Construction Scheduling and Resource Management: A Review of Manual Planning, Microsoft Project and Resource Optimization

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Abstract: Construction projects involve several interconnected activities, resources, and financial commitments that need to be carefully planned and coordinated to achieve the desired objectives within the time and budget. Traditionally, construction schedules have been developed using engineers' experience, bar charts, spreadsheets, and manual calculations. While these methods are suitable for relatively simple projects, managing complex activities, changing work sequences, and fluctuating resource requirements becomes increasingly difficult as project complexity increases. The current research evaluates approaches to preparing construction schedules and managing resources, with special emphasis on conventional planning practices, use of Microsoft Project and resource allocation optimization. The body of literature covers scheduling techniques in residential and commercial construction, activity scheduling, resource allocation and leveling, time and cost estimating, use of project management tools as well as the use of artificial intelligence. Research shows that scheduling is not only about defining the times of beginning and completing tasks, but also about having enough resources (materials, workforce and machinery) to have a seamless work. The article also discusses the use of Microsoft Project for scheduling, linking activities, identifying key stages, allocating resources and tracking the process. This research indicates that a systematic analysis should be done on both manual scheduling and planning via Microsoft Project using identical parameters. The aspects evaluated involve things like total construction time, project duration, critical path, resource usage, over-usage, and the cost of resources. In general, the study concludes that an efficient combination of computerized scheduling tools, correct project data, resource management and a good judgment of specialists is necessary for the success of construction scheduling.

Keywords: Construction Scheduling, Resource Management, Manual Planning, Microsoft Project, Resource Allocation, Resource Levelling, Resource Optimization.

1. Introduction

A construction project consists of multiple activities and processes that are related and should be performed in a special sequence. Most of the activities like earthwork, construction of foundations, reinforced concrete works, brickwork, engineering systems, plastering, and finishing works are normally carried out by different teams and

depend on the proper carrying out of the previous activities. Any delay at any stage can have an impact on the rest of the actions and can lead to the overall increase of the project duration. That is why proper construction planning implies consideration of the working sequence and the needed resources.

Construction scheduling assists in turning the project plan into a workable time-based framework. It comprises steps of defining specific job activities, determining how long each activity is likely to take, defining interdependencies between activities, and setting start and end dates, as well as important milestones and overall project duration. Apart from scheduling, resource management includes making sure that required quantities of labor, materials, and equipment are procured on time and in sufficient amounts. Without adequate planning of the resources, even a carefully prepared schedule might be hard to implement on the site.

The articles examined in this review explore construction scheduling and resource management in a range of contexts, which include practical case studies, project management software, optimization techniques, and surveys of construction experts. Some studies show application of Microsoft Project for building projects, while others provide comparative insights into different software tools and address wider issues of project management. Most articles show the practical implications of traditional planning approaches and computer-based scheduling in construction projects.

1.1. Concepts Relevant to Construction Scheduling

The concepts relevant to construction scheduling are as follows:

1. Activity identification and work breakdown: The first step in developing a schedule is to break down the project into smaller actions or tasks. The project participants then get a clearer understanding of the scope of work. To do it, a Work Breakdown Structure (WBS) is developed, which organizes work into different levels starting from major works and leading to certain tasks. In their study on the G+3 type residence, Yadav et al. (2015) made use of WBS so that such activities as preparing the land for construction, excavation, concreting, masonry works, plastering works, wiring and plumbing, and finishing could be identified [9]. Using WBS, construction projects are translated to the list of activities that are easy to plan [18].

2. Activity duration and logical relationships: Estimating the duration of each activity is an important part of construction scheduling. The time required to complete a particular task depends on several factors, including work quantity, labour productivity, workforce size, working hours, and actual site conditions. In addition to estimating durations, it is necessary to establish logical relationships between activities. For example, concrete work can begin only after the formwork and reinforcement have been properly completed and inspected. Microsoft Project provides different relationship types, such as Finish-to-Start and Start-to-Start, to represent these dependencies. However, the accuracy of the schedule largely depends on the planner's ability to establish realistic activity durations and relationships [13], [16].

3. Critical path and float: The Critical Path Method (CPM) are widely used to identify the sequence of activities that directly influences the overall project completion time. Activities falling on the critical path generally have zero total float, meaning that any delay in these activities may affect the project completion date. On the other hand, non-critical activities may have some scheduling flexibility, which can be useful when adjusting work sequences or resolving resource-related conflicts. Since changes in activity duration and dependencies can influence the critical path, it is important to review it whenever the project schedule is revised [14], [17].

4. Resource allocation and resource levelling: Resource management focuses on ensuring that the required labour, machinery, and equipment are available when construction activities are scheduled. Resource allocation involves assigning available resources to different activities, whereas resource levelling aims to resolve situations where resource requirements exceed actual availability. Maruthi, Patil and Agawane explain that resource levelling can involve shifting non-critical activities within their available float to achieve a more balanced resource requirement. When float is available, its adjustment helps to use the resources more effectively without extending the project duration [1], [18].

5. Time, cost and resource relationship: Time, cost, and resources in construction are related to each other since any change in one of those parameters affects the others. For instance, if there are more workers to do the job, it is possible to complete the task sooner, but it would increase the cost of labor and create traffic problems at the construction area. On the contrary, cutting down the number of workers lowers the cost in the short run but lengthens the activity duration and postpones the project realization. Thus, the optimization of resources does not mean performing activities as fast as possible or utilizing all available labor force. It is important to find the necessary

compromise between the productivity, availability of resources, construction expenses, working conditions, security, and other project requirements [15], [16].

1.2 Fishbone Diagram for Factors Affecting Construction Scheduling and Resource Management

The fishbone illustration displayed in Figure 1 depicts the key elements that can have an impact on construction scheduling and resource management during various types of construction projects. The diagram presents a systematic view of the different factors that can cause construction delays, improper use of resources, and challenges in coordinating building activities. The fishbone illustrates eight main categories of these factors: labour, materials, equipment, methods, costs, stakeholders, external factors, and technologies.

Each group of factors deals with a separate part of the construction management area that can have a negative effect on the work of the construction project. There are different labour-related problems, which include a lack of skilled workers, low productivity, high labour turnover, improper allocation, and insufficient training. Material-related problems include a delay in supply, price changes, poor quality, problems with storage, material waste, and unreliable source of supply. As for the equipment, there are different difficulties, which include failures of machines, lack of availability, lack of quantity, low level of utilization, and high rent or operating costs.

The methods and planning classification brings attention to issues related to wrong activity durations, poor sequencing, ineffective resource planning, absence of resource leveling, insufficient control, and constant adjustments of the construction schedule. The financial aspect, such as budget limitations, cost increases, inaccurate cost estimates, payment delays, and lack of financial resources, may affect the project situation. Poor communication, vague responsibilities, conflicts between interested parties, insufficient decision making, and resistance to changes create problems for the project coordination as well.

The external factors, namely bad weather conditions, approvals, changes in governmental policies, site limitations, unknown subsurface situation, and unexpected obstacles may also change the original construction program. Additionally, interoperability problems with software, poor training and inaccurate data may result in reduced efficiency of construction planning.

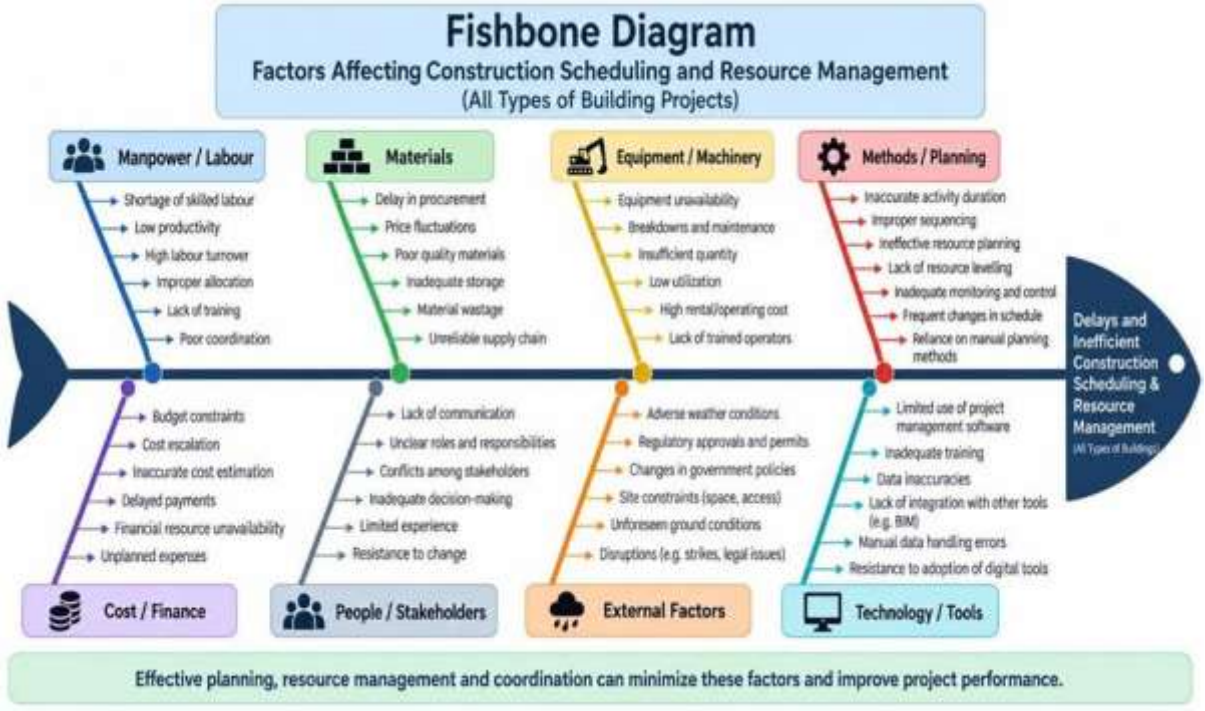


Figure 1: Fishbone Diagram for Factors Affecting Construction Scheduling and Resource Management

The fishbone diagram indicates that delays in construction and poor construction scheduling are seldom caused by one factor but rather a combination of various technical, financial, operational, administrative, and external causes. If identified at an early stage, some of these causes can help construction specialists take the right planning decisions, enhance resource allocation, promote coordination, and prevent delays and excessive costs.

2. Review of the Supplied Research Past Studies

The review of the supplied research Past Studies are as follows:

The significance of managing fluctuating resource demands in construction projects was discussed by **Patil et al. (2015).** They pointed out that project completion is dependent on the quality and extent of work but also on the timely supply of resources for the execution of various activities. They delineated the differences in resource allocation versus resource leveling and illustrated how the resource demands may vary in the course of the construction process. The authors adapted a two-phase methodology. In the first phase, a schedule of the building construction activity was developed with the help of Microsoft Project software and with allocation of the required resources to the different activities according to the standard rates, construction drawings, and the actual conditions at the construction site. Later, resource needs were revisited and adjusted to prevent unexpected shifts in demand. Alterations to duration of activities and allocation of resources were included to allow for more stable resources. Further, resource optimization, project length and cash flow were analyzed in this work. The highlighted study is most pertinent for this research as it proves that construction scheduling needs to be endorsed beyond total time for completing a project. Daily or weekly resource needs, peak demand moments and resource over-allocation need to be factored in when finding out how viable a schedule is. Hence, the authors demonstrate that resource levelling may involve subsequent changes introduced into activity timing or duration, which is supposed to be minutely compared with critical path and conditions on the site [1].

Subramani et al. (2018) analyzed resource scheduling in a commercial construction project through the utilization of Microsoft Project software. Their focus was on formulating an activity-oriented construction schedule using Standard Schedule Rates for resource estimation together with the use of site-specific information. Resource leveling was performed in this study to achieve balance between demand and the duration of activities, underscoring the need for proactive and accurate resource allocation. However, it was noted that the comparison between manual scheduling techniques and those based on software was absent in this research. Further studies can be implemented to compare these two methods of scheduling and show their advantages and disadvantages in the project under the same circumstances [2].

A comparative analysis of Microsoft Project 2016 and Primavera P6 R16.1 was conducted by **Phophalia et al. (2018)** to compare their features in terms of project management. The authors distributed a questionnaire amongst construction professionals who had experience using both toolsets and evaluated the software based on a number of factors, such as resource levelling, ease of operation, training requirements, cost, and overall capabilities of the software. The results indicated that while Primavera P6 had the highest efficiency, Microsoft Project was chosen in terms of effectiveness and usability. This study reached the conclusion that the appropriateness of various software depends on user experiences and the needs of projects, and thus Microsoft Project could be an appropriate tool for building construction planning, although it was not compared to P6 directly [3].

The use of Microsoft Project in planning a residential construction project was investigated in the study conducted by **Kamire et al. (2022).** The main focus was on the importance of logical ordering of construction processes to produce a good schedule. The use of software made it possible to come up with a construction program filled with a Gantt chart and organized resources to simplify the planning process. The authors concluded that the duration of the project decreased although it was not applicable to every project. Their research also opens doors for further studies, which can be done by comparing traditional and Microsoft Project scheduling approaches.[4].

Gunaga et al. (2022) investigated the use of Microsoft Project in the context of villa project planning, scheduling, and cost estimation. They stressed the interrelationship of construction schedules, resource allocation, and costs, showing that scheduling needs more than just Gantt charts. Reliable data on project conduct, including construction quantities, is needed for effective work. Additionally, it is noted in the study that the effectiveness of the generated schedules depends on the accuracy of the planner's input since Microsoft Project cannot correct any unrealistic data. The practical value of the software is evident from the study; however, it does not claim that computerized scheduling is more efficient than traditional planning [5].

Thota et al. (2023) examined aspects of resource allocation, scheduling, and planning in constructing a multi-storey residential building. They mentioned the complication involved in coordinating simultaneous construction activities at different levels. Common activities include reinforcement, masonry and utility installation on several levels so that scheduling and resource allocation becomes important. If two similar activities take place concurrently at the same level, there is a demand for labor, materials and equipment. Consequently, careful planning is needed to avoid

disruptions. The issues raised by the research proves the necessity of regarding resource allocation as an essential aspect of construction scheduling [6].

Aguda et al. (2024) construction scheduling and resource optimization is investigated within sustainable construction projects. The relationship between project deadlines and resource choice and the impact on the deployment of eco-materials and technologies is studied as well. The study is based on the case studies, interviews with the industry professionals and life cycle assessments that helped to connect construction projects with sustainability objectives. The authors conclude that sustainability should appear in the planning stage. Proper coordination of raw materials and installation processes will allow the implementation of sustainable practices [7].

Yadav et al. (2025) the role of Microsoft Project in planning and resource optimization for a G+3 residential building is investigated. In their project, they developed a Work Breakdown Structure (WBS) for significant construction activities, assigning human labor, equipment, and materials. The study also looked at the obtained schedule to report on resources availability and conflicts. The utilization of resource leveling allows saving four days (3.1%), decreasing the duration of the project from 130 to 126 work days, while keeping the critical path unchanged. Furthermore, resource allocation was optimized, which decreased the project costs by ₹2.9 lakh (7.07%) [9].

Al-Dhamad et al. (2025) examined the design and scheduling of a double-storey residential construction project in Baghdad/Abi Ghraib area from its excavation to the completion stage. The researchers determined the critical path; allocated resources as well as evaluated labor and material costs associated with the project. The obtained results were analyzed through a comparative lens of two approaches of planning: manual approach (Plan A) and automated approach (Plan B). Unlike Plan A, which took 210 days for completion, Plan B helped to finish the operation in 188 days. The total cost was also decreased from $78,500 to $72,000. These positive outcomes can be attributed to the efficiency of the tools being used for the planning process. It is noteworthy that the authors paid attention to the importance of certain factors in order to ensure that the comparison between both planning methods was fair [10].

Oyier et al. (2025) conducted research to explore the effects of project management in performance of residential construction projects in Nairobi City County by investigating several project management practices such as resource scheduling and stakeholder coordination. The data collection involved use of questionnaires that focused on people in the construction industry. It was noted that the success of the project execution is not solely relied on having a good construction schedule. Effective coordination and communication as well as acting promptly and having good management practices are also significant [8].

Tej Shah et al. (2025) conducted a survey on 431 construction industry practitioners to evaluate construction project management software programs, such as Microsoft Project, Wrike, and Powerplay Site Management. The researchers reported that Microsoft Project was the best software in six different criteria, although other software programs were good for different functions. The implication of the findings was that the choice of the software is dependent on the specific construction activities involved and on the users' experiences [11]. On the other hand, another team composed of **Darshit Shah et al. (2025)** also used the same tools, but reported that Powerplay Site Management too was the best in light of 77 respondents' perspectives. The difference in conclusions suggests that the criteria for evaluation should be better formulated and that none of the tools could be applied in every situation. It is better to focus on the results of scheduling and resource management [12].

Jane et al. (2026) examined the ways of improving construction scheduling and resource allocation through artificial intelligence (AI). They pointed out various AI techniques, particularly machine learning and predictive analytics enabling the analysis of project data, forecasting resource needs, identifying possible problems, and modifying time schedules. They showed the difficulties in the application of AI in terms of data quality, hardware needs, system linkage, and acceptance by workers in construction sphere. In fact, the implementation of these technologies assumes successful management of information and qualified staff. The research proposes to develop the trustworthy database for the projects and digital planning methods [13].

3. Thematic Synthesis of the Literature

The thematic synthesis of the literature are as follows:

1. The reviewed studies highlight that effective construction scheduling begins with identifying the various project activities, organizing them systematically, and establishing the correct sequence of work. Research conducted by Kamire et al. and Yadav et al. demonstrates how Work Breakdown Structures (WBS) and detailed activity lists can be used to divide residential building projects into manageable tasks [4]. Similarly, Al-Dhamad et al. emphasized the

importance of understanding activity relationships and applying critical path analysis to determine the sequence of work that influences overall project completion. Collectively, these studies indicate that a construction schedule should reflect the actual sequence and dependencies of site activities rather than simply assigning planned start and finish dates. A properly developed schedule provides a realistic framework for coordinating construction operations and monitoring project progress [10].

2. Maruthi et al. and Subramani and Karthick give particular attention to resource demand and levelling. Yadav et al. also report the use of resource levelling in a residential building. Together, they suggested that a useful schedule should reveal when resource demand exceeds availability and whether activities can be shifted without unacceptable effects on completion time [1], [2], [19].

3. The Al-Dhamad et al. and Yadav et al. connect scheduling and resource assignment with cost outcomes. Their reported case-study results indicate that better coordination can be associated with reductions in duration or resource-related expenditure. However, the numerical results are project-specific and depend on the quantities, productivity assumptions, resource rates and planning constraints used in each study [10].

4. Research on the usability and selection of software emphasizes that the selection of project management tools such as Microsoft Project should be dependent on certain criteria, user experience, and other factors related to the project [3], [11], [19]. It is important to base software choice on actual effectiveness rather than theoretical superiority. Moreover, successful project management in residential construction does not depend on scheduling software, but also entails effective communication, clarity of responsibilities, prompt decision making, and coordination of all involved parties. A carefully constructed schedule is effective only in case it is consistent with the conditions of the construction site and was constructed based on proper planning, accurate information, and available resources [7], [15], [16].

3.1 Comparative Summary of the Past Studies

The comparative summary of the Past Studies is shown in table 1:

Table 1: Comparative Summary of the Past Studies

Study	Main focus / method	Contribution reported	Use in proposed research
Maruthi et al. (2015)	Resource demand; MSP schedule and levelling	Explains allocation, levelling and fluctuating demand	Compare resource peaks and over-allocation
Subramani & Karthick (2018)	Fast-track commercial building; MSP and standard rates	Links activity schedules, resources and time-cost effects	Inform resource and duration data collection
Kamire et al. (2022)	Residential building schedule using MSP	Shows WBS/activity scheduling and software use	Inform activity list and Gantt schedule
Gunaga & George (2022)	Villa planning, scheduling and cost estimation	Connects schedule development with cost estimation	Inform cost-related schedule inputs
Thota et al. (2023)	Multi-storey residential resource planning	Highlights resource coordination in multi-storey work	Consider floor-wise and trade-wise resource demand
Aguda (2024)	Sustainable construction; case studies/interviews/LCA	Links scheduling/resource decisions with sustainability	Supporting context and future scope
Phophalia & Basu (2018)	MS Project vs Primavera; questionnaire	Compares software efficiency and effectiveness	Explain software selection criteria

Yadav et al. (2025)	G+3 residential building; MSP resource optimization	Reports duration/resource/cost changes after levelling	Most direct residential MSP reference
Al-Dhamad et al. (2025)	Two-storey building; manual vs software plan	Reports duration and cost comparison	Inform controlled comparison design
Oyier & Tumuti (2025)	Residential project performance; survey	Connects project-management practices with performance	Include management/coordination considerations
Tej Shah et al. (2025)	MSP, Wrike and Powerplay; 431 responses	Reports MSP leading on six parameters	Software-selection context
Darshit Shah et al. (2025)	MSP, Wrike and Powerplay; 77 responses	Reports Powerplay outperforming overall	Shows dependence on criteria/sample
Jane (2026)	AI-driven resource allocation and scheduling	Discusses predictive and adaptive scheduling and barriers	Future research direction

3.2. Proposed Framework for the Dissertation

According to literature, the study method has been proposed to evaluate normal manual planning method against that of MS Project method in construction scheduling. It involves the following main steps: the building project has to be selected after preparing the Work Breakdown Structure (WBS), then, the duration of activities has to be calculated and relationship of activity established, followed by determining the resources needed and preparing schedule using both manual and MS Project. The analysis will include critical path and resource utilization followed by performing comparison using various parameters such as project duration, time taken to prepare schedule and use of resources. The purpose of these methodology is to analyze the capability of both methods on the case of the project.

3.3. Suggested Comparison Parameters

Category	Measure	Suggested evidence
Time	Total planned duration; activity durations	Baseline schedule and project summary
Planning effort	Time to prepare and revise the schedule	Time log maintained by researcher
Logic	Predecessors, critical activities and float	Network diagram and critical-path report
Labour	Peak demand, total labour-days, over-allocation	Manual resource calculations and resource usage reports
Equipment	Demand periods, utilization and idle time	Equipment assignment records and usage reports
Cost	Labour and equipment cost under stated assumptions	Resource rates and cost calculations
Practical management	Ease of update, visibility and coordination issues	Observation notes and structured feedback

4. Conclusion

The review of the available literature on construction scheduling and resource management leads to the following important conclusions:

1. Successful construction scheduling is very crucial to the accomplishment of the projects in accordance with the established time and cost parameters. The approved schedule should list construction activities, the number of days necessary for their completion, as well as logical connections and order of these operations.

2. Construction scheduling is interrelated with resource management. Labor, materials, and tools should be synchronized with planned tasks to prevent delays, resource waste, and extra costs.
3. Research carried out by Maruthi and others and by Subramani and Karthick prove the significance of resource allocation and resource leveling in achieving the equilibrium of resource needs.
4. Research by Kamire et al., Yadav et al. and Al-Dhamad et al. shows effectiveness of Microsoft Project in construction scheduling, resource allocation, Gantt chart preparation, recognition of critical path and cost analysis. All these studies prove that electronic scheduling tools help in implementation of effective project planning and monitoring [4], [9], [10].
5. The literature review indicates that effectiveness of project management software depends on project requirements, assessment criteria, user knowledge and the correctness of the input data. No software for project management can be considered the best solution in any construction project.
6. Successful implementation of construction project depends not only on scheduling methods, but also on the possibility of effective communication among stakeholders, distribution of duties, time of procurement and site conditions. Practical experience and professional judgement are important for successful construction management.
7. The research studies reviewed offer a basis for assessing differences between manual scheduling and Microsoft Project scheduling in relation to the same project scope, activity characteristics, resource requirements, productivity assumptions, and work conditions.
8. All things considered, the suggested comparative study can compare the two approaches based on such parameters as time of schedule production, duration of the project, relationships between activities, critical path, resource demand, resource over-allocation, resource utilization, and resource costs. The research outcomes may reveal advantages and disadvantages of both methods.

Acknowledgement

The authors are very grateful to Prof. (Dr.) Vinay J. Patel, Principal, Birla Vishvakarma Mahavidyalaya Engineering College (BVM), and Prof. (Dr.) Reshma L. Patel, Civil Engineering Department, BVM, Vallabh Vidyanagar, Gujarat, India, for their unwavering encouragement, guidance, and significant institutional and infrastructure support for this research work. The authors are also thankful to Er. Mehul V. Oza, Proprietor/Head, Vimek Construction Co., for providing practical help and assistance for the completion of this research work.

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