Research on Schedule Control Strategies in Construction Project Management

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Abstract: The current construction industry is facing dual trends of increasing project scale, complex formats, and accelerated digital transformation. In this context, building systematic schedule control strategies from a full life-cycle perspective becomes key to solving problems of schedule overruns and cost overruns in construction projects, and is also an important direction for promoting the upgrade of industry management efficiency. This article takes the pain points of construction project schedule control as the starting point, discusses the core role of schedule control in achieving project objectives, focuses on the schedule management requirements at various stages of the full life cycle, and explores scientific and feasible schedule control strategies. It aims to provide reference for the schedule management practices of construction units and contractors, and supplement the empirical basis for improving the theoretical system of construction project management.

1. Introduction

As an important carrier of national economic development, the smooth delivery of construction projects is directly related to the improvement of urban functions, the satisfaction of people's livelihood needs, and the enhancement of social and economic benefits. Schedule control, as one of the three core objectives of construction project management, is a key link to ensure project delivery on time, control costs, and avoid default risks. If the schedule is out of control, it will not only lead to additional costs such as labor idle time and equipment underutilization but may also cause losses to multiple parties due to missing market windows or violating contract agreements.

2. The Core Role of Schedule Control in Achieving Project Objectives

In the process of achieving construction project objectives, schedule control is a core supporting link. The main executive body is the project management team, and its role is mainly reflected in the comprehensive guarantee of project duration, cost, quality, compliance, and resource coordination. It can be specifically organized coherently from the following aspects:

2.1 Ensuring Project Completion on Time

The project management team first formulates a detailed schedule plan based on project requirements, clarifying the completion time for each stage. Then, by monitoring the progress of on-site activities in real-time, they promptly identify schedule delays and make quick adjustments, preventing delays in a single link from spreading into an overall schedule overrun. This ensures the project can finally enter the completion and delivery stage within the preset time.

2.2 Ensuring Project Cost Control

If a project experiences schedule delays, it often leads to additional costs. For example, a prolonged duration can lead to increased labor idle costs (paying workers when there's no work), equipment rental costs for unused equipment like tower cranes, and additional storage management costs for materials that arrived early[1]. Through strict schedule control, the project management team ensures that all links proceed according to plan, reducing such unnecessary costs from the source and helping to keep project costs within budget.

2.3 Ensuring Overall Project Quality

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If a project rushes work blindly due to early stage delays, it can easily lead to simplified processes, omissions in quality checks, and subsequently, quality hidden dangers. Through scientific schedule control, the project management team reserves sufficient time for each construction activity and quality inspection, avoiding sacrificing quality for the sake of rushing progress, and ensuring the finally delivered project meets quality standards[2].

2.4 Ensuring Rational Resource Allocation

The project management team, based on the schedule plan, plans in advance the demand for resources: how many steelworkers and carpenters are needed during peak periods; how many tons of cement and cubic meters of sand and gravel are required in a certain stage; how many excavators and concrete mixer trucks need to be deployed in a particular month. Based on this, they coordinate and allocate resources to ensure they are precisely available when needed[3]. This avoids waste caused by early stockpiling of resources and also prevents work stoppages due to resource shortages, allowing all project phases to proceed orderly and ultimately contributing to the achievement of overall objectives.

2.5 Ensuring the Realization of Project Objectives

In construction projects, the owner and the contractor, or the contractor and suppliers, usually specify the duration clearly in the contract. If the duration is breached, the responsible party needs to pay liquidated damages, and commercial reputation may be affected. Through effective schedule control, the project management team ensures the project progresses according to the contractual time nodes, is finally completed and delivered on time, avoids default risks, and protects the legitimate rights, interests, and commercial reputation of all parties.

3. Pain Points in Current Construction Project Schedule Management

The pain points in current construction project schedule management are mainly concentrated in multiple links of the entire process, involving issues related to the project team, various participants, and management mechanisms.

3.1 Unsolid Task Planning in the Planning Stage

Project teams often have issues with unsolid task planning. Many project schedules are developed solely based on industry quotas or similar project experiences. The work breakdown is relatively rough, not detailed down to the specific activities of sub-items, and does not fully investigate resource supply capacity and actual site conditions[4]. For example, some projects, when formulating concrete pouring plans, do not confirm the supply cycle of sand and gravel suppliers in advance, leading to a disconnect between the planned duration and the actual resource availability time, causing delay risks right after commencement. Simultaneously, plans generally lack flexible buffers, with insufficient consideration for potential risks such as weather or policy changes. Once unexpected situations occur, the entire plan easily becomes passive.

3.2 Lag in Progress Tracking and Data Feedback

Most project managers still rely on traditional methods like weekly reports and monthly inspections to track progress, resulting in untimely feedback of on-site data. After a construction team completes an activity, it needs to be signed by the supervisor and summarized by the project department before the progress is updated. This process can lag by 2-3 days. Even though some projects have introduced digital tools like BIM, they mostly remain at the model display level and do not achieve real-time linkage between schedule data and the model. This makes it impossible to timely discover issues like delayed rebar tying or formwork installation deviations. By the time managers notice schedule deviations, the best time for adjustment has often been missed, significantly increasing the remedial cost[5].

3.3 Poor Collaboration Among Multiple Participants and Information Barriers

Construction projects involve multiple participants such as the owner, contractor, design unit, supervision agency, and suppliers. Information transfer barriers exist among these parties. Notifications of drawing changes from the design unit are often communicated via email or paper documents. The contractor might not receive them timely and continue working according to the old drawings, leading to rework and delays later. Communication issues also often arise between the contractor and material suppliers. For instance, suppliers might not inform in advance about material price increases, causing procurement delays, while the contractor fails to provide timely feedback on schedule adjustment needs. Furthermore, responsibility demarcation among parties is often vague. When schedule problems occur, blame-shifting is common, lacking a clear collaboration mechanism.

3.4 Lack of Dynamic Resource Coordination Mechanisms

During resource planning, project teams mostly use fixed schemes and fail to establish dynamic adjustment mechanisms. For example, a residential building project estimated needing 50 carpenters based on the total duration but failed to consider the concentrated demand during the peak period of main structure construction. This resulted in a carpenter shortage during the construction of certain floors, while manpower was idle during other stages[6]. Similar problems exist in material management. Some projects stockpile large amounts of steel bars in advance to rush progress but encounter rusting due to limited space. Others, failing to predict the risk of material price increases, face supply cuts from suppliers during peak construction periods.

3.5 Passivity in Risk Response

The passivity in risk response is particularly significant. Project teams have omissions in the early risk identification stage, with insufficient consideration of risks such as changes in geological conditions, tightening environmental policies, and supply chain disruptions. For example, some municipal projects failed to investigate the distribution of underground pipelines in advance, leading to work stoppages and rectification after damaging pipelines during construction. Other projects did not develop contingency plans for heavy rain,were forced to stop work due to insufficient drainage measures on rainy days, affecting the progress of the critical path. When risks materialize, project teams often lack effective response plans and can only coordinate resources temporally, further exacerbating schedule delays.

4. Effective Schedule Control Strategies for the Full Life Cycle of Construction Projects

4.1 Preliminary Planning Stage

In the preliminary planning stage of full life-cycle schedule control for construction projects, the core task of the project management team is to scientifically formulate the schedule plan, ensuring it aligns with project objectives and is feasible for implementation.

Firstly, the project management team will use the Work Breakdown Structure (WBS) to decompose the overall project tasks layer by layer from large to small: first clarifying individual projects, then refining to unit projects, further decomposing into sub-divisional works, and finally down to sub-item works. After the decomposition, the team will use the Critical Path Method (CPM) to analyze the logical relationships between sub-item tasks, identify core tasks affecting the total duration and flexible non-core tasks, clarify task priorities, and avoid diverted efforts during subsequent execution due to unclear focus.

Secondly, the project management team will estimate activity durations by integrating multi-dimensional data to ensure accurate results. On one hand, they reference industry quota standards; on the other hand, they retrieve historical data from similar projects. Based on this, they organize technical experts and construction team leaders for reviews to correct estimation deviations[7]. Simultaneously, the team will reserve 10% to 15% of buffer time in the estimated duration specifically for unexpected situations like work stoppages due to heavy rain or temporary shortages of building materials, preventing overall delays caused by an overly tight plan.

Finally, the project management team will promote the deep matching of the schedule plan with resource requirements to avoid disconnection between plan and actual execution. Based on the decomposed tasks and estimated durations, the team will sort out the demand lists for manpower, materials, and equipment for each stage. For example, how many steelworkers and carpenters are needed during the peak period of main structure construction; how many tons of cement and cubic meters of sand and gravel need to be delivered in a certain month; how many tower cranes and concrete mixer trucks are required in which phase. For critical resources such as special types of materials and skilled labor teams, the project management team will communicate with suppliers and labor companies in advance, sign letters of intent or cooperation agreements, clarify resource supply cycles and delivery times, and ensure resources are available before the corresponding tasks commence, avoiding work stoppages due to resource shortages.

4.2 Completion and Handover Stage

In the completion stage of construction project schedule control, the core tasks of the project management team are to push for the final sprint and conduct experience review. They must ensure the project is completed and delivered quickly and smoothly, while also accumulating effective experience for the schedule management of subsequent projects.

Firstly, the project management team will refine the completion and handover schedule plan, clarifying the responsible entities and completion times for each task. The team will break down the closing work into sub-tasks such as organizing completion data, special inspections (fire control, planning, environmental protection, etc.), final account settlement, and site cleaning. For instance, specifying that the data specialist needs to complete the compilation and archiving of construction logs, test reports, drawing changes, and other materials within 15 days; assigning the inspection coordinator to initiate fire control inspection with the construction department within 10 days after data completion. Meanwhile, the team will prioritize key inspection links, as these directly affect whether the project can be delivered legally. For example, if the planning inspection fails, the project cannot proceed with property registration. Therefore, the team will communicate requirements with the inspection department in advance, preparing materials such as survey reports and as-built drawings to avoid inspection delays due to missing documents.

Secondly, for issues remaining from the project implementation process, the project management team will establish a register and promote quick resolution. The team will jointly conduct on-site inspections with construction teams and the supervision unit, registering all unfinished items such as local wall repairs, poor sealing of doors and windows, and undelivered ancillary facilities. These will be sorted based on "urgency + impact on delivery scope." For example, rectification of water and electricity pipelines affecting owner occupancy would be listed as the highest priority, requiring completion by the construction team within 3 days; whereas perfecting landscape features that do not affect core use can be appropriately postponed[8]. During the rectification process, the team will assign dedicated personnel to track progress, checking the status daily, while coordinating with testing agencies to conduct inspections simultaneously. For instance, applying for inspection promptly upon completion of each rectification item, avoiding time waste caused by disconnection between rectification and inspection.

Thirdly, the project management team will conduct a experience review of schedule control, sorting out the gains and losses of the project. The team will compare the actual duration with the planned duration, analyzing the reasons for differences. If the actual duration was shorter than expected, effective practices will be summarized, such as the use of BIM visual monitoring for early detection and adjustment of schedule deviations, or the "priority supply agreement" with suppliers that avoided material shortages. If the actual duration exceeded expectations, the project management team will delve into the root causes, such as work stoppages due to unforeseen tightening of environmental policies in a certain stage, or rework caused by delayed transmission of design change notifications during multi-party coordination. Subsequently, the team will compile these analysis results into case reports, recording reusable strategies and risk points to avoid, and store them in the enterprise project management database to provide reference for formulating

schedule plans and conducting schedule control for similar future projects.

5. Conclusion

In summary, this article, from the core perspective of the "full life cycle" and considering the management characteristics of each stage of construction projects, systematically constructs schedule control strategies. This includes focusing on the scientific nature of planning in the preliminary stage and addressing closing efficiency and experience reuse in the completion stage. It provides project management teams with a set of usable and practical operational methods, helping more projects achieve on-time delivery, cost control, and quality compliance. Simultaneously, it supplements the practice level content for the schedule management theory of the construction industry, promoting the industry's transition from extensive management to refined management.

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