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# Decade in Review: The Role of PERT and CPM in Civil Engineering

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***Abstract***
*Over the past decade, the construction industry has witnessed significant advancements in project management methodologies, notably the continued application and evolution of the Program Evaluation and Review Technique (PERT) and the Critical Path Method (CPM). This review synthesizes research from 2015 to 2025, highlighting the integration of PERT and CPM in civil engineering. Emphasis is placed on methodological innovations, practical applications, and the challenges encountered in contemporary construction projects. The findings underscore the enduring relevance of these techniques and their adaptability to modern project management demands.*

## I. Introduction

For civil engineering projects to be successful, effective project management is still essential. In this field, PERT and CPM have long been fundamental instruments that support the careful planning and implementation of challenging projects. In order to understand how these approaches have been used, improved, and incorporated into contemporary building practices, this review explores academic works from the last ten years.

## II. Methodological Developments

### 2.1 Integration of PERT and CPM

The synergistic usage of PERT and CPM to improve project scheduling accuracy has been investigated in recent studies. Combining these techniques enables the identification of important routes and the evaluation of the likelihood that a project will be completed within predetermined timescales, as shown by Ba'Its et al. (2020). According to their analysis, there was a 50% chance that a project with a minimum duration of 135 days would be completed on time; this number rose to 68% with an extension to 139.78 days.

### 2.2 Incorporation of Fuzzy Logic

It has been combined with conventional scheduling methods by researchers to address the uncertainties present in construction projects. In order to handle ambiguous activity durations, a 2024 study presented the Fuzzy-Graphical Evaluation and Review Technique (F-GERT), which blends fuzzy logic with the Graphical Evaluation and Review Technique (GERT). F-GERT's ability to manage uncertainty was demonstrated when it was used to create schedules for a two-story residential building project that nearly matched the actual project timelines.

## III. Practical Applications in Civil Engineering

### 3.1 Construction Project Scheduling

In order to create thorough and practical construction schedules, PERT and CPM integration has proven essential. In order to minimize delays and expense overruns, project managers can identify key activities and assign resources efficiently by mapping out activity sequences and dependencies.

### 3.2 Risk Management

A thorough examination of possible project delays is made possible by PERT's probabilistic character, which also makes proactive risk reduction techniques possible. Anticipating uncertainties and creating backup plans to deal with them are made possible by this method.

### 3.3 Resource Optimization

The emphasis placed by CPM on identifying the critical path facilitates the effective distribution of resources to tasks that have a direct bearing on project schedules. This guarantees that the tasks that are essential to the timely completion of the project receive the majority of the attention.

## IV. Case Studies

### 4.1 Building Construction Projects

The use of PERT and CPM has been crucial in the building construction industry for methodically planning project timelines. According to a review report, these techniques make it easier to create appropriate project models using network diagrams and shorten project completion times.

### 4.2 Institutional Processes

PERT and CPM have been used to optimize institutional procedures outside of the realm of traditional building. As an illustration of how adaptable these strategies are in a range of organizational settings, a study on university enrolment processes used them to optimize operations.

## V. Advantages and Challenges

### 5.1 Advantages

- **Improved Scheduling Accuracy:** A thorough framework for creating accurate project schedules is provided by the combination of PERT and CPM.
- **Better Risk Assessment:** PERT's built-in probabilistic analysis makes it possible to anticipate and manage possible delays more effectively.
- **Effective Resource Allocation:** By using CPM to identify important routes, resources are allocated to the tasks that have the biggest effects on project timeframes.

### 5.2 Challenges

- **Intricacy in Large-Scale Projects:** Using PERT and CPM in large-scale projects can be challenging, necessitating advanced equipment and knowledge.
- **Data Accuracy:** These techniques' efficacy depends on the precision of the supplied data; inaccurate estimations may result in irregular scheduling.
- **Flexibility in Changing Conditions:** Conventional PERT and CPM might not be able to adapt to quickly evolving project circumstances without regular modifications.

## VI. Conclusion

The use of PERT and CPM in civil engineering has advanced significantly during the 2015–2025 timeframe. They are now more useful in controlling uncertainty thanks to innovations like the incorporation of fuzzy logic. These approaches continue to be vital instruments in contemporary project management, always changing to satisfy the demands of modern construction projects, even in the face of complexity and data dependability issues.

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