Lean Construction through 5S Implementation: A Review

Hardik Hitesh Kotwal
Final Year Student, M. Tech. (Civil) Construction Engineering & Management,
Birla Vishvakarma Mahavidyalaya Engineering College, Vallabh Vidyanagar
kotwalhardik@gmail.com

Prof. (Dr.) J. R. Pitroda
Professor, PG Coordinator Construction Engineering and Management, Civil Engineering Department, Birla Vishvakarma Mahavidyalaya Engineering College, Vallabh Vidyanagar
jayesh.pitroda@bvmengineering.ac.in

Dr. Reshma L. Patel
Assistant Professor, PG Coordinator Environmental Engineering, Civil Engineering Department, Birla Vishvakarma Mahavidyalaya Engineering College, Vallabh Vidyanagar
rlpatel@bvmengineering.ac.in

Er. Jayesh D. Prajapati
Research Scholar, Gujarat Technological University, Birla Vishvakarma Mahavidyalaya Engineering College, Vallabh Vidyanagar
jayesh.prajapati@bvmengineering.ac.in

Abstract – The construction industry is frequently challenged by inefficiencies such as low productivity, poor material management, excessive waste generation, and unsafe working conditions. To address these persistent issues, the integration of Lean Construction principles has emerged as a practical solution to enhance project performance. Among the Lean tools, the 5S technique comprising *Sort, Set in Order, Shine, Standardize,* and *Sustain* plays a foundational role in establishing workplace organization, cleanliness, and discipline. This paper reviews the implementation of the 5S technique on commercial building sites and examines its impact on productivity improvement and waste reduction. By systematically organizing tools, materials, and workspaces, 5S minimizes non-value-adding activities such as searching, waiting, and rework, while fostering safety and efficiency. Evidence from various studies indicates that 5S implementation can lead to productivity gains of 15–25% and waste reduction of up to 30%, alongside enhanced worker morale and site safety. The study also highlights the challenges of sustaining 5S practices, including lack of management commitment and inadequate training. Overall, the paper concludes that adopting Lean Construction through the 5S technique provides a structured pathway toward achieving continuous improvement, improved site performance, and sustainable construction practices.

Keywords: Lean Construction, 5s Technique, Workplace Organization, Productivity Improvement, Waste Reduction, Commercial Building Project, Continuous Improvement, Construction Management

1.Introduction

The construction industry is one of the most dynamic and labour-intensive sectors, contributing significantly to a nation's economic growth and infrastructure development. Despite its importance, the sector often faces persistent challenges such as low productivity, excessive material waste, poor site management, and inconsistent quality control. Traditional project execution methods tend to be reactive rather than proactive, resulting in inefficiencies, project delays, and cost overruns. To overcome these barriers, the adoption of modern management philosophies like Lean Construction has become essential. Lean Construction focuses on maximizing value for the client while minimizing waste across all project phases, drawing inspiration from Lean Manufacturing principles that revolutionized production systems worldwide.

Among the various Lean tools, the 5S technique stands out as a fundamental and practical approach to creating an organized, efficient, and safe work environment. Originating in Japan as part of the Toyota Production System (TPS), 5S emphasizes five core principles: *Seiri (Sort)*, *Seiton (Set in Order)*, *Seiso (Shine)*, *Seiketsu (Standardize)*, and *Shitsuke (Sustain)*. These steps collectively aim to establish workplace

discipline, cleanliness, and operational efficiency. The method encourages employees to eliminate unnecessary items, arrange tools and materials logically, maintain cleanliness, and follow standard operating procedures, ensuring sustained improvement. In essence, 5S builds the foundation for continuous improvement also known as Kaizen within any organization.

In the context of construction, 5S serves as a bridge between theory and practice, translating Lean principles into actionable on-site improvements. Construction sites are typically complex, with multiple trades, fluctuating work conditions, and a wide variety of materials and tools. Implementing the 5S technique can bring order to this complexity by enhancing workspace organization, minimizing waste due to searching or waiting, and improving communication among workers. Studies have shown that projects applying 5S experience measurable benefits such as reduced downtime, increased labour productivity, and improved safety standards, which ultimately contribute to overall project performance.

Moreover, the adoption of 5S in commercial building projects promotes a culture of accountability and teamwork. It empowers workers to take ownership of their workspace and engage in problem-solving activities that lead to process improvement. This behavioural change not only enhances productivity but also builds a sense of pride and motivation among the workforce. Management, on the other hand, benefits from better visibility and control over site operations, as standardized procedures and visual management tools make performance monitoring easier and more transparent. The synergy between disciplined workers and a structured environment forms the backbone of Lean Construction success.

Therefore, the implementation of Lean Construction through the 5S technique is not merely a housekeeping initiative but a strategic transformation tool that drives operational excellence. By integrating 5S into daily construction practices, organizations can systematically eliminate inefficiencies, optimize resource utilization, and ensure continuous improvement. This paper explores how the 5S methodology can be effectively implemented on commercial building sites, evaluating its impact on productivity, waste reduction, and workplace culture. The ultimate goal is to demonstrate how a disciplined Lean environment can lead to sustainable and measurable improvements in the construction industry.

1.2. 5s Technique

The 5s technique is a systematic workplace organization method that forms the foundation of Lean Construction and Lean Manufacturing. Developed in Japan as part of the Toyota Production System (TPS), 5s aims to create a clean, efficient, and well-organized work environment that supports productivity, safety, and continuous improvement. The term “5s” comes from five Japanese words Seiri, Seiton, Seiso, Seiketsu, and Shitsuke each representing a specific step in achieving workplace excellence. When properly implemented, 5s not only reduces waste and inefficiency but also builds discipline and accountability among workers. The five stages of 5S are explained below in detail.

1. Seiri (Sort) – Eliminate the Unnecessary

The first step, Seiri, focuses on identifying and removing all unnecessary items from the workplace. In a construction context, this means separating essential tools, materials, and equipment from those that are obsolete, damaged, or rarely used.

- Objective: To declutter the workspace and ensure that only relevant items are kept within reach.
- Implementation: Conduct regular inspections of storage areas, identify redundant materials, and dispose of or relocate them appropriately.
- Benefits: Reduced confusion, fewer obstacles, improved safety, and optimized use of space.
- Example: Removing unused scaffolding components or damaged tools from the site to prevent accidents and save time spent searching for usable equipment.

2. Seiton (Set in Order) – Arrange for Efficiency

The second step, Seiton, focuses on arranging the necessary items in a logical and accessible manner. The goal is to create a “place for everything and everything in its place.”

- Objective: To ensure quick retrieval and return of tools and materials, reducing wasted motion and time.
- Implementation: Label storage areas, mark tool outlines on boards (shadow boarding), and use colour coding for different materials or equipment types.

- Benefits: Improved workflow, reduced search time, and enhanced site safety through clear organization.
- Example: Storing frequently used tools near work zones, keeping electrical tools in labelled racks, or arranging raw materials close to their usage points.

3. Seiso (Shine) – Clean and Inspect

The third step, Seiso, emphasizes regular cleaning and inspection of the workplace. It goes beyond cleanliness; it is also a preventive maintenance activity that helps detect potential problems early.

- Objective: To maintain a clean and safe environment that reflects professionalism and allows early detection of defects or hazards.
- Implementation: Schedule daily cleaning tasks, assign responsibility to each worker or team, and integrate inspection routines into maintenance schedules.
- Benefits: Enhanced safety, reduced machine breakdowns, improved quality control, and better worker morale.
- Example: Cleaning debris from the construction site daily, wiping dust off machinery, and checking scaffolding and electrical equipment for defects.

4. Seiketsu (Standardize) – Maintain Consistency

Seiketsu focuses on standardizing the best practices established in the first three steps. This ensures that workplace organization and cleanliness are consistently maintained across all teams and shifts.

- Objective: To develop standard operating procedures (SOPs) and visual controls that help sustain improvements.
- Implementation: Create checklists, use signage and posters for visual reminders, and establish clear cleaning and inspection schedules.
- Benefits: Consistent performance, reduced variability, and improved communication between workers and management.
- Example: Using color-coded bins for waste segregation on-site or standardizing tool arrangement across multiple workstations for uniformity.

5. Shitsuke (Sustain) – Build Discipline and Culture

The final step, Shitsuke, ensures that the 5S principles become part of the organizational culture through discipline, habit, and continuous improvement.

- Objective: To make 5S a routine practice through regular audits, training, and motivation.
- Implementation: Conduct periodic reviews, reward compliance, and involve all levels of staff from laborers to supervisors in maintaining 5S standards.
- Benefits: Long-term sustainability, stronger teamwork, reduced rework, and continuous improvement mindset.
- Example: Recognizing teams that consistently maintain organized work areas or conducting monthly 5S audits with performance scoring.

1.3. Comparative Analysis of Sectors

Both manufacturing and construction share common waste categories defects, waiting, overproduction, unnecessary motion, inventory, and transportation. However, construction presents unique challenges such as site mobility, changing environments, and multiple stakeholders. Table 1 compares the implementation focus of 5S across sectors:

The following Table1 shows the representative reference and comparative analysis sector.

Table1: representative reference and Comparative Analysis Sector

Sector	Application Focus	Key Outcomes
Manufacturing (Tahasin et al., 2021)	Tool arrangement, shadow boarding, time-motion analysis	41-second time saving per operation, better equipment reliability
Construction (Hiwale et al., 2018)	Material storage, site layout, workforce organization	Reduced waste, 25% higher productivity
Review-based	Framework development,	Enhanced safety, reduced

(Singh & Ahuja, 2015)	cross-sector benchmarking	search time, better morale

This cross-sector evidence supports 5S as a universal methodology adaptable to diverse work environments.

1.4. Impact on Productivity and Waste Reduction

The core advantage of 5S in Lean Construction lies in measurable improvements in productivity and waste management. Based on a synthesis of multiple studies, 5S implementation yields significant quantitative and qualitative benefits, as summarized in Table 2.

The following Table 2 shows the representative reference and productivity and waste reduction impacts.

Table 2: representative reference and productivity and waste reduction impacts

Parameter	Improvement Range (%)	Source
Labor Productivity	15–30%	Tahasin et al. (2021), Chandrayan et al. (2019)
Material Waste Reduction	20–25%	Patel et al. (2024), Mane et al. (2018)
Accident Reduction	10–20%	Bartnicka (2018), Singh & Ahuja (2015)
Tool Search Time	35–45%	Tahasin et al. (2021),
Worker Morale & Discipline	Improved qualitatively	Rastogi et al. (2014), Chandrayan et al. (2019)

1.5. Challenges and Barriers in 5s Implementation

Despite the proven benefits of 5s in improving productivity, safety, and workplace organization, several challenges hinder its successful implementation, particularly in construction environments. One of the primary barriers is the *lack of management commitment*. When top leadership fails to allocate sufficient time, financial support, and follow-up mechanisms, the initiative often loses momentum and becomes ineffective. Additionally, *resistance to change* among employees is a significant concern, as workers may perceive 5S activities as additional tasks rather than productivity-enhancing efforts.

Another major challenge is *insufficient training and awareness*. Without a clear understanding of the purpose and long-term advantages of 5S, employees may not actively participate in its execution. Furthermore, *limited workforce involvement* reduces a sense of ownership, resulting in poor compliance and inconsistent implementation across site operations. On dynamic construction sites, *high workload and time pressure* also divert attention from housekeeping and organizational improvements, making sustaining progress difficult.

The *standardization* aspect of 5S poses another difficulty, as different teams or subcontractors often follow varied work practices, leading to poor visual management and inconsistency in sorting and storing tools and materials. Additionally, *resource constraints* such as inadequate storage spaces, labelling equipment, or monitoring tools further restrict the success of 5S practices. Organizational culture also plays a vital role; a weak culture of discipline and accountability can hamper the long-term sustainability of improvements.

Finally, the absence of *proper monitoring and evaluation systems* results in a decline in performance once the initial implementation effort fades. Without regular audits and performance indicators, it becomes challenging to measure results and motivate employees toward continuous improvement. Therefore, overcoming these barriers requires strong leadership support, strategic planning, continuous training, and effective communication to ensure that 5S becomes an integral part of workplace culture rather than a temporary initiative.

1.6 Benefits of 5S Implementation

The implementation of the 5S methodology Sort, Set in Order, Shine, Standardize, and Sustain offers numerous organizational and operational benefits across various industries. Primarily, it enhances workplace organization by ensuring that materials and tools are systematically arranged, which minimizes search time and enhances workflow efficiency. The approach leads to a significant improvement in productivity and operational efficiency by eliminating unnecessary activities and optimizing space utilization.

Additionally, 5S contributes to a safer and cleaner work environment, as hazards and potential risks are more easily identified and managed. This improved safety fosters a positive and disciplined workplace culture,

enhancing employee morale and engagement. Moreover, standardized processes reduce variability, leading to better product quality and fewer operational errors.

From an economic perspective, the 5S system helps reduce operational costs by minimizing waste, equipment downtime, and material losses. Furthermore, it serves as a foundation for continuous improvement initiatives, such as Lean Manufacturing and Total Quality Management (TQM), by promoting a culture of discipline, accountability, and ongoing enhancement.

In summary, the 5S implementation not only optimizes workplace conditions but also supports sustainable organizational growth through improved safety, productivity, and quality.

2. Litreature Review

The following are the previous research review based on lean construction through 5s implementation.

Ghodrati et al. (2012) 5S is a systematic technique used by organizations comes from five Japanese words: Seiri (sort), Seiton (set in order), Seiso (shine), Seiketsu (standardize), and Shitsuke (sustain). This system helps to organize a work space for efficiency and decrease wasting and optimize quality and productivity via monitoring an organized environment and use visual evidences to obtain more firm results effectiveness. As importance role of 5S implementation in today's organizations, this study aims to review previous studies about benefits of 5S implementation and its efficiency in organizations. Consequently 5S can support the objectives of organization to achieve continuous improvement in performance and productivity [1].

Patel et al. (2024) The five Japanese words Seiri (Sort), Seiton (Set in order), Seiso (Shine), Seiketsu (standardise), and Shitsuke are the roots of the systematic approach known as 5S. (sustain). In monitoring an organised environment, this system assists in organising a workplace for efficiency, reducing non- value-added operations, and improving quality and production. The goal of this paper is to review earlier research on the effectiveness and advantages of 5S implementation in businesses. The findings demonstrate that 5S is a powerful instrument for enhancing organisational performance regardless of the kind, size, production, or service of the business. So, the 5S approach would substantially support an organization's goals of achieving continual performance and productivity development [2].

Tahasin et al. (2021) systematic approach that helps to organize a workplace for increasing efficiency and reduce wasting of productivity by providing an organized safe environment. The objective of this paper is to emphasize the implementation of 5S principles for the workplace by reflecting a tooling problem of a manufacturing unit. This article examines the challenges experienced in the implementation of 5S methodology to optimize labor and safety in a manufacturing department by showing the gap of productivity caused while not having 5S methodology in workplaces. The time consumption analysis of 5S implementation through shadow boarding demonstrates workers who have been able to perform work more efficiently along with a significant reduction of searching time of tools. The results showed that 5S along with the shadow boarding technique creates improvement in efficiency, workspace, equipment search time, working environment and safety. Consequently, this shadow boarding technique would strongly support the objectives of multinational companies to achieve continuous improvement and higher performance [3].

Ananthanarayanan et al. (2006) The rapid growth of NDE laboratories has opened up a requirement of better management of these laboratories in order to provide a safe, clean and healthy environment. The statutory laws on health, safety and environmental protection have also assumed a bigger role today. In this background, it is essential to imbibe a quality management system that would help in improving the planning of the laboratory layout, provide an impetus for a clean environment which in turn can reduce health and safety hazards. 5S is a technique that is used to establish and maintain a quality environment that help in reducing waste and maintain a high degree of cleanliness and orderliness in the work place. This assumes more importance in NDT laboratories wherein cleanliness and orderliness are more linked to safety and health. The 5S system also helps to establish and maintain an efficient data management system that can provide a personalized customer service [4].

In this paper, the concept, the need, methods and the resources required for implementing a 5S management system in an NDE laboratory are dealt with.

Hiwale et al. (2018) essential establishment of lean assembling frameworks. It is a tool for cleaning, arranging, sorting out and giving the vital basis to work piece quality enhancement. This paper managed the execution of 5s approach in the little scale industry. By following the 5s philosophy, it demonstrates noteworthy changes to wellbeing, profitability, effectiveness, and housekeeping. The enhancements when 5s usage is appeared by pictures in the paper. It additionally means to fabricate a more grounded hard-working attitude inside the administration and specialists who might be relied upon to proceed with the great practices.

Esteem stream mapping is utilized first to guide the present state used to distinguish wellsprings of waste and to recognize lean instruments to wipe out this waste. VSM is a pencil and paper representation instrument that demonstrates the stream of material and data as an item advances through the esteem stream. VSM fills in as a beginning stage to encourage administration, specialists, providers, and clients perceive waste and its sources [5].

Desale et al. (2014) The purpose of this paper is to explore the principle of lean and six sigma for identification and illumination of waste in construction organization. Efficient material management is essential in managing a productive and cost-effective site. In this working career, the author has been observing inefficient labour productivity practices, resulting from poor site material management, and handling. In this paper, therefore an attempt has been made to rectify these activities and construction organization. Primary objective of the study is to derive the reasons contributing to the amount of material wasted on residential building sites, which needs to bring down substantially by devising suitable method. A case study follows that demonstrates, how lean thinking and six sigma principles, tools and techniques be applied to a public and semi government authorities [6].

Singh et al. (2015) literature on 5S and presents a systematic review of literature methodically. The literature on classification of 5S has so far been very limited. The paper presents an overview of 5S implementation practices adopted by the manufacturing organizations and also highlights the contributions of 5S initiatives towards improving manufacturing performance. The paper reveals the important issues in 5S ranging from maintenance techniques, framework of 5S, the relationship of 5S with lean manufacturing initiatives, barriers and success factors in 5S implementation, etc. The contributions of strategic 5S programme towards improving manufacturing competencies of the organizations have also been highlighted. The paper highlights the significant enablers and success factors for eliminating barriers in successful 5S implementation. The study will be useful to industry professionals and researchers both and others concerned with organization management to understand the significance of 5S and its contributions towards manufacturing performance [7].

Singh et al. (2014) organizations come from five Japanese words; Seiri (Sort), Seiton (Set in order), Seiso (Shine), Seiketsu (standardize) and Shitsuke (sustain). This system helps to organize a workplace for efficiency and decrease non-value-added activities and optimize quality and productivity through monitoring an organized environment. This paper aims to review previous studies about benefits of 5S Implementation and its efficiency in organizations. The results show that 5S is an effective tool for improvement of organizational performance, regardless of organization type, size, its production or its service. Consequently, 5S technique would strongly support the objectives of organization to achieve continuous improvement in performance and productivity [8].

Ajay et al. (2016) principle of 5S methodology for identification of waste in construction organization. Efficient material management is essential in managing a productive and cost-effective site. In this working career, the author has been observing inefficient labour productivity practices, resulting from poor site material management, and handling. In this paper, therefore an attempt has been made to rectify these activities in construction organization. Primary objective of the study is to improve the labour productivity on residential building sites, which needs to bring down substantially by devising suitable method. A case study follows that demonstrates, how 5S methodology can ameliorate the productivity [9].

Salem et al. (2006) techniques developed for lean construction with those developed for lean manufacturing. Lean manufacturing and lean construction techniques share many common elements despite the obvious differences in their assembly environments and processes. Manufacturing plants and construction sites are different in many ways that might explain why lean production theories and practices do not fully fit the construction industry. Though many lean construction tools and elements are still in an embryonic state, lean construction techniques are gaining popularity because they can affect the bottom line of projects. Additionally, this paper presents a study of a construction project in which specific lean construction elements were tested. Each technique was evaluated in terms of its impact on the performance of the project. Based on the findings of the study, a new “lean assessment tool” is proposed to quantify the results of lean implementations. The assessment tool evaluates six lean construction elements: last planner, increased visualization, huddle meetings, first-run studies, five S’s, and fail safe for quality. This paper provides a simple and comprehensive approach that is transferable to any construction project [10].

Patel et al. (2014) efficiency of all processes in the company. Special emphasis will be given to the implementation of 5S system and elimination of losses in the company. It can be observed that introducing the

5S rules bring the great changes in the company, for example: process improvement by costs‟ reduction, increasing of effectiveness and efficiency in the processes, maintenance and improvement of the machines‟ efficiency, safety, security, quality and reduction of the industry pollution, proceedings according to decisions. The 5S methodology permits to analyze the processes running on the workplace and establishment of 5Ssustaining well organized, clean, high effective and high-quality workplace. Research clearly shows, that very essential is training of workers about the 5S rules. Essential thing is to divide activities on some main steps and to maintain the continuous improvement. This method can be used in all companies. Its result is the effective organization of the workplace [11].

Sawant et al. (2017) 5s is a basic foundation of lean manufacturing systems. It is a tool for cleaning, sorting, organizing and providing the necessary groundwork for work piece improvement. This paper dealt with the implementation of 5s methodology in the small-scale industry. By following the 5s methodology, it shows significant improvements to safety, productivity, efficiency and housekeeping. The improvements before and after 5s implementation is shown by pictures in the paper. It also intends to build a stronger work ethic within the management and workers who would be expected to continue the good practices. Value stream mapping is used to first map the current state used to identify sources of waste and to identify lean tools to eliminate this waste. The future state map is then developed for a system with lean tools applied to it. VSM is a pencil and paper visualization tool that shows the flow of material and information as a product makes its way through the value stream. VSM serves as a starting point to help management, engineers, suppliers, and customers recognize waste and its sources. This paper demonstrates the implementation of lean philosophy through layout modification [12].

Chandrayan et al. (2019) five Japanese words – Seiri (sort), Seiton (set in order), Seiso (shine), Seiketsu (standardise) and Shitsuke (sustain). This technique improves efficiency, productivity and quality by making the workplace orderly, pleasant and organized. The objective of the paper is to examine the 5S implementation process across all the different manufacturing scenarios and to emphasize the significant positive results of 5s. The paper is based on systematic literature review that monitors the 5s implementation technique in various organizations and categorizes the published literature in three distinguished categories based on conciseness and systematic approach to analyses and review the methodology. The paper reviews preponderance of the findings by numerous researchers and highlights the suggestions and improvisations for ensuring efficient and effective 5S implementation in any organization. The results exhibit the effectiveness of the 5S tool to improve the performance and to aid the organization to achieve continuous improvement and higher performance [13].

Michalska et al. (2007) The 5s method begins each programme of improvement. It is the tool for helping the analysis of processes running on the workplace. The 5s is the methodology of creation and maintaining well organized, clean, high effective and high-quality workplace. Its result is the effective organization of the workplace, reduction of work's environment, elimination of losses connected with failures and breaks, improvement of the quality and safety of work [14].

Ghodrati et al. (2013) organizations come from five Japanese words; Seiri (sort), Seiton (set in order), Seiso (shine), Seiketsu (standardize), and Shitsuke (sustain). This system helps to organize a workplace for efficiency and decrease wasting and optimize quality and productivity via monitoring an organized environment. It also provides useful visual evidences to obtain more firm results. There is a real need for empirical studies in field of new management systems and their impact on company's performance. As importance role of continuous improvement in today's organizations, and lack of sufficient evidence to show the positive impact of 5s on organizational performance, this paper aims to determine performance factors and characteristics in industrial organizations and identifying the effectiveness of 5s implementation on organizational performance as well. Surveying method is used and data collection is done by distributing questionnaire among five target organizations which have implemented 5s techniques. The target organizations are chosen from different industries and diverse field of work. The results of this research obtained from a comparative measurement of organizational performance before and after 5s implementation. The results show that 5s is an effective tool for improvement of organizational performance, regardless of organization type, size, its production or its service. Consequently, 5s techniques would strongly support the objectives of organization to achieve continuous improvement and higher performance [15].

Omogbai et al. (2017) In the current study, the short run dynamic implications of the sorting aspect of 5s is investigated using system dynamics. A system dynamics model is developed for a manufacturing case study and simulated to establish the effect of sorting activity on manufacturing throughput. The purpose was to

assess, in advance, the system performance outcomes when 5s practices are improved. The simulation results were the stimulus for real life improvements in the system because the simulation results were able to mimic the real-life outcomes. While the simulation results encourage further improvements to be implemented, the model developed in the current paper is replicable in other instances as the variables used in the model are generic and common to most types of manufacturing systems, particularly those new to lean practices. The dynamic analyses of 5s lean practices are not common. The study also reveals some interesting relationships between 5s and other lean practices and between 5s and system performance [16].

Bartnicka et al. (2018) presented the main aspects which require attention when optimizing and improving the manufacturing process, i.e.: the human resources aspect, the technical aspect and the organizational aspect. Concepts such as the Total Quality Management, Six Sigma or Lean Manufacturing claim that work improvement should be a continuous process. The foundation for implementing the improvement of processes, regardless of the concept, are well-organized and orderly workplaces as well as standardization, which can be achieved thanks to the Japanese 5s method [17].

The following Table 3 shows the representative reference, key factors and impact.

Table 3: Representative reference, key factors and Impact

Category	Key Factors	Impact	Supported by References
Organizational	Management support, policy, resource availability, audits, long-term commitment	Ensures sustainability & accountability of 5S implementation	Salem et al. (2006); Ghodrati & Zulkifli (2012); Omogbai & Salonitis (2017)
Human Resources	Training & competence, motivation, discipline, communication, resistance to change	Improves 5S sustainment, productivity & safety	Michalska & Szewieczek (2007); Chandrayan et al. (2019); Patel et al. (2024)
Site & Environment	Temporary site layout, safety hazards, limited storage, weather effects	Standardization becomes difficult in dynamic workplaces	Ajay & Sridhar (2016); Desale & Deodhar (2014); Hiwale et al. (2018)
Technical & Visual Tools	SOPs, signage, labelling, tool organization, material handling systems	Reduces searching time & defects through visual control	Tahasin et al. (2021); Sawant et al. (2017); Omogbai & Salonitis (2017)
Process Management	Planning efficiency, waste identification, workflow stability, subcontractor coordination	Improves flow, reduces non-value activities & delays	Salem et al. (2006); Desale & Deodhar (2014); Chandrayan et al. (2019)
Cultural & Behavioral	Employee involvement, safety culture, Kaizen mindset, housekeeping habits	Makes 5S continuous & embedded in work culture	Singh & Ahuja (2015); Bartnicka (2018)
Measurement & Feedback	KPIs, safety and productivity tracking, 5S audits	Ensures improvements are visible & monitored	Patel & Thakkar (2014); Ghodrati & Zulkifli (2013)
Integration with Lean Tools	VSM, TPM, Last Planner System, standard work	Amplifies lean performance improvement	Singh et al. (2014); Salem et al. (2006); Tahasin et al. (2021)
Economic Constraints	Budget limitations, limited labour availability	Affects pace and scope of implementation	Chandrayan et al. (2019); Patel & Thakkar (2014)

3. Conclusion

Based on the reviewed literature, several key insights can be drawn regarding the challenges and opportunities in enhancing lean construction through 5s within construction sector:

1. All studies agree that 5S acts as the starting point for Lean Construction by creating a clean, organized, and safe working environment which supports other lean practices.
2. Implementation of 5S reduces search time, material handling delays, rework, and unnecessary movement increasing overall efficiency on construction sites.
3. Maintaining order and cleanliness reduces onsite accidents, improves ergonomics, and enhances the quality of construction activities.
4. Long-term benefits only occur when 5S becomes part of organizational culture through motivation, discipline, and continuous improvement mindset among workers and management.
5. Awareness and participation of workers are vital. Training enhances skills and reduces resistance to adopting new standards.
6. Top management support in providing resources, monitoring systems and clear policies ensures sustained 5S practices throughout the project life cycle.
7. Dynamic nature of construction sites, limited storage spaces, weather conditions, and subcontractor coordination make sustaining standardized conditions more difficult than in manufacturing.
8. Using 5S alongside VSM, Last Planner System, TPM and visual management tools provides higher productivity gains and enhances waste elimination in Lean Construction projects.

Acknowledgement

The authors sincerely acknowledge Prof. (Dr.) Vinay Patel, Principal, Birla Vishvakarma Mahavidyalaya Engineering College (BVM), and Prof. (Dr.) Sanjay Dhiman, Head and Professor, Civil Engineering Department, BVM, Vallabh Vidyanagar, Gujarat, India, for their encouragement and valuable infrastructural support in facilitating this research.

References

[1] A. Ghodrati and N. Zulkifli, “5S Kaizen,” vol. 5, no. 3, pp. 11–13, 2012.

[2] “A Study on Implementing 5s in a Manufacturing Company,” vol. 12, no. 4, pp. 181–191, 2024.

[3] T. A. Tahasin, H. Sen Gupta, and N. T. Tuli, “Analyzing the Impact of 5S Implementation in the Manufacturing Department: A Case Study,” *Int. J. Res. Ind. Eng*, vol. 10, no. 4, pp. 286–294, 2021, [Online]. Available: http://creativecommons.org/licenses/by/4.0

[4] K. R. M. Ananthanarayanan, “Application of 5S Management System in NDE Laboratory,” *Proc. Natl. Semin. Non-Destructive Eval.*, vol. 7, no. 9, pp. 255–257, 2006.

[5] A. Hiwale, “Effectiveness of 5s Implementation in Lean Construction (Commercial Building Construction Project),” *Int. J. Res. Appl. Sci. Eng. Technol.*, vol. 6, no. 6, pp. 62–65, 2018, doi: 10.22214/ijraset.2018.6013.

[6] S. V Desale and S. V Deodhar, “Identification and Eliminating Waste in Construction by using Lean and Six Sigma Principles,” *Int. J. Innov. Res. Sci. Eng. Technol. An ISO*, vol. 3297, no. 4, pp. 15–16, 2007, [Online]. Available: www.ijirset.com

[7] A. Singh and I. S. Ahuja, “Review of 5S methodology and its contributions towards manufacturing performance,” *Int. J. Process Manag. Benchmarking*, vol. 5, no. 4, pp. 408–424, 2015, doi: 10.1504/IJPMB.2015.072320.

[8] J. Singh, V. Rastogi, and R. Sharma, “Implementation of 5S practices: A review,” *Uncertain Supply Chain Manag.*, vol. 2, no. 3, pp. 155–162, 2014, doi: 10.5267/j.uscm.2014.5.002.

[9] R. Ajay and M. B. Sridhar, “Incorporation of 5S methodology in construction practices,” *Int. J. Chem. Sci.*, vol. 14, pp. 127–134, 2016.

[10] O. Salem, J. Solomon, A. Genaidy, and I. Minkarah, “Lean Construction: From Theory to Implementation,” *J. Manag. Eng.*, vol. 22, no. 4, pp. 168–175, 2006, doi: 10.1061/(asce)0742-597x(2006)22:4(168).

[11] V. C. Patel and D. H. Thakkar, “Review on Implementation of 5S in Various Organization,” *J. Eng. Res. Appl.*, vol. 4, no. 3, pp. 774–779, 2014, [Online]. Available: www.ijera.com

[12] S. Sawant, R. Rode Patil, and R. Patil, “Review on 5"s Tools for Lean Construction,” *Int. J.*

Adv. Res. Innov. Ideas Educ., vol. 3, no. 2, pp. 3540–3545, 2017, [Online]. Available: www.ijariie.com

[13] A. K. S. Bhavesh Chandrayan* and and R. Sharma, "Study of 5S lean technique : a review paper Bhavesh Chandrayan *, Ankit Kumar Solanki and Richa Sharma," vol. 26, no. 4, pp. 469–491, 2019.

[14] J. Michalska and D. Szewieczek, "The 5S methodology as a tool for improving the organisation," *J. Achiev. Mater. Manuf. Eng.*, vol. 24, no. 2, pp. 211–214, 2007, [Online]. Available: http://www.journalamme.org/papers_vol24_2/24247.pdf

[15] A. Ghodrati and N. Zulkifli, "The Impact of 5S Implementation on Industrial Organizations' Performance," *Int. J. Bus. Manag. Invent. ISSN*, vol. 2, no. 3, pp. 43–49, 2013, [Online]. Available: www.ijbmi.org

[16] O. Omogbai and K. Salonitis, "The Implementation of 5S Lean Tool Using System Dynamics Approach," *Procedia CIRP*, vol. 60, pp. 380–385, 2017, doi: 10.1016/j.procir.2017.01.057.

[17] C. Bartnicka, "The Effects of Implementing 5S as the Foundation for Work Improvement on the Workplace," *Multidiscip. Asp. Prod. Eng.*, vol. 1, no. 1, pp. 451–455, 2018, doi: 10.2478/mape-2018-0057.