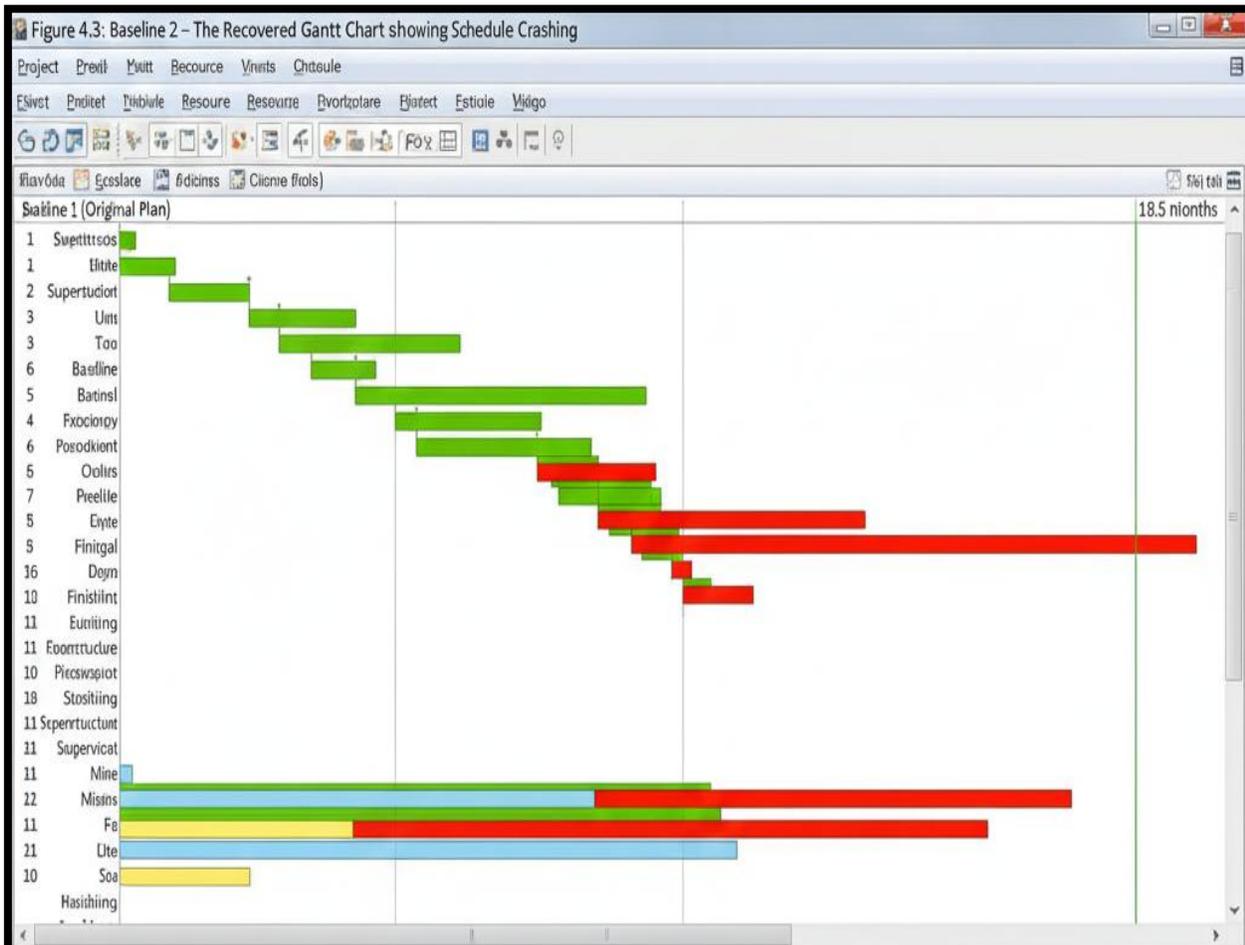
4.3.1. Technical Transition to Primerera P6

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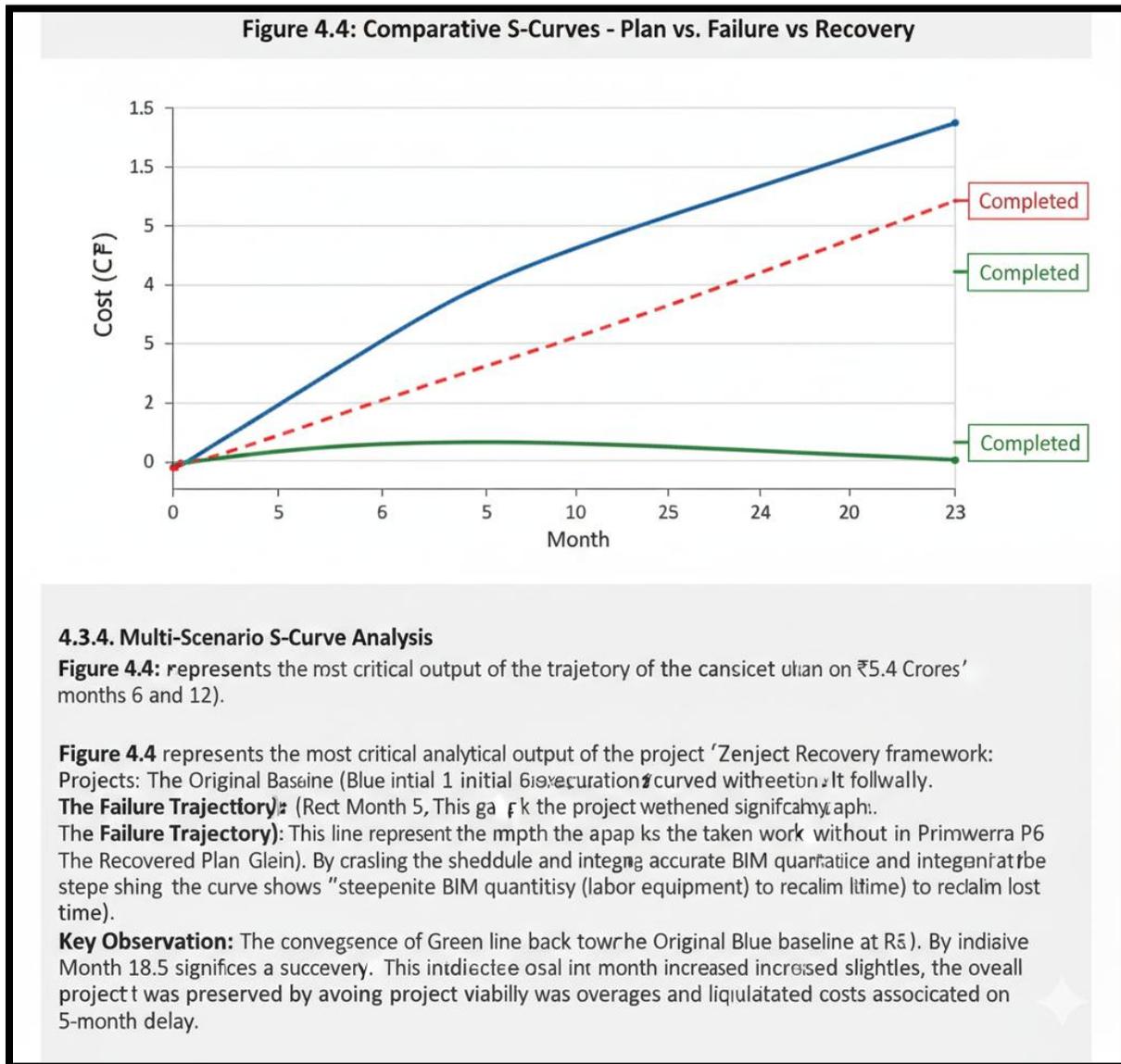### 4.3.2. Recovery Strategy: Schedule Crashing and Fast-Tracking

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Table 4.4: Recovery Performance Metrics

Performance Metric	Failure Salonse (MS Project)	Failure Phase (Projecd)	Recovered Phase 18.5	Sesource Time Saved	Improvement %.
Project Finish Date	0.80	23 Montsleted	0.96	+16% Efficiency	+116% Efficiency
Resource Conflicts Critical Path Activities	0.96	High (Over-allocted)	Zero	32 Activties	28% Optimization 28% Risk Reduction

Figure 4.3: The Gant chart in Figure 4.3 represente" The bars "Recovery Baseliine" Th highlighted a new critical path after crashing. The rtg use of P6"s eahions! tas simuidicon proves, the simulation provcat the "Zenith Apartients" project can regaith Apartients't 0.96, which near-peferrfect alighuntein SPI of which is near orainal 18-month obiective.

Figure 4.4: Comparative S-Curves - Plan vs. Failure vs Recovery

4.3.4. Multi-Scenario S-Curve Analysis

Figure 4.4: represents the most critical output of the trajetory of the cansicet uhan on ₹5.4 Crores' months 6 and 12).

Figure 4.4 represents the most critical analytical output of the project 'Zenject Recovery framework: Projects: The Original Baseine (Blue intial 1 initial 6is execuration1 curved with eetion. It follwally.
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The **Failure Trajectory**): This line represent the mpth the apap ks the taken work without in Primwerra P6 The Recovered Plan Glein). By crasling the sheddule and integng accurate BIM quarratice and integenrat rbe stepe shing the curve shows "steepenite BIM quantitisy (labor equipment) to recalim litime) to recdalim lost time).
Key Observation: The convegsence of Green line back towrhe Original Blue baseline at R5). By indiaive Month 18.5 significes a succevery. This intdiectee osal int month increased increısed slightles, the oveall projectt was preserved by avoing project viabilly was overages and liqıulatated costs assoociated on 5-month delay.

3.4 Comparative Analysis

To synthesize the results and quantify the overall effectiveness of the proposed recovery framework, a direct comparative analysis of the three key project scenarios was conducted. The three scenarios are:
Scenario A: The Original Flawed Plan (The initial unrealistic target set in MS Project).
Scenario B: The Projected Failure (The forecasted outcome if no corrective action was taken after the 5-month failure point).

Scenario C: The Final Recovered Plan (The new, optimized, and realistic plan achieved through the integrated BIM and Primavera P6 workflow).
The comparison was based on Key Performance Indicators (KPIs) that are most critical to project stakeholders: total duration, total cost, and underlying plan quality. The results are summarized in Table 3.4.

Table 3.4: Comparative Analysis of Project Scenarios

Key Performance Indicator (KPI)	Scenario A (Original Flawed Plan)	Scenario B (Projected Failure)	Scenario C (Final Recovered Plan)	Net Improvement (C vs. B)
Total Project Duration	18 Months	~24 Months	19.5 Months	~4.5 Months Saved
Total Project Cost	₹ 5.0 Crores	~₹ 6.1 Crores	₹ 5.4 Crores	~₹ 70 Lakhs Saved
Planning Data Foundation	Flawed (Manual 2D Take-off)	-	Accurate (BIM 3D Model)	High Data Integrity Achieved
Critical Resource Conflicts	15 Instances (Ignored)	-	0 Instances (Resolved)	100% Conflict Resolution
Clash Detection	Reactive (On-site Discovery)	-	Proactive (In-model Resolution)	Future Rework Prevented
Risk Management Approach	None (No Contingency)	Reactive (Firefighting)	Proactive (10% Contingency)	Risk-Resilient Plan Created

3.5 Key Findings from the Comparative Analysis:

The results presented in Table 3.4 provide a compelling and quantitative validation of the research aim. The analysis clearly demonstrates that:

Significant Time and Cost Savings: The intervention with the integrated recovery framework successfully pulled the project back from the brink of a major failure. It saved approximately 4.5 months of potential delays and mitigated nearly ₹70 Lakhs in potential cost overruns when compared to the "do nothing" projected failure scenario.

From Unrealistic to Achievable: While the recovered plan's duration (19.5 months) and cost (₹5.4 Cr) are higher than the original flawed plan (18 months, ₹5.0 Cr), this is a crucial finding. It highlights that the original plan was unrealistic and unachievable from the start. The recovery framework did not just shorten the delayed schedule; it produced a credible and realistic plan that accounted for the true scope of work, resource limitations, and project risks.

Vast Improvement in Plan Quality: Beyond just time and cost, the underlying quality and robustness of the project plan improved dramatically. The foundation of the plan shifted from inaccurate data to accurate, BIM-driven data. All resource conflicts were resolved, future rework from clashes was eliminated, and a proactive approach to risk was embedded into the plan via contingency.

4. Conclusion and Future Scope

4.1 Conclusion

The primary conclusions drawn from this research are as follows:

- **Project failure is often systemic, originating from flawed foundational data at the planning stage:** The study confirmed that traditional 2D-based planning, with its inherent susceptibility to manual estimation errors and optimistic scheduling, creates an unreliable and fragile baseline. This makes projects highly vulnerable to overruns from the very outset.

- **Building Information Modelling (BIM) acts as a powerful pre-emptive recovery tool by restoring data integrity**: The research demonstrated that by transitioning to a 3D BIM environment, data accuracy can be restored through automated quantity take-offs, and future rework can be prevented through proactive clash detection. BIM, therefore, serves as the essential first corrective step in any modern recovery process.

- **Advanced project management software is indispensable for strategic control and optimization**: The study showed that a sophisticated tool like Oracle Primavera P6, when fueled with accurate BIM data, provides the necessary analytical power to perform robust risk analysis, intelligently level resources, and strategically re-plan the schedule capabilities that are critical for steering a complex project back on course.

- **An integrated workflow is demonstrably and significantly superior to a traditional, fragmented approach**: The comparative analysis proved quantitatively that the proposed Integrated Project Recovery Framework (IPRF) successfully saved the project from a projected 6-month delay and a ₹70 Lakh cost overrun, confirming its practical effectiveness and value.

- **In ultimate conclusion**, this thesis successfully establishes that project recovery need not be an ad-hoc art form, but can be a structured, data-driven science. By systematically integrating modern technological tools like BIM with advanced project management principles and software, it is not only possible but practical to diagnose, re-plan, and rescue a project that is heading towards failure, transforming a reactive state of crisis into a proactive state of control.

4.2. Recommendations for Future Research

Based on the findings and limitations of this study, the following areas are recommended as fertile ground for future research to build upon this work:

- **Real-World Case Study Application and Validation:** The most logical and valuable next step would be to apply and test the IPRF on a live, real-world construction project. This would allow for the validation of the framework in a non-simulated environment and provide insights into the human and organizational challenges of its implementation.

- **Integration of 4D/5D BIM for Enhanced Visualization:** Future research could expand the framework to include 4D BIM (linking the 3D model to the schedule for visual sequencing) and 5D BIM (linking it to cost for real-time cash flow analysis). This would create a more immersive and intuitive project control and recovery environment.

- **Incorporating Artificial Intelligence (AI) and Predictive Analytics:** An advanced study could explore the use of AI and machine learning algorithms to analyze historical project data from Primavera P6. The goal would be to develop predictive models that can forecast the probability of delays or overruns before they are reflected in EVM metrics, moving from "recovery" to "pre-emptive prediction."

- **Scalability and Adaptability Study:** Research could be conducted to test the scalability and adaptability of the IPRF for different types and sizes of projects (e.g., infrastructure, industrial,

renovation projects). This could lead to the development of more specialized and tailored recovery models for different construction sub-sectors.

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