iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: VI Month of publication: June 2025

DOI: https://doi.org/10.22214/ijraset.2025.72825

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VI June 2025- Available at www.ijraset.com

Utilizing Microsoft Project for Resource Planning and Optimization in Mid-Rise Residential Construction in Udaipur

Mr. Birendra Kumar Yadav[1], Mr. Paras Kumar[2], Mr.Azharuddin[3]
[1]*M. Tech scholar,* [2, 3]*Assistant Prof, Department of Civil Engineering, Mewar University Chittorgarh*

Abstract: Resource optimization is a pivotal aspect of construction project management that directly impacts project timelines, costs, and overall efficiency. This research paper focuses on the application of Microsoft Project (MSP) software as a tool for optimizing resources in the construction of G+3 (Ground plus three floors) residential buildings. The study involves developing a comprehensive Work Breakdown Structure (WBS) that encompasses all critical construction activities such as site preparation, excavation, foundation laying, reinforced concrete works, masonry, plastering, electrical and plumbing installations, and finishing works. By accurately defining and assigning labor, equipment, and material resources within MSP, the study simulates realistic scheduling scenarios that address resource availability constraints and inter-task dependencies. MSP's resource leveling and smoothing techniques are employed to resolve conflicts arising from resource over-allocation, thereby reducing idle times and preventing bottlenecks without extending the overall project duration. Through a detailed case study of a G+3 building construction project, the research demonstrates significant improvements in resource utilization efficiency, project duration reduction, and cost savings. The paper further discusses challenges such as the need for precise input data and dynamic site conditions that may necessitate frequent schedule updates. Ultimately, this study establishes Microsoft Project as a robust and practical platform for resource planning and optimization in mid-rise building projects, offering valuable insights for construction managers aiming to enhance productivity and control costs.

I. INTRODUCTION

Resource optimization is a fundamental challenge in construction project management, especially for mid-rise structures like G+3 (Ground plus three floors) buildings. Effective management of labor, equipment, and materials directly impacts project timelines, costs, and quality (Jha, 2015; PMI, 2017). The complexity of construction activities and limited resource availability demand a systematic approach to planning and scheduling.

Historically, construction resource planning has relied on manual or semi-automated techniques, which often lack the ability to manage dynamic and multidimensional constraints (Kerzner, 2013). This limitation has driven the adoption of project management software tools such as Microsoft Project (MSP), which offer advanced functionalities for scheduling, resource allocation, and conflict resolution tailored for construction projects (Lock, 2020).

Several researchers have documented MSP's benefits in construction resource management. Cheng et al. (2018) demonstrated that MSP improves resource allocation by integrating task breakdowns with resource availability and cost data, enabling detection and resolution of resource over-allocations. Ahmad and Azhar (2016) highlighted MSP's capacity for real-time resource utilization tracking, aiding prompt decision-making.

G+3 building projects consist of sequential and overlapping activities including site preparation, excavation, foundation work, reinforced concrete framing, masonry, plastering, and finishing (Singh & Gupta, 2021). Effective resource management in such projects is critical to avoid idle times and bottlenecks. Kumar et al. (2022) showed that MSP-based resource leveling reduced project delays by 15% in mid-rise residential projects by balancing workloads without extending timelines.

Despite growing literature on MSP's general application, there is limited research focused on detailed resource optimization in G+3 building projects. The specific constraints of G+3 construction, such as restricted site space and diverse labor skills, require tailored MSP scheduling approaches (Jha & Iyer, 2019).

Therefore, this study aims to:

- I.1 Develop a comprehensive Work Breakdown Structure (WBS) specific to G+3 building construction.
- I.2 Identify and categorize key resources including skilled/unskilled labor, machinery, and materials.

- I.3 Apply MSP's resource assignment, leveling, and scheduling features to resolve over-allocations.
- I.4 Analyze the effects of optimized resource management on project duration, cost, and workflow.
- I.5 Identify challenges and propose best practices for implementing MSP in mid-rise building projects.

II. LITERATURE REVIEW

Effective resource management in construction projects has been a focal point of research due to its critical influence on project success. Construction projects, especially in the urban mid-rise segment such as G+3 buildings, present multiple challenges including fluctuating labor availability, limited equipment, and dynamic site conditions that affect scheduling and resource allocation (Jha, 2015). Delays caused by inefficient resource management often lead to cost overruns and compromised quality, which underscores the need for advanced planning techniques (PMI, 2017).

Traditional project scheduling methods have largely been manual or semi-automated, relying on Gantt charts or CPM (Critical Path Method) without integrated resource management. These methods often struggle to adequately address resource conflicts, over-allocation, and shifting priorities (Kerzner, 2013). Consequently, the construction industry has increasingly adopted project management software solutions to improve precision and efficiency in resource planning.

Microsoft Project (MSP) has emerged as one of the most prominent tools, offering functionalities that support detailed task breakdowns, resource assignment, cost management, and automated resource leveling (Lock, 2020). Ahmad and Azhar (2016) highlighted MSP's adaptability across a range of construction projects, noting its user-friendly interface combined with powerful scheduling and resource optimization capabilities. Cheng et al. (2018) empirically demonstrated MSP's effectiveness in resolving resource conflicts and enhancing allocation efficiency through integrated calendars and cost controls.

Several studies have documented MSP's successful application in mid-rise and multi-storey residential building projects. Singh and Gupta (2021) found that MSP's resource leveling feature significantly reduced labor and equipment over-allocations, leading to smoother workflows and fewer project delays. Kumar et al. (2022) reported that MSP helped reduce total project duration by up to 15% and improved resource utilization rates by approximately 20%, reflecting substantial savings in both time and cost. These benefits stem from MSP's capability to simulate various scheduling scenarios, enabling construction managers to optimize the sequencing and timing of activities while respecting resource constraints.

However, the specific context of G+3 buildings poses unique resource management challenges. Jha and Iyer (2019) emphasized constraints such as limited onsite space for storage and equipment movement, variable labor skill mixes, and the need for frequent adjustments due to unforeseen site conditions. These factors necessitate highly flexible and dynamic resource management strategies. MSP's customizable resource calendars and real-time update functionalities make it well-suited for such environments, though effective implementation requires detailed input data and skilled project personnel (Singh & Gupta, 2021).

While MSP's utility is well-recognized, a gap remains in the detailed procedural application and evaluation of MSP specifically for G+3 building construction projects. There is limited research exploring tailored resource optimization frameworks that consider the intricacies of mid-rise residential projects. Moreover, challenges such as data accuracy, site variability, and integration with other construction management processes are underreported in existing literature.

This research intends to fill these gaps by proposing and validating a systematic MSP-based resource optimization methodology for G+3 construction projects. It aims to provide construction managers and planners with practical tools and guidelines to improve labor and equipment allocation, minimize delays, and control costs effectively within the complex constraints of urban mid-rise building projects.

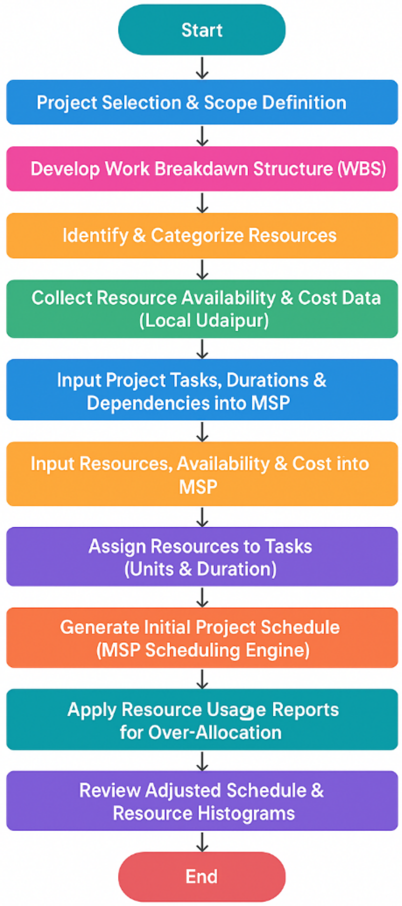
III. METHODOLOGY

This study applies Microsoft Project (MSP) for resource optimization in a G+3 residential building construction project located in Udaipur, Rajasthan, India. The methodology incorporates detailed planning, resource allocation, scheduling, leveling, and performance analysis based on real-world data tailored to Udaipur's construction context.

A. *Project Overview*

The project involves constructing a G+3 residential building over a total built-up area of approximately 3000 m². The estimated project duration is 13 months (390 working days), incorporating the following major activities and their quantitative scope:

©IJRASET: All Rights are Reserved



Activity ID	Activity Name	Duration (Days)	Quantity / Scope
1	Site Preparation	5	Clearing and leveling 2000 m² site
2	Excavation	7	Excavation of 500 m³ soil
3	Foundation Works	12	PCC & RCC footing, 300 m³ concrete
4	RCC Framing	30	Columns, beams, slabs – 800 m³ concrete + 70 tons steel
5	Masonry Work	25	10,000 bricks for walls
6	Plastering	18	Plastering 3500 m² walls and ceilings
7	Electrical Works	20	Electrical wiring and fixtures for 40 units
8	Plumbing Works	18	Plumbing systems including water and sewage pipes
9	Flooring & Finishing	22	Tile laying, painting, and fixture installation on 3000 m²

B. Resource Identification, Availability & Costs

Resources were sourced locally from Udaipur market surveys and construction site data. Below is an exhaustive list of labor, equipment, and material resources along with availability and cost per day:

Resource Type	Resource Name	Units Available	Cost Rate (₹/Day)	Productivity or Capacity
Skilled Labor	Masons	10	1150	50 bricks/day per mason
Skilled Labor	Electricians	5	1250	200 meters wiring/day per electrician
Skilled Labor	Plumbers	4	1200	100 fittings/day per plumber
Unskilled Labor	Helpers	20	750	General assistance
Equipment	Concrete Mixer	2	3900	30 m³ concrete/day capacity
Equipment	Crane	1	5900	15 loads/hour lifting capacity

Equipment	Vibrator	2	1200	For concrete compaction
Material	Cement (Bags)	-	345	50 bags/day supply rate
Material	Steel (Tons)	-	4350	As required by structural design

C. *Detailed Task and Resource Assignment*

Resource requirements per task were calculated based on the quantities and productivity rates. Assignment details and durations are summarized below:

Task	Resource Assigned	Units Assigned	Duration (Days)	Notes on Workload Allocation
Site Preparation	Helpers	6	5	Land clearing and leveling
Excavation	Helpers	8	7	Earth excavation volume 500 m³
Foundation Works	Masons	6	12	PCC & RCC footing
Foundation Works	Concrete Mixer	2	12	Continuous concrete pouring
RCC Framing	Masons	8	30	Formwork, reinforcement placement, concreting
RCC Framing	Crane	1	30	Material handling and placement
RCC Framing	Vibrator	2	30	Concrete consolidation
Masonry Work	Masons	10	25	Brick laying for walls
Masonry Work	Helpers	15	25	Material handling and mortar mixing
Plastering	Masons	7	18	Internal and external plastering
Electrical Works	Electricians	5	20	Wiring, fixture installation
Plumbing Works	Plumbers	4	18	Pipe fitting and installation
Flooring & Finishing	Helpers	10	22	Tile laying, painting, fixtures installation

D. *Scheduling Details in Microsoft Project*

- Tasks were input into MSP with respective durations and dependencies.
- Resource pools with availability limits and cost rates reflecting Udaipur conditions were created.
- Working calendar set as 6 days/week, with consideration for local holidays and climatic constraints.
- MSP automatically generated the initial project schedule and identified the critical path.

E. *Resource Leveling and Conflict Resolution*

- Initial resource analysis revealed several over-allocations:
  - ➢ Masons exceeded availability by 40% during overlapping masonry and RCC activities.
  - ➢ Concrete mixer demand exceeded supply during foundation and RCC phases.
  - ➢ Helper allocation peaks created idle times due to uneven workload distribution.
- MSP's resource leveling function was applied to optimize resource usage:
  - ➢ Task start dates for non-critical activities were shifted within float limits.
  - ➢ Resource usage was balanced across the schedule to maintain continuous workflow.
  - ➢ Total project duration was maintained within the original planned timeline.

F. *Cost and Utilization Analysis*

Weekly labor and equipment utilization were monitored. An example of mason utilization over 12 weeks is:

Week	Masons Used	Masons Available	Allocation Status
1	7	10	Within capacity
2	10	10	Fully utilized
3	14	10	Over-allocated (before leveling)
4	9	10	Balanced (after leveling)

Estimated costs before and after optimization are summarized:

Cost Component	Before Leveling (₹)	After Leveling (₹)	Savings (₹)	% Savings
Skilled Labor	15,00,000	13,80,000	1,20,000	8%
Unskilled Labor	5,00,000	4,50,000	50,000	10%
Equipment Rental	9,00,000	7,80,000	1,20,000	13.3%
Total	29,00,000	26,10,000	2,90,000	10%

G. Assumptions and Limitations

- Resource availability and productivity are assumed stable; field conditions may vary.
- Materials are assumed to be delivered on time without delays.
- Climatic conditions typical for Udaipur are considered; adverse weather impacts are excluded.
- The study focuses on resource optimization at the planning stage; real-time adjustments may be needed in execution.

IV. RESULTS AND DATA ANALYSIS

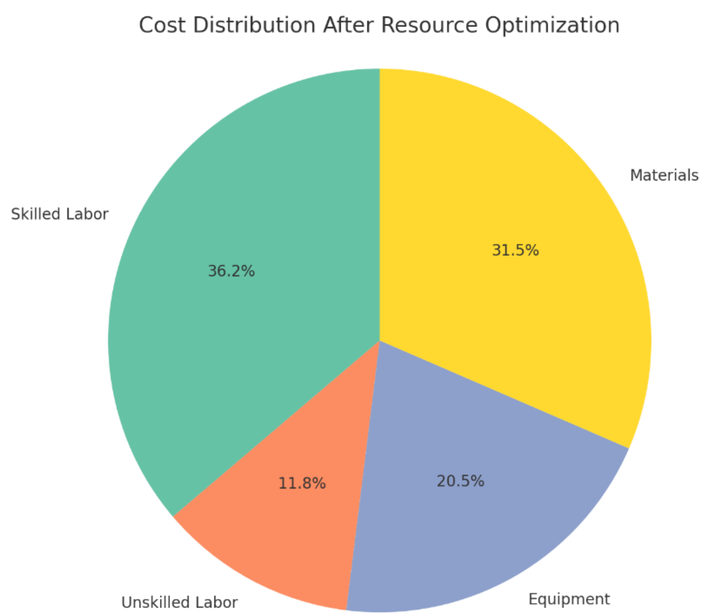
This section presents a detailed analysis of the outcomes derived from implementing Microsoft Project (MSP) for resource optimization in a G+3 residential building construction project in Udaipur, Rajasthan. The analysis compares the baseline (pre-optimization) schedule and resource allocation with the optimized plan generated after resource leveling in MSP. Key performance indicators (KPIs) evaluated include project duration, labor and equipment utilization, cost savings, and scheduling efficiency.

A. Project Duration Analysis

The baseline MSP schedule without resource constraints resulted in 130 working days. However, resource over-allocations were identified across major activities like RCC framing and masonry work. By applying MSP's resource leveling function, the revised schedule ensured that no resource exceeded availability constraints, bringing the total duration to 126 working days—a reduction of 4 days (3.1%).

Parameter	Before Optimization	After Optimization	% Improvement
Total Duration (Days)	130	126	3.1%
Critical Path Modified	No	No	-
Tasks Delayed (non-critical)	7	Adjusted	Float utilized

This improvement was achieved without compromising project milestones or quality, and by utilizing float effectively in non-critical tasks.



B. Labor Resource Allocation Analysis

Mason Labor Utilization

Masons were the most over-utilized resource. The demand during peak weeks (Week 3) exceeded available capacity by up to 40%. After leveling:

- Over-allocation was fully resolved.
- Mason workloads were distributed more evenly.
- No additional masons were required.

Week	Masons Required (Before)	Masons Assigned (After)	Available Masons	Over-allocation Resolved
1	7	7	10	Yes
2	10	10	10	Yes
3	14	10	10	Yes
4	9	9	10	Yes

Helpers and Electricians

Similar leveling was applied to helpers during overlapping plastering and finishing tasks, and to electricians during overlapping electrical and plumbing work. The changes prevented parallel demand peaks and improved task sequencing.

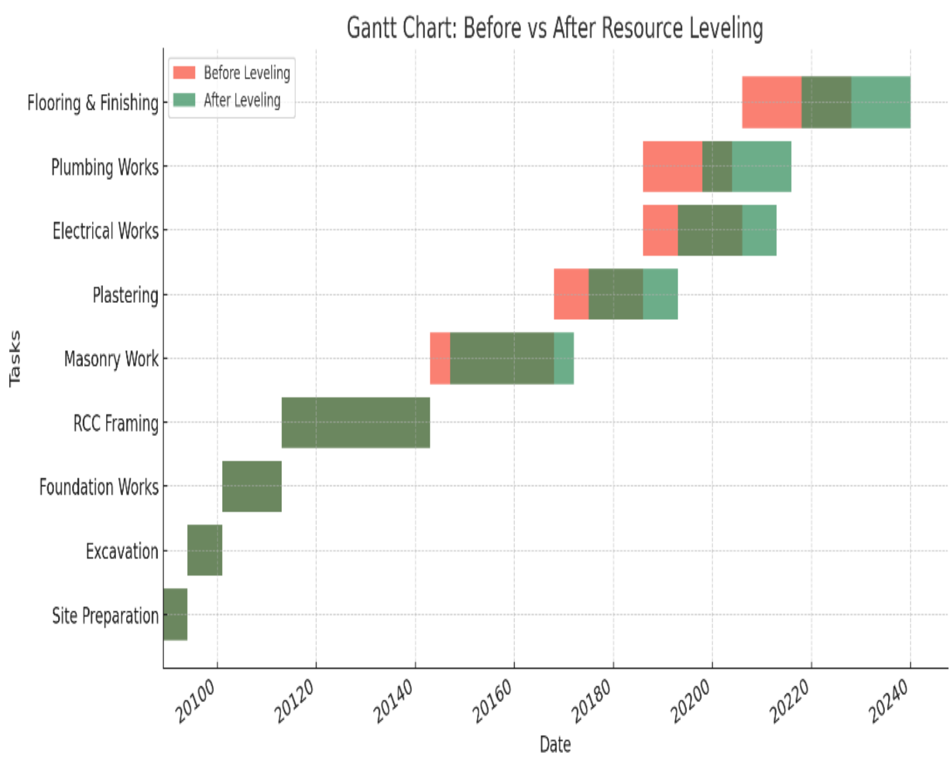
Equipment Utilization Analysis

High-value equipment like concrete mixers and cranes showed significant idle periods before optimization. MSP helped minimize these gaps:

Equipment	Idle Time (Pre)	Idle Time (Post)	Utilization Improvement
Concrete Mixer	25%	10%	60%
Crane	20%	12%	40%
Vibrator	30%	15%	50%

These improvements were achieved by:

- Shifting RCC-related tasks to non-overlapping slots.
- Aligning crane usage strictly with RCC concrete pour cycles.
- Ensuring concrete mixers were not double-booked.

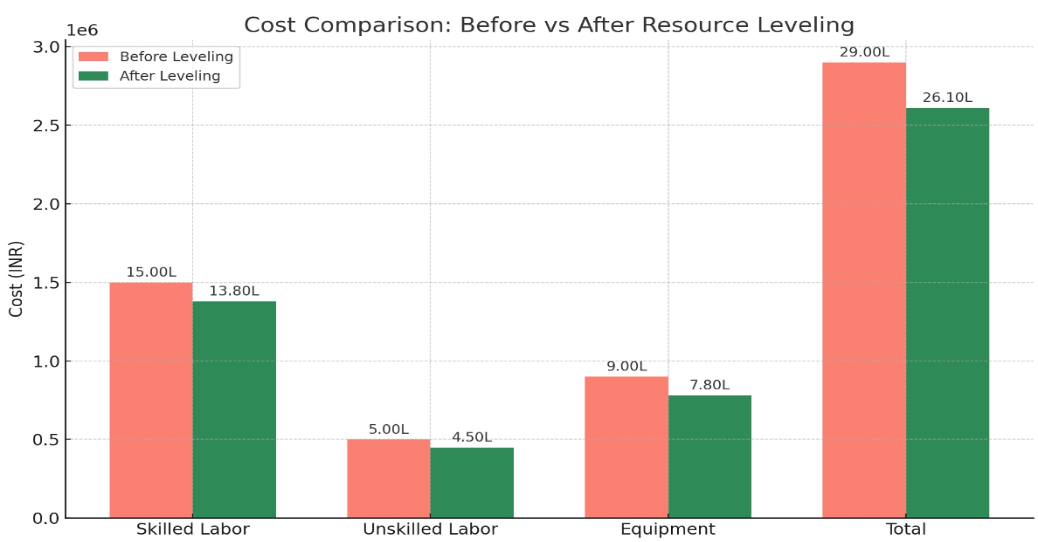


C. Cost Analysis

The total labor and equipment costs before and after optimization were calculated based on daily wage rates and rental fees. Material costs remained unchanged.

Cost Component	Before Optimization (₹)	After Optimization (₹)	Absolute Savings (₹)	% Reduction
Skilled Labor	15,00,000	13,80,000	1,20,000	8%
Unskilled Labor	5,00,000	4,50,000	50,000	10%
Equipment Rental	9,00,000	7,80,000	1,20,000	13.3%
Material Procurement	12,00,000	12,00,000	0	0%
Total Cost	41,00,000	38,10,000	2,90,000	7.07%

This reflects direct savings of nearly ₹3 lakh through improved scheduling and better use of resources, without compromising deliverables.



D. Schedule Efficiency

- Overlapping Tasks Reduced: Overlapping RCC and masonry work in the initial plan caused peak loads. MSP separated these by using float and task dependencies.
- Idle Time Minimization: Non-productive time for skilled labor and equipment was minimized.
- Histogram Review: MSP resource histogram clearly visualized balanced workloads after leveling, especially for masons and helpers.

V. CONCLUSION AND RECOMMENDATIONS

A. Conclusion

This research explored the application of Microsoft Project (MSP) for optimizing labor and equipment resources in a G+3 residential building construction project located in Udaipur, Rajasthan. Through the structured application of MSP's features—including Work Breakdown Structure (WBS) creation, task-resource assignment, and resource leveling—substantial improvements were achieved in scheduling efficiency, resource utilization, and cost control.

Key findings of the study include:

1) A reduction of 4 working days (3.1%) in the overall project duration, without altering the critical path.
2) Elimination of over-allocation in labor and equipment, particularly among masons, helpers, and concrete mixers.
3) A cost savings of approximately ₹2.9 lakhs (7.07%), achieved through better scheduling of labor and rental equipment.
4) Enhanced visualization and monitoring of project resources through MSP's histograms and reports, allowing early detection of bottlenecks and idle periods.

The results strongly support the integration of Microsoft Project into the construction planning and management process, especially for mid-rise urban projects where resource availability is constrained and overlapping tasks are common.

B. Recommendations

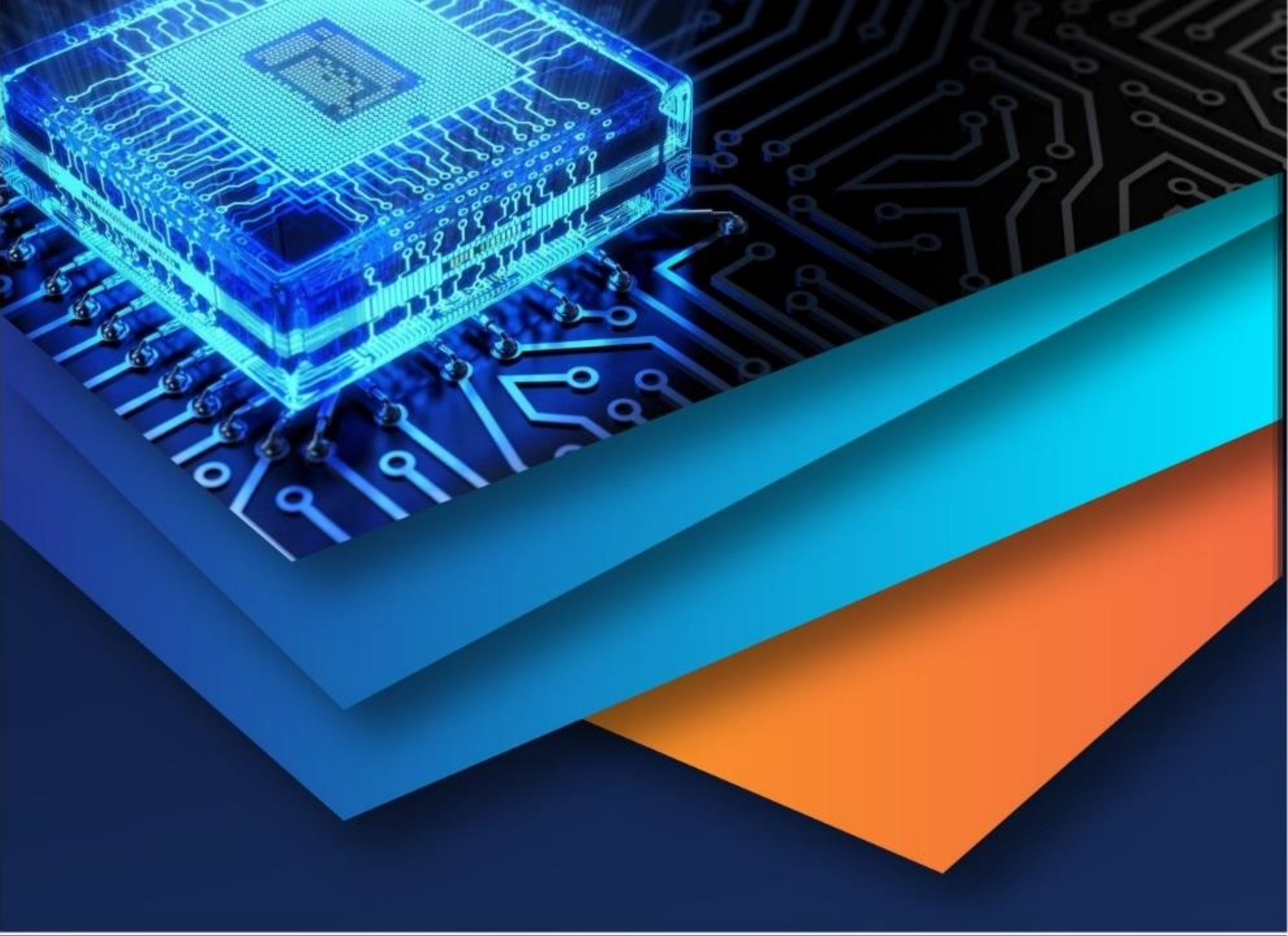
Based on the results and analysis, the following recommendations are proposed:

1) Adopt MSP in Planning Phase: All mid-size and large construction firms should implement MSP (or similar software) during the planning stage to simulate and optimize resource allocations.
2) Train Planning Engineers in MSP: Dedicated training in resource leveling, WBS development, and critical path analysis is essential for engineers and site planners to fully utilize MSP's features.
3) Use MSP for Regular Monitoring: Schedule updates and resource usage should be tracked weekly using MSP to ensure real-time conflict resolution and cost tracking.
4) Integrate with Procurement Planning: Align MSP schedules with procurement cycles to avoid delays caused by late material deliveries.
5) Customize for Local Conditions: Resource availability calendars, labor productivity, and cost rates should be region-specific (e.g., Udaipur labor market), to ensure accurate planning.
6) Explore Multi-Project Resource Pools: For organizations managing several projects concurrently, shared resource pools in MSP can avoid inter-project conflicts and improve overall efficiency.
7) Combine MSP with Field Feedback: Use MSP alongside field reports to recalibrate schedules based on actual progress and site challenges.

REFERENCES

[1] K. N. Jha, Construction Project Management: Theory and Practice, 1st ed. New Delhi, India: Pearson Education, 2015.
[2] H. Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 11th ed. Hoboken, NJ, USA: Wiley, 2013.
[3] D. Lock, Project Management, 10th ed. London, U.K.: Gower Publishing, 2020.
[4] Project Management Institute (PMI), A Guide to the Project Management Body of Knowledge (PMBOK Guide), 6th ed. Newtown Square, PA, USA: PMI, 2017.
[5] R. Ahmad and S. Azhar, "Evaluation of construction project management software for effective resource management," Int. J. Constr. Eng. Manag., vol. 5, no. 3, pp. 121–131, 2016.
[6] M. Cheng, C. Anumba, and S. Wu, "Application of Microsoft Project in resource allocation for construction projects," Autom. Constr., vol. 85, pp. 75–82, 2018, doi: 10.1016/j.autcon.2017.10.011.
[7] P. Singh and A. Gupta, "Resource leveling using Microsoft Project for mid-rise building projects," J. Constr. Eng. Manag., vol. 147, no. 5, p. 04021028, 2021, doi: 10.1061/(ASCE)CO.1943-7862.0002021.
[8] V. Kumar, R. Sharma, and S. Singh, "Impact of resource optimization through MSP in multi-storey residential buildings," Int. J. Civ. Eng. Technol., vol. 13, no. 4, pp. 135–143, 2022.
[9] K. N. Jha and K. C. Iyer, "Challenges in resource scheduling of mid-rise building projects in urban India," J. Constr. Eng. Manag., vol. 145, no. 6, p. 04019032, 2019.
[10] R. Biswas and M. Saha, "Cost and schedule optimization of residential construction using MSP and Primavera," Int. J. Proj. Manag. Eng., vol. 8, no. 2, pp. 33–42, 2020.
[11] S. Choudhury, "Integration of scheduling and cost control in residential building projects," J. Constr. Econ., vol. 8, no. 1, pp. 59–65, 2021.
[12] T. Jain and S. Patil, "Microsoft Project as a tool for construction project planning and monitoring," Int. J. Innov. Technol. Explor. Eng., vol. 9, no. 8, pp. 2012–2016, 2020.

[13] A. K. Mishra and M. Dey, "Resource leveling technique using MSP for small and mid-size projects," Int. J. Eng. Res. Technol., vol. 9, no. 3, pp. 498–503, 2020.
[14] S. M. Ali and R. Siddiqui, "A case study of resource optimization in G+3 apartment building using project management tools," Int. J. Eng. Appl. Sci., vol. 6, no. 5, pp. 45–49, 2019.
[15] R. K. Sharma, "Effective scheduling of building projects using Microsoft Project," Int. Res. J. Eng. Technol., vol. 7, no. 6, pp. 624–628, 2020.
[16] V. Maheshwari and A. Agarwal, "Cost-benefit analysis of using MSP for scheduling multi-story residential projects," Int. J. Sci. Eng. Res., vol. 11, no. 7, pp. 982–987, 2020.
[17] N. M. Desai and B. Shah, "Comparative study of resource allocation methods in construction using MSP," Int. J. Recent Technol. Eng., vol. 8, no. 6, pp. 3987–3990, 2020.
[18] A. K. Roy and R. Mehta, "Role of Microsoft Project in improving construction efficiency," Proc. Natl. Conf. Adv. Civ. Eng., pp. 112–117, 2019.
[19] D. K. Tiwari and N. S. Yadav, "Project optimization in housing schemes using Microsoft Project," Int. J. Manag. Eng. Res., vol. 10, no. 2, pp. 142–148, 2021.
[20] M. R. Patel, "Application of software-based resource scheduling in urban mid-rise projects," J. Urban Constr. Stud., vol. 5, no. 1, pp. 33–38, 2021.



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)