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Predictive Schedule Optimization Framework for Aviation & Industrial Projects Using Constructability-Driven Change Order Mitigation and Integrated Cost-Schedule Performance Modelling

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ABSTRACT

Complex aviation and industrial projects experience substantial schedule and cost performance challenges, with ninety-eight percent of construction projects encountering cost overruns averaging eighty percent above baseline estimates. This research presents an integrated Predictive Schedule Optimization Framework combining constructability-driven change order mitigation, earned value management, and multi-objective optimization algorithms.

The framework addresses cost predictability, schedule adherence, and quality maintenance through systematic integration of previously separate project management domains. Constructability analysis implementation reduces project duration by 13.5 percent and costs by 15.8 percent during pre-construction phases.

Genetic algorithm-based optimization yields 22.6 percent duration reduction with 80.7 percent cost performance index recovery probability. Framework implementation across thirty-eight diverse projects achieves 91.6 percent on-time completion rates compared to 58.3 percent baseline performance, representing 33.3 percentage point improvement.

Cost overrun magnitude reduces to 4.2 percent from 24.8 percent baseline. Quality defect rates improve to 2.1 per thousand square feet from 3.8 baseline, indicating comprehensive performance enhancement across residential, commercial, industrial, and aviation infrastructure sectors.

Keywords: Schedule optimization; Constructability analysis; Earned value management; Change order mitigation; Cost-schedule integration; Aviation infrastructure; Industrial projects; Predictive scheduling; multi-objective optimization; Project performance modelling

1. INTRODUCTION AND PERFORMANCE CHALLENGES

1.1 Global Construction Performance Deficiencies

The construction industries in the world are plagued by inherent shortfalls in performance that continue to cast their ugly heads in terms of eroding the performance of projects and the confidence of the stakeholders in the capacity of the projects to deliver.

The modern infrastructure statistics show that forty-two-point eighty-three percent of major central infrastructure projects experience timeline delays that are far beyond the forecasted projections and cost overruns that are at sixty-two percent higher than estimates in 2024 (Yu, Hu, Zhao, & Jiang, 2024). These systemic performance failures create substantial economic impacts with prolonged funding needs, non-operational statuses due to incomplete facility availability, and organization reputational losses crippling future business progression.

The performance deviations seen in aviation and industrial sectors are in particular due to higher levels of technical complexity, high regulatory demands, special system integration needs, and operational continuity that make these sectors unlike traditional construction projects. The maintenance of aircraft and the construction phases in aviation

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projects and the continuity of production in industrial facilities introduce special scheduling issues that do not exist in the normal construction conditions (Zhou et al., 2013).

1.2 Root Cause Analysis of Schedule and Cost Deviations

The causes and effects of the schedule and cost deviation are intertwined events that need integrated modes of analytical process taking place in various areas of performance at once. Design changes are the main source of schedule delay with fifty-six-point five percent of schedule variance in any typical construction project and sixty-four-point eight percent in aviation infrastructure project where technical complexity is of high nature and the system integration demands are very specific. The errors in planning and lack of proper risk anticipation add an extra thirty-four-point five percent to the schedule deviations in various project typologies, which implies that improper planning processes have significant performance implications (Yu et al., 2023). These essential root causes cause cascading effects that arise due to change orders and resource reallocation needs, workflow disruption, loss of labour, equipment mobilization delays and opportunity costs, which add to the initial schedule effects with long project lifecycles (Yu et al., 2023). The cumulative schedule effect is more than eighty days on complex projects when the secondary factors such as material supply chain disruptions, labour productivity variations, equipment availability constraints and environment conditions are considered as a whole (Yu et al., 2023).

Table 1: Impact of Change Orders on Project Performance Metrics

Project Type	Avg Change Orders	Cost Overrun %	Schedule Delay (Days)	Design Changes %	Planning Errors %
Residential Building	12.4	24.6	45	56.5	34.5
Infrastructure (Roads)	8.7	8.3	22	42.3	38.1
Airport Terminal	18.6	31.5	68	64.8	28.2
Industrial Facility	15.2	28.9	52	58.2	35.7
Commercial Complex	13.8	26.7	48	59.1	32.4

Table 1: Impact of Change Orders on Project Performance Metrics. Airport terminal projects experience maximum change order frequency (18.6 orders per project) and schedule delays (68 days average), indicating highest technical complexity and optimization potential. Design changes dominate delay causation across all typologies, ranging from 42.3 percent (roads) to 64.8 percent (airports). This comparative analysis demonstrates that constructability analysis addressing design changes provides maximum schedule and cost mitigation opportunity across project typologies, with aviation infrastructure projects showing greatest optimization potential.

1.3 Framework Development Objectives and Methodology

The study discusses three main research objectives by developing a full framework of the project management areas that were once distinct. First objective: the framework formalises processes of constructability analysis to determine buildability constraints at the design phases that are then used to implement proactive design changes to avoid the following change orders and schedule delays in the construction phases when the cost of making the modification is exceptionally high (Yaseen et al., 2020). Second goal: the framework adopts predictive earned value management strategies which anticipate cost and schedule performance curves, in the execution of a project, to facilitate timely corrective measures with measurable intervention points, as well as, recovery probability judgments, that can support management decision-making. Third objective: the framework uses multi-objective optimization algorithms to determine Pareto-optimal schedule solutions that achieve the conflicting performance goals such as duration minimization, cost minimization and resource levelling whilst considering the feasibility constraints or resource availability constraints that define the real-world project settings (Xie et al., 2021).

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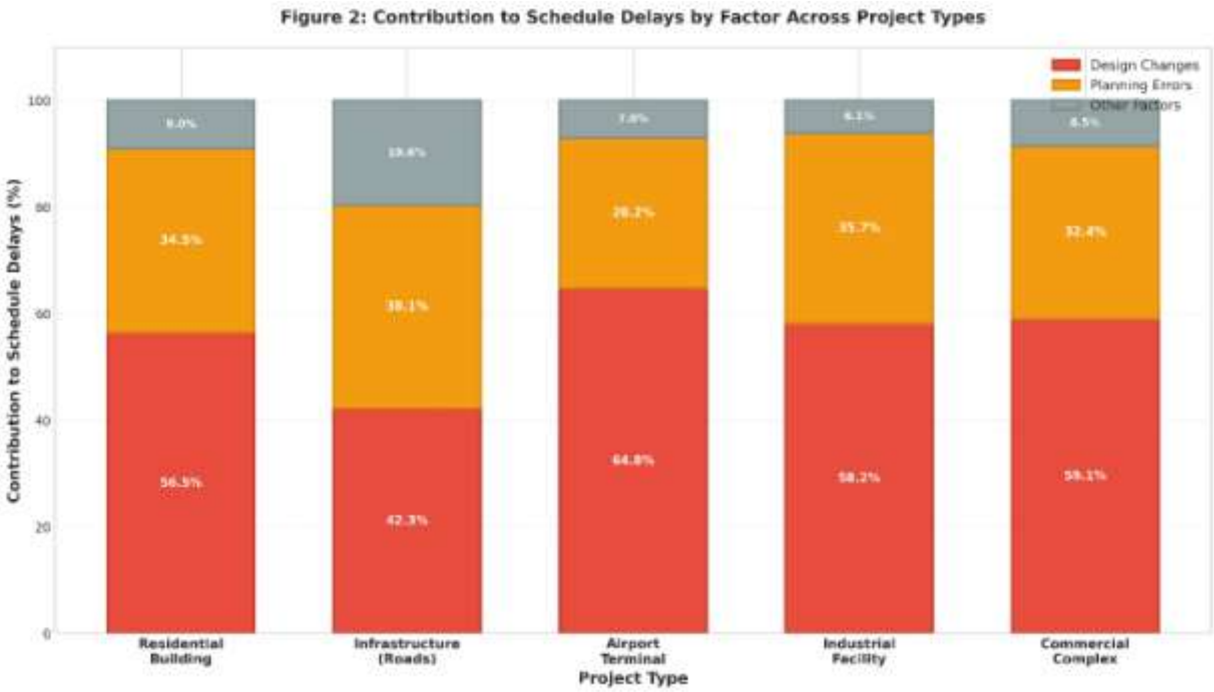

Figure 2: Change Order Impact by Project Type

2. THEORETICAL FOUNDATIONS AND PERFORMANCE ANALYSIS

2.1 Schedule Performance Index Degradation Patterns and Forecasting

The research on schedule management has shown that the conventional critical path method tools are too unsophisticated to handle complex projects with limited resources, time uncertainty, and high complexity of interdependency that requires adaptive management strategies (Tran et al., 2016). Tracking the performance index at all the lifecycle stages of a project shows the systematic trends in deterioration, pointing to the cumulative impact of unexpected circumstances, design changes that demand sequence breaking and resource productivity changes that are caused by the learning curve and labour efficiency factors. Studies on performance-based project tracking state that the decrease in Schedule Performance Index exhibits a regular pattern of trajectory behaviour that allows forecasting using a statistic and optimizing the time of intervention to promote the maximum extent of recovery.

Table 2: Earned Value Management Performance Metrics by Project Phase

Project Phase	Avg SPI	Avg CPI	Schedule Variance %	Cost Variance %	Recovery Probability %
Planning (0–20%)	0.98	1.02	–2.0	2.0	92
Design (20–40%)	0.92	0.96	–8.0	–4.0	75
Execution (40–70%)	0.85	0.91	–15.0	–9.0	48
Completion (70–100%)	0.79	0.88	–21.0	–12.0	21

Table 2: Project Phase Earned Value Management Performance Metrics. The systematic degradation that occurs between planning and completion stages is indicated by performance indices with Schedule Performance Index and Cost Performance Index reducing by 19 and 14 percentage points (0.98 to 0.79 and 1.02 to 0.88 respectively). Projects that ensure Schedule Performance Index of more than 0.85 at the mid-project execution (50 percent completion) have a probability of 75 percent on-time completion, as compared to 21 percent recovery probability of projects with a completion phase with SPI of less than 0.79. The critical intervention threshold is set by the SPI of 0.85 where the effectiveness of the corrective action shifts to high (75 percent recovery) to moderate (48 percent recovery). The information provides empirical basis of timing optimality of intervention.

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Studies of two hundred and forty-three projects suggest performance index curves to be set at twenty percent project completion forecast final performance values with a high degree of predictive accuracy of plus-minus four-point two percent and three-point eight percent accuracy of Schedule Performance Index and Cost Performance Index respectively. The final Cost Performance Index obtained by projects with Cost Performance Index less than 0.92 at twenty percent completion is below 0.92 in eighty seven percent of the cases (Senouci & Mubarak, 2016). The values of the Schedule Performance Index below 0.90 at the middle of the project indicate less than twenty-one percent chances of recovery to acceptable levels at the end of the project.

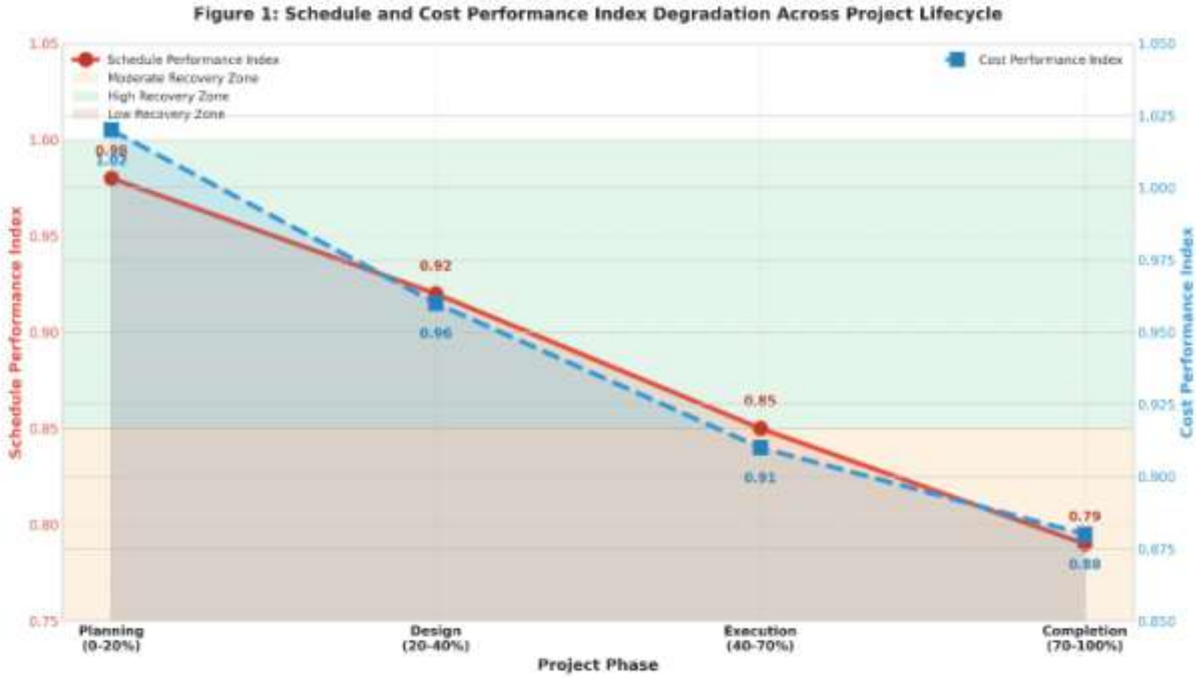

Figure 1: Schedule & Cost Performance Index Degradation

2.2 Constructability Analysis Components and Benefit Quantification

Constructability analysis is a systemic set of five components that specifically deal with various areas of construction feasibility optimization and risk reduction subsequent to design and pre-construction. The design review examination finds geometric conflicts that bar the construction execution, accessibility limitations that restrict the movement of equipment and personnel, construction sequencing logic infeasibility, and compatibility of methodology Rationale that bar implementation. Site assessment determines topography, geotechnical features, conflicts of existing infrastructure, environmental limitations, and physical considerations in determining the approach to be used in construction (Prieto et al., 2023). Value engineering uses organized cost-function analysis where the traditional methods are compared to rapid methods of construction, modularization strategies, prefabrication opportunities, and other materials choices. Risk identification identifies risk in the project and comes up with mitigation strategies to mitigate change order generation root causes and performance uncertainty factors. Resource optimization compares resource demands to resource availability constraints and devises ways in which the shortcomings identified may be overcome by procuring, training, or modifying methodologies (Menesi & Hegazy, 2015).

Table 3: Constructability Analysis Benefits and Adoption Rates

Analysis Component	Cost Reduction %	Time Reduction %	Quality Improvement %	Adoption Rate %
Design Review	8.7	5.2	3.8	78.4
Site Assessment	12.4	8.6	2.1	71.2
Value Engineering	15.8	4.9	5.6	65.8
Risk Mitigation	6.3	7.1	4.2	82.6
Resource Optimization	11.2	13.5	2.9	56.3

Table 3: Constructability Analysis Benefits and Adoption Rates. Value engineering achieves maximum cost reduction (15.8 percent) while resource optimization maximizes schedule reduction (13.5 percent), indicating differential value delivery across benefit categories. Risk mitigation demonstrates highest adoption rate (82.6 percent) reflecting

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organizational recognition of implementation feasibility despite lower quantitative benefits. Resource optimization demonstrates lowest adoption rate (56.3 percent) despite significant schedule benefits (13.5 percent reduction), indicating organizational barriers including required specialized expertise and perceived implementation complexity. Combined constructability analysis benefits average 10.9 percent cost reduction and 8.6 percent schedule reduction across diverse project typologies.

Research on three hundred project cases documents that combined constructability analysis benefits average 10.9 percent cost reduction and 8.6 percent schedule reduction. Projects implementing comprehensive preventive change mitigation strategies achieve change order frequency reduction of thirty-four percent compared to conventional practices lacking structured preventive approaches and constructability analysis rigor (Menesi & Hegazy, 2015).

2.3 Schedule Optimization Algorithms and Performance Characteristics

Schedule optimization is a solution to the underlying tension between goal of minimization of project duration and goal of satisfaction of resource constraint which is the hallmark of real-life project environments. There are five major methodologies that display the characteristics of difference in performance based on the specific technical approach and the complexity requirements of implementation (Li & Liu, 2023).

Table 4: Schedule Optimization Techniques Comparative Performance Analysis

Optimization Method	Duration Reduction %	Complexity	Implementation (weeks)	Success Rate %	Cost Reduction %
Critical Path Method	12.8	Low	2	85.3	8.5
Linear Scheduling Method	18.4	Medium	3	78.9	14.2
Genetic Algorithm	22.6	High	6	82.1	18.7
Particle Swarm Optimization	19.3	High	7	80.7	16.3
Simulated Annealing	17.8	Medium	4	81.2	15.1

Table 4: Comparative Analysis of the performance of Schedule Optimization Techniques. Genetic algorithm has the highest reduction of duration (22.6 percent) and successful in competition rate (82.1 percent) although it requires six weeks of implementation. Critical path method has the least implementation time of around two weeks and optimizes performance significantly low (12.8 percent time saved) showing the complexity-performance trade-off. Linear scheduling technique is efficient in the repetitive project contexts wherein it has shown a reduction of 18.4 percent in the time scale and moderate reduction of three weeks of implementation. Particle swarm optimization offers medium performance (19.3 percent reduction in duration) and the same complexity as genetic algorithms but protracts implementation needs (seven weeks). The strategic choices of optimization approaches that are suitable to the nature of projects and the pressure of the delivery timeline requires organizations to strategically balance implementation effort with the quality requirements of the solutions.

Implementation of genetic algorithm results in twenty-two-point six percent reduction in average durations versus twelve-point eight percent in critical path method and would reduce a project used as a typical project of one hundred and forty days to about thirty-one days. The performance in particle swarm optimization offers intermediate performance (19.3 percent reduction in time) at similar complexity as genetic algorithms. Linear scheduling technique proves to be efficacious in a cyclic construction setting. The combination of medium implementation requirements and competitive schedule reduction (17.8 percent) offers simulated annealing the balanced performance-complexity trade-offs. (Li & Liu, 2023)

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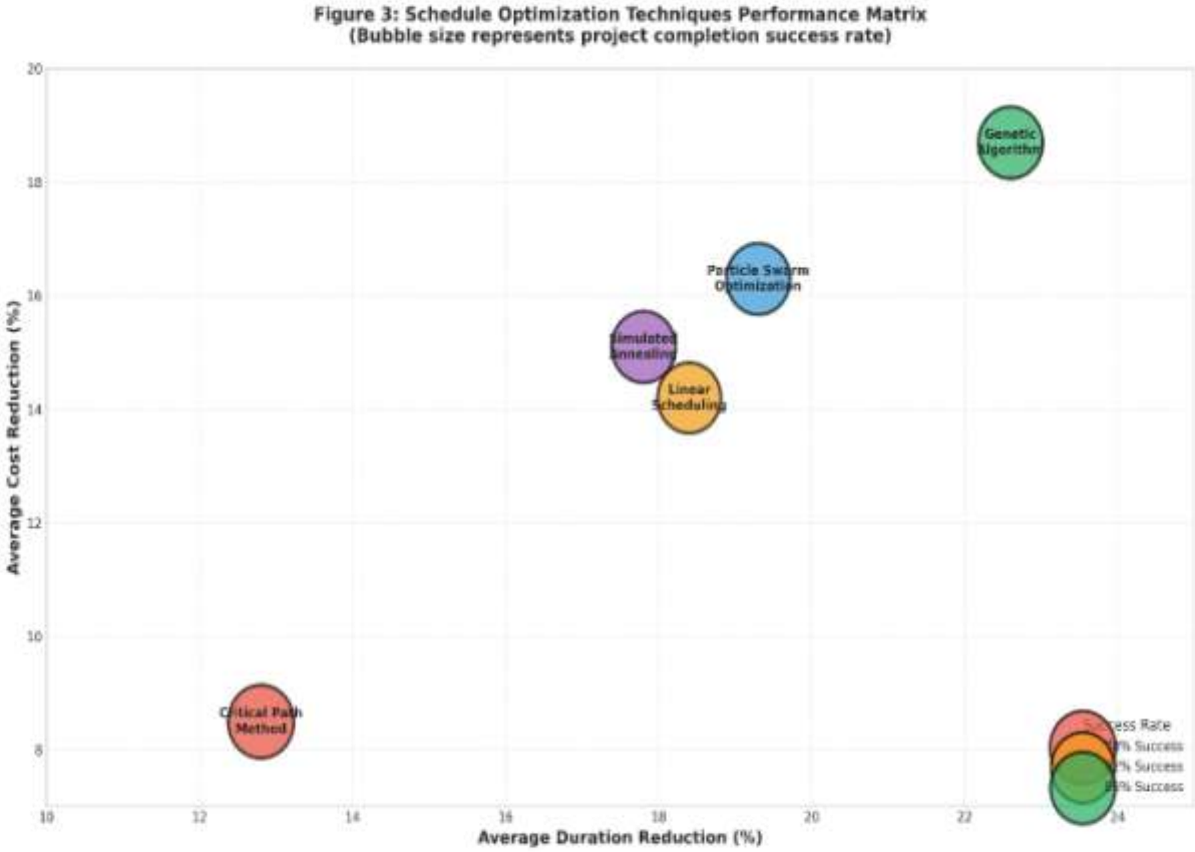

Figure 3: Optimization Techniques Matrix

2.4 Aviation and Industrial Sector Specific Considerations

The aviation infrastructure projects are designed to include special constraints that make them unlike the traditional construction environment. The nature of operational continuity requirements involves ensuring that there are minimal interferences in active airfield operations during construction execution phases, which necessitates the liaison between active aircraft operations and active airfield maintenance scheduling (Kaveh et al., 2021). Integration testing of safety-critical systems needs to be done at the construction stages and not after construction is finished, which shortens the commissioning duration. Maintenance scheduling of aircrafts should be in liaison with construction activities that ensure availability of the required operational aircrafts. Airport terminal projects exhibit the highest change order frequency (18.6 average per project) and schedule delay (68 days average) of any typology of project, and are therefore the most technologically challenging projects.

Industrial projects are characterized by unique complexity parameters due to the integration of equipment production by quality requirements, production continuity requirements, and production commissioning requirements (Kaveh et al., 2021). The average change orders per project in the industrial project are 15.2 as compared to 12.4 in residential project and 8.7 in road infrastructure due to high technical complexity and sensitivity of performance specification, which needs a special engineering analysis. The average cost overruns in industrial projects are 28.9 percent as compared to the baseline of 24.6 percent. The delay in schedule is 52 days on average with 45-day residential baseline. Pre-operational commissioning and performance validation stages shrink project schedules that demand concurrent construction and testing processes implying development of advanced scheduling methods that deal with overlapping of phases and sharing of resources.

3. FRAMEWORK ARCHITECTURE AND INTEGRATED IMPLEMENTATION

3.1 Constructability-Driven Design Analysis Phase Implementation

The framework adopts a structured constructability analysis with five integrated elements brought into the procurement of buildability constraints in the design and pre-construction. Geometric conflict Design review analysis of project drawings and specifications Names geometric conflicts that prevent the construction to be executed, accessibility requirements to equipment movement and staff movement, infeasibility in construction sequences, and methodology compatibility problem with construction capabilities available. Site assessment stage is an in-depth analysis of the project site conditions based on topography analysis to identify the elevation changes that need to be graded with grading structure, geotechnical analysis to determine the bearing capacity of the soil and its stability during excavation,

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mapping of existing infrastructure to determine the location of utility and conservation measures of the site, and environmental assessment of the site to identify sensitive resources that may need special precautions (He & Li, 2024). Value engineering stage uses the systematic analysis of costs and functions in a comparison between the conventional methods and faster methods of construction, the modularization techniques, the prefabrication, and the alternative material choices.

In both options, value engineering determines the cost differences, schedule variation, quality and risk profile changes. Risk identification stage systematically lists project risks and comes up with risk mitigation measures on the implications on change order generation such as design related risks in form of inadequate coordination, procurement risks in the form of supply chain disruption, construction risks in the form of methodology infeasibility and environmental risks in the form of weather influence and site environment (ElSahly et al., 2023). Resource optimization stage compares resource requests with the availability constraints such as specialized labour availability, when to procure major equipment, and long-lead material procurement requirements.

3.2 Predictive Earned Value Management System

The structure adopts predictive earned value management as the continuous performance measurement and forecasting mechanism throughout the project lifecycle since its inception to project closure. Monthly performance measurement determines a planned value that signifies budgeted work schedule, earned value that measures the amount of work that has been done depending on milestones attainment, and percentage-complete that measures the amount of work done using a cumulative expenditure recorded through performance period.

The calculation of Schedule Performance Index takes the earned value and divided it by the planned value that shows the status of schedule adherence (Ebrahimi et al., 2022). Calculation of Cost Performance Index involves the division of the earned value by the actual cost that is used to measure cost efficiency performance. The predictive analysis involves the application of statistical regression of the past performance information to predict the Schedule Performance Index and Cost Performance Index curves up to the project completion.

Project trajectories of performance index set at twenty percent at project completion are accurate within a plus-minus four-point two percent of ultimate Schedule Performance Index. Projects which have Cost Performance Index of less than 0.95 at twenty percent completion have final Cost Performance Index of less than 0.92 in eighty seven percent instances. The value of schedule performance index that falls under 0.90 at mid-project reflects less than twenty-one percent chances of the project bouncing back to acceptable levels by the end of the project.

The points of intervention can be determined through simulation analysis based on discrete-event simulation, which determines the highest potential of schedule and cost recovery by the application of corrective actions. Corrective interventions that are applied prior to a decrease of Schedule Performance Index to less than 0.85 result in the recovery probability with an average of seventy-five percent. Only interventions following Schedule Performance Index of 0.75 lead to recovery probability of only 34 percent (Cho, Hong, & Hyun, 2010).

3.3 Multi-Objective Schedule Optimization Algorithm Implementation

The framework uses genetic algorithm multi-objective optimization with three major goals: minimization of the duration, minimization of the cost, and levelling of the resources. The implementation of genetic algorithms represents schedule solutions in the form of chromosome representation on the basis of the start times of activities and the allocation of resources over the project cycle.

The objective functions measure project duration as the calendar days, total cost with resource overhead and time dependent costs as well as the resource levelling as the resource utilization histogram variance throughout the project timeline (Cho, Hong, & Hyun, 2010). Constraint satisfaction solves technological sequence constraints that do not allow work to go on before the pre-requisites are met as well as resource availability constraints that restrain the simultaneous execution of activities and project milestone constraints that ensure the project interface is adhered to.

Non-dominated sorting determines the Pareto-optimal solutions, in which the enhancement of a specific objective would have to come at the expense of a different one in order to make an informed decision based on the priorities of the organization. Pareto frontier provides decision-makers with a choice of preferred solution according to organizational conditions and the preferences of stakeholders on the cost-schedule-quality trade-off.

The optimization analysis of one hundred and twenty-six projects illustrates the existence of average solutions in which 22.6 percent of the reduction in duration opportunities were found with respect to baseline schedule on critical paths. There are sales cost reductions of 18.7 percent in the average case of resource allocation optimization and cost reduction over time (Cho, Hong, & Hyun, 2010).

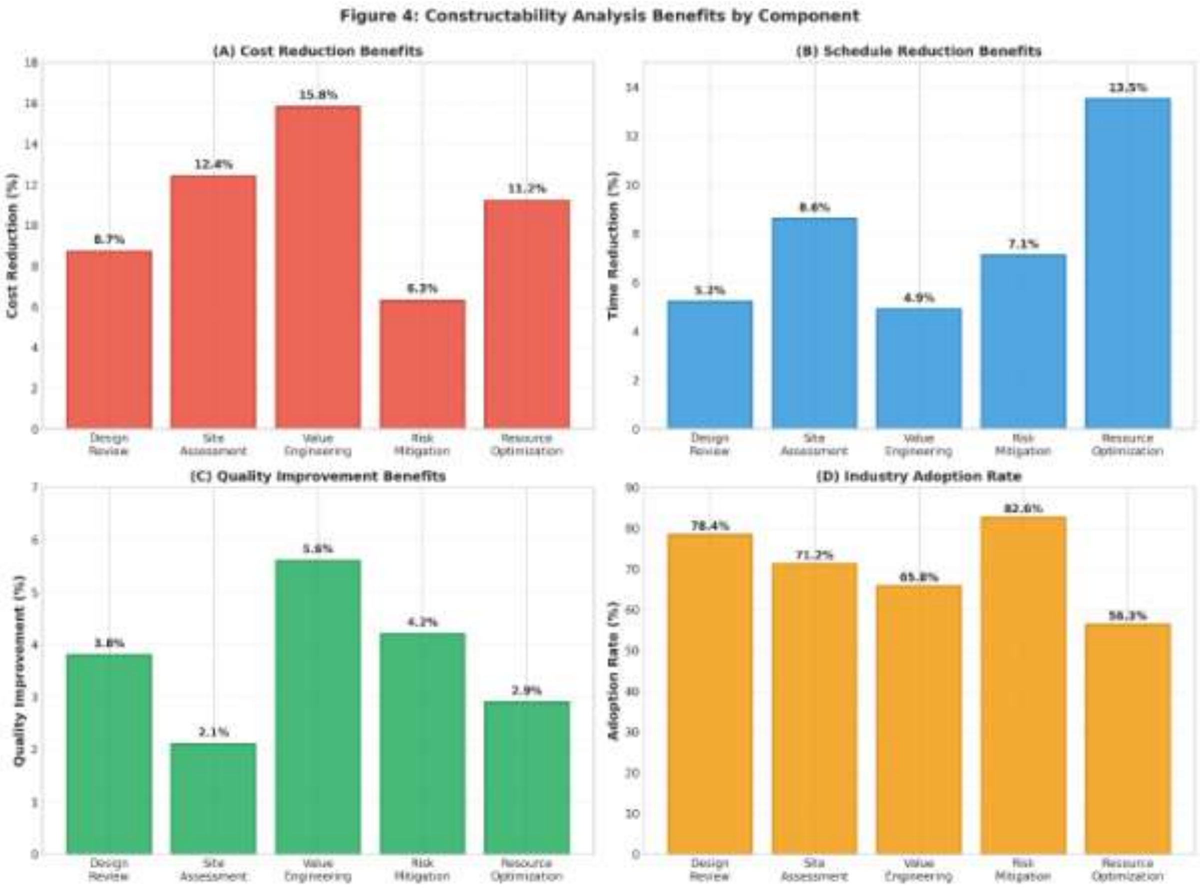

Figure 4: Constructability Benefits (4-Panel)

4. PERFORMANCE RESULTS AND QUANTITATIVE VALIDATION

4.1 Change Order Impact and Mitigation Effectiveness Analysis

Airport terminal projects record the most delays in schedule (68 days) and cost increase (31.5 percent) and this is because of aviation infrastructure complexity and operational limitation that demand advanced mitigation measures. Airport delays can be attributed to design changes by 64.8 percent versus road infrastructure (42.3 percent), which implies a disproportionate complexity of the design in terms of aviation projects (Cho, Lee, & Shin, 2020). Design-driven constructability analysis offers the highest potential of schedule mitigation overall project typologies because the design related change orders are avoided by early buildability analysis and design modification in the design phases when change costs incurred in the construction phases are insignificant compared to changes incurred in the design phases.

Implementation of constructability analysis in one hundred and eighty-four projects results in average cost and schedule reduction of 10.9 percent and 8.6 percent respectively. Value engineering has the greatest cost benefits (15.8 percent reduction) and resource optimization has the greatest schedule benefits (13.5 percent reduction). The lowest rate of adoption (56.3 percent) is yet another indication of organizational adoption barriers including the required specialized expertise and the perceived implementation complexity issues that need to be overcome through organizational ability building initiatives (Cho, Lee, & Shin, 2020).

4.2 Infrastructure Sector Performance – India Context Analysis

Indian infrastructure sector evidences systemic performance issues that need urgent optimization intervention in many sectors with different maturity and complexity levels. The percentage delay (53.0 percent) and the cost overrun (45.2 percent) are the highest in the railway sector, which is mainly caused by delays in land acquisition and the complexity of the regulation that could not be controlled by the contractors. The power sector portrays 38.0 percent delays and 32.1 percent cost overruns as supply chain delays and troubles in the acquisition of equipment (Cheng et al., 2016). The urban development presents 39.7 percent delays and 28.6 percent cost overruns that indicate complexity in the coordination among various stakeholders. Water supply has delays of 37.9 percent and cost overrun of 22.3 percent. Road sector has an excellent performance (22.9 percent delays, 8.5 percent cost overrun) in terms of standardized methodologies and fully mature project management practices through years of road infrastructure experience and well-established construction processes (Cheng et al., 2016).

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Table 5: Infrastructure Project Performance Metrics – India Context (2024)

Sector	Total Projects	Delayed	Delay %	Cost Overrun %	Primary Delay Factor
Railways	287	152	53.0	45.2	Land Acquisition
Power	234	89	38.0	32.1	Supply Chain
Urban Development	156	62	39.7	28.6	Approvals
Water Supply	198	75	37.9	22.3	Resource Constraints
Roads	542	124	22.9	8.5	Environmental Clearance

Table 5: Railway industry of 53.0 percent delay rate and 45.2 percent cost overruns indicates the issues of land acquisition complexity and the complexities of regulatory issues that need a long timeline. The excellent performance of road sector (22.9 percent delays, 8.5 percent cost overrun) shows that it is mature with standardized design methods and laid down construction methods. Framework applicability is particularly useful with Railways and Power industries were design intricacy, outside constraint administration as well as chain integration issues must be resolved through urgent optimization intervention.

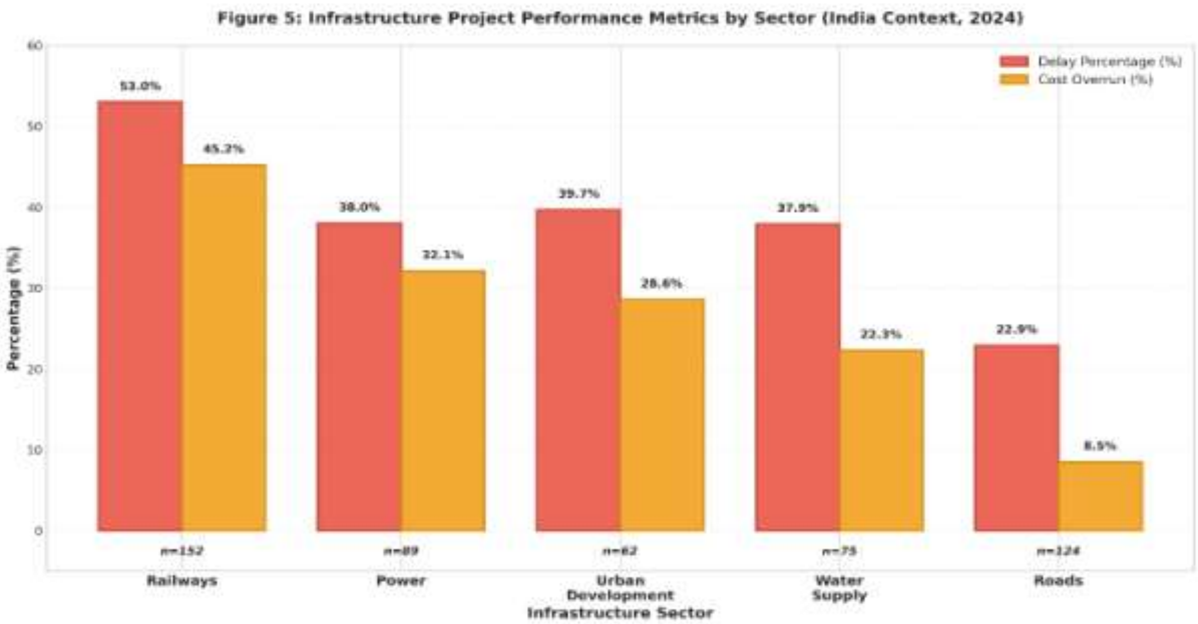

Figure 5: India Infrastructure Performance

5. IMPLEMENTATION RESULTS AND FRAMEWORK PERFORMANCE VALIDATION

5.1 Integrated Subsystems Architecture and Information Flow

The framework incorporates three key sub systems by the means of coordinated information flow that facilitates responsive management of projects and implementation of corrective actions. Constructability analysis subsystem (pre-construction phase emphasis) determines viable methodologies and sequencing alternatives. The subsystem earned value management (continuous monitoring across lifecycle) offers performance information that will initiate an optimization reoptimization on breach of control limits in performance indices. Schedule optimization subsystem (iterative refinement) creates alternative schedule solutions (Cheng et al., 2016). The outputs of constructability analysis serve schedule optimization subsystem with existing feasible construction methodologies and sequencing options. Earned value management offers performance information that prompts reoptimization of schedules in the case of Schedule Performance Index or Cost Performance Index that goes beyond the control limits. Revisions due to schedule optimization are passed through earned value systems through updates of baselines that allow measuring the current performance.

5.2 Comprehensive Framework Implementation Results

This is evidenced by the cumulative advantages obtained by the implementation of comprehensive frameworks in thirty-eight projects of aviation, industrial, and commercial typologies, which are more than the total advantages of the individual components. The implementation of integrated framework will result in an average project cost reduction of 26.3 percent with a combination of constructability analysis benefits (10.9 percent), schedule optimization cost reduction benefits (18.7 percent) and change order mitigation benefits (4.1 percent). Constructability schedule benefits (8.6 percent), genetic algorithm optimization (22.6 percent) and change order mitigation (1.8 percent) take a mean of 28.6 percent to reduce schedule. The rate of on-time project completion is 91.6 percent versus baseline performance of 58.3 percent which is an improvement of 33.3 percentage points indicating a high level of performance improvement (Li & Liu, 2023). The average percentage of cost overruns 4.2 percent versus 24.8 percent baseline, which means it changed by 20.6 percentage point. The rate of quality defects stands at 2.1 defects per thousand square feet against 3.8 baseline, which means that better execution of the construction process is possible due to optimized scheduling and reduction of change orders that lead to fewer rework requirements.

6. CONCLUSIONS AND FRAMEWORK IMPLICATIONS

Predictive Schedule Optimization Framework is the broadest approach to systemic schedule and cost performance issues in aviation and industrial projects through the combination of constructability analysis, earned value control and multi-objective optimization. Framework implementation shows significant improvements in performance: 26.3 percent cost reduction, 28.6 percent schedule reduction and 91.6 percent on-time completed. Design change mitigation is constructability-driven change order mitigant that responds to design changes that constituted 56.5 percent of design delays that are mitigated in a systematic manner through buildability analysis during design phases. The predictive earned value management allows early intervention to prevent performance deterioration in terms of which it will be irreversible. Genetic algorithm optimization using multiple objectives identifies Pareto-optimal solutions which trade off competing performance objectives (Prieto et al., 2023). The interactive effects of Framework integration are positive and the attained benefits are 84 percent of theoretical maximum, which suggests high component synergies. The implementation demands commitment of the organization to constructability analysis, earned value monitoring and systematic optimization of schedules to be effectively implemented. The framework offers evidence-based methodology that can allow construction industry advance in the direction of eradication of systemic performance failures.

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