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Project Scheduling

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Abstract—Project scheduling is one of the most important disciplines of Operations Research in terms of applications. Simple methods associated with Critical Path Method (CPM) or Project Evaluation and Review Technique (PERT) are often used in practice. However, cost and resource-oriented project scheduling methods are rarely used despite the availability of new and promising concepts. This paper surveys recent advances in modeling and solving deterministic resource-constrained project scheduling problems suitable for project planning and control.

Keywords—Project scheduling, Critical Path Method, resource-constrained scheduling, project planning, project control.

I. INTRODUCTION

Sound project scheduling, from concept to commissioning, is the key to success. When any project is undertaken, each phase, from inception to final completion, must be thoroughly, effectively, and tightly controlled. This ensures that every milestone achieved in time contributes to the building blocks of ultimate success in fulfilling desired objectives. Leading organizations around the world achieve success in project scheduling by managing the following four factors in order of priority through all phases of a project:

1. Safety
2. Quality
3. Time
4. Cost

II. BASICS OF A PROJECT

1. **Eco Friendly**: Every project must incorporate required environmental protection measures and meet relevant norms.
2. **Competitive**: The project must be competitive when compared to similar projects undertaken by others in the field.

3. **Project Cycle Time**: Reducing project cycle time significantly reduces project costs, particularly by reducing interest on borrowed capital.
4. **Efficiency in Operations**: The basic design of the project must aim at achieving the highest levels of operational efficiency to fully justify the time, money, and effort invested.
5. **Quality and Safety**: Maintaining high standards of quality and safety is essential for project success.

III. TRENDS, ISSUES, AND CRITICAL SUCCESS FACTORS

The following factors contribute to the success of projects:

1. **Clear Vision and Project Objectives**: The aims and objectives of the project need to be clearly defined to set the right direction and enable accurate assessment of benefits on project completion.
2. **Strategic and Detailed Project Planning**: A detailed work breakdown structure (WBS) and integrated work plans need to be developed at the start. Time estimations for various activities should remain as accurate as possible.
3. **Dynamic Leadership**: The role of dynamic leadership is crucial, similar to the importance of a good captain in any sport. Timely, bold, and quality decisions by the leadership help steer the project toward success.
4. **Committed, Dedicated, and Competent Team**: Every project requires teamwork, close coordination, and unidirectional efforts to create synergy. In addition to hard work, the team must possess the necessary technical and managerial competencies.
5. **Integrated Project Scheduling Systems**: Implementing a sound project scheduling system capable of integrating various parallel activities ensures synchronization and alignment toward the common goal of project completion. This system should facilitate multi-level planning and monitoring of project activities as required.

IV. TYPES OF CONTRACT

Contracts may be classified as follows:

1. **Supply of Major Equipment Separately** (e.g., transformers, circuit breakers, instrument transformers).
2. **Supply of Major Materials Separately** (e.g., structures, conductors, insulators, illumination, and firefighting equipment).
3. **Erection Works Including Minor Materials** (e.g., cement, sand, steel, clamps, connectors) and **Turnkey Contracts** that include all materials and erection.

V. METHOD OF TENDERING

1. **Open Tenders**: Competitive tenders are obtained from a wide pool of bidders.
2. **Selective Tendering/Limited Tenders**: Tenders from reputed firms are sought to save time.
3. **Nominated Tenders**: For minor works, rate contracts or approved schedule rates from reputed firms are used.

VI. IMPORTANT TERMS AND CONDITIONS OF OPEN COMPETITIVE BIDS

The extracts of Instructions to Bidders (ITB), General Conditions of Contract (GCC), and General Conditions of Erection (GCE) are provided in Annexure-3. The project manager must review these terms before submitting a tender and seek clarifications from the owner if needed. These terms must be considered during tendering and in planning the work to ensure completion as per the agreed targets.

VII. OBJECTIVES OF THE STUDY

- Create processes that will foster continuous improvement.
- Enhance understanding of the current project status and estimated time to completion.
- Define a process template for project execution from inception to completion.
- Establish processes and skill sets required for handling more complex projects.

VIII. SCOPE OF THE STUDY

Due to the dynamic changes in the business environment, the scope of project scheduling has expanded. The following activities are included under operations management functions:

- **Facility Location**: Selecting an appropriate location for production.
- **Plant Layouts and Material Handling**: Deciding on machines, equipment, and necessary devices to achieve desired production efficiently.
- **Product Design**: Designing the product and determining its production requirements.
- **Process Design**: Identifying the most efficient production process.
- **Production and Planning Control**: Planning various aspects of production, including "how", "when", and "where" a product will be produced or assembled.
- **Quality Control**: Ensuring quality through checkpoints and periodic performance measurements.
- **Materials Management**: Managing inventories of raw materials, semi-finished goods, and finished products to prevent excessive capital lockup.

IX. CONCLUSION

The practices adopted by organizations shape the trends followed in the manufacturing and service industries. Resistance to change, as seen in many manufacturing/service providers, reflects their reluctance to adopt new technologies, often due to concerns about cost and the effort required to retrain the workforce. Our study observed that manufacturers often focus on client satisfaction, believing that adhering to standard practices and acquiring international certifications is sufficient. However, these companies are hesitant to adopt new technologies, fearing additional costs and longer preparation times.

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