Coordination of Multiple Engineering Teams at Substation Sites for Deadline Compliance

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Abstract

Electrical substations are critical components of power systems, yet construction projects frequently experience delays caused by design changes, procurement issues, coordination problems, material delivery delays, and conflicts between construction activities. This study evaluated a structured scheduling framework developed to improve coordination and reduce project delays in electrical substation construction. The framework was implemented through a pilot project and included logic ties, resource allocation, contingency buffers, digital scheduling tools, daily check-ins, assigned team leads, phased access protocols, weekly progress reviews, standardized procedures, training, and automated reporting mechanisms. Project performance was assessed by comparing documented issues before and during implementation. Results showed that total documented issues decreased from 13 before the pilot to 3 during implementation, representing a 77% overall reduction. Design coordination, deadlines and construction dates, and material ordering each achieved a 100% reduction in documented issues. Construction-related issues decreased by 75%, while meeting-related issues decreased by 50%. These findings demonstrate measurable improvements in coordination, communication, procurement alignment, and construction activity management.

Introduction

Electrical substations are essential components of the electric power system because they allow electricity to be transformed, controlled, protected, and distributed between transmission and distribution networks. These facilities reduce or increase voltage levels as required, provide switching and protection functions, and support the reliable delivery of electricity to residential, commercial, industrial, and public service users. Due to their role in system reliability and energy distribution, the construction and modernization of substations require careful technical planning, coordination, and execution.

Literature Review

The literature shows that scheduling methods such as the Critical Path Method (CPM) are useful because they divide the project into activities, establish relationships between tasks, and identify the activities that control the project completion date.
Important concepts from the literature include:

- Optimization-based scheduling helps improve decision-making by identifying efficient project sequences.
- CPM scheduling supports deadline management by identifying critical activities.
- Substation EPC projects require coordination between design, procurement, construction, testing, and commissioning.
- Utility project scheduling must consider resources, dependencies, costs, risks, and competing priorities.
- Power transmission projects are often affected by access limitations, stakeholder coordination, right-of-way issues, and external constraints.
- Schedule risk analysis is important because real projects rarely occur exactly as planned.

Methodology

This study used a phased management approach based on integrated project scheduling and cross-team collaboration. The methodology was organized into five completed phases:

Phase 1: Current-State Analysis
The first phase reviewed recent substation project activities to identify common sources of delay and coordination problems.

- This phase included:
- Review of site logs
- Review of project records
- Review of available schedule information
- Identification of task durations
- Identification of recurring project issues
- Input from engineers and site leads
- This phase established the baseline conditions used to compare project performance before and during the pilot implementation

Figure 1
Initial Master Schedule Framework for the Pilot Substation Project

Phase 2: Framework Design
The second phase focused on developing a master schedule framework for the pilot project. The framework incorporated:

- Logic ties between activities
- Resource allocation
- Contingency buffers
- Activity sequencing
- Digital scheduling tools such as Asana or Primavera
- Real-time dashboards
- Project notifications
- Progress tracking

Phase 3: Pilot Implementation
The third phase tested the scheduling framework on a pilot substation project.
The pilot implementation included:

- Daily check-ins
- Assigned team leads
- Phased access protocols
- Weekly progress reviews
- Coordination between civil, electrical, procurement, and construction teams

Phase 4: Evaluation
The fourth phase evaluated the results of the pilot implementation by comparing documented issues before and during the pilot project. The evaluation focused on:

- Coordination improvements
- Schedule adherence
- Activity overlap reduction
- Communication improvements
- Procurement alignment
- Construction workflow continuity
- Risk assessments and collaborative workshops were also used to refine the framework and identify improvements for future use.

Phase 5: Rollout Preparation
The fifth phase prepared the refined framework for future implementation across multiple sites. This phase included:

- Structured training
- Standardized procedures
- Automated reporting mechanisms
- Updated master schedule templates
- Logic ties and discipline dependencies
- Assigned team leads for each discipline
- Procurement-to-construction alignment checks
- Risk review and contingency adjustments

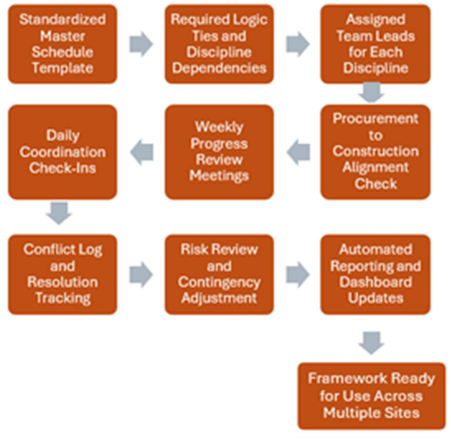

Figure 2
Refined Master Schedule Framework for Multi-Site Implementation

Results

The pilot implementation showed measurable improvements in project coordination, communication, schedule control, material ordering, and construction activity management.
The main comparison was based on the number of documented issues before and during the pilot project.
Overall Result
Issues before pilot: **13**
Issues during pilot: **3**
Issues reduced: **10**
Overall reduction: **77%**
This reduction shows that the scheduling framework helped reduce documented project issues during implementation

Table 1
Issues Reduction Rate per Project Activity

Activity	Issues Before Pilot	Issues During Pilot	Issues Resolved
Design Coordination	2	0	100.00%
Meetings	4	2	50.00%
Deadlines / Construction Dates	2	0	100.00%
Material Ordering	1	0	100.00%
Construction	4	1	75.00%
Total	**13**	**3**	**77.00%**

Conclusion

This project evaluated scheduling and coordination challenges in electrical substation construction projects and examined how a structured scheduling framework could help reduce delays..
The pilot results showed that the framework helped reduce documented project issues during implementation. The total number of issues decreased from 13 before the pilot project to 3 during the pilot project, representing an overall issue reduction rate of 77%. Design coordination, deadlines and construction dates, and material ordering each achieved a 100% reduction in documented issues. Construction-related issues decreased by 75%, while meeting-related issues decreased by 50%. These results provide evidence that the new framework improved coordination, communication, schedule control, procurement alignment, and construction activity management.

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