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Implementing Lean Engineering in a Computer Lab: A Case Study at a University

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Abstract

Lean Methodology, initially developed for manufacturing, has also been successfully applied across service sector, including hospitals, banks, hotels, and university laboratories. In this case study, Lean engineering has been implemented in a computer lab of an international university to address issues related to cluttered spaces, non-operational computers, lack of orderliness. These problems resulted in inefficiencies, long waiting times, unnecessary travel distances to find working computers, and underutilized space. The study aimed to reduce travel time to locate functional computers, eliminate waste, improve efficiency, and create a safe and sustainable working environment using Lean engineering tools such as the 5S framework (Sort, Set in Order, Shine, Standardize, Sustain), Fishbone diagrams, time studies, and Muda analysis. Successful implementation of Lean engineering has been resulted in a notable reduction in travel distances to operational computers, a cleaner environment with the removal of broken furniture and materials, and the introduction of regular cleaning schedules to maintain organization. Additionally, waiting times for assistance were reduced, significantly enhancing lab efficiency. By incorporating tools like the 5S methodology, Pareto diagrams, and simulations (e.g., Layout IQ and Draw.io), the project successfully tackled the lab's inefficiencies, improving overall organization and workflow. This study demonstrates how Lean principles can transform laboratory environments, offering insights for future applications of Lean in similar settings.

Keywords
5S, Continuous Improvement, Lean Engineering, Layout, Pareto Analysis, Waste.

1. Introduction

The most prevalent comprehensive management approach that helps organisations to do more with less while reducing waste is the Lean engineering technique. Lean Methodology originated in the Japanese motor vehicle sector in the late 1950s and the early 1960s at Toyota Motor Vehicle Corporation (Silva and Ferreira, 2019). Studies have confirmed that indeed Lean can improve operational performance, regardless many organisations still struggle with implementing Lean (Brooker and Hayward, 2018). The success of Lean usually means there is potential room for improvement, but organisations are more concerned about applying the tools and improving productivity (Loyd et al., 2020). Lean operates based on two essential guidelines which are to make the customer happy and then satisfy the customer's needs at a profit. Lean prioritises customers' necessities, by eliminating processes that are non-value-adding to the overall ongoing process. Lean methodology permits the elimination of waste in a process (Pereira and Tortorella, 2018). Waste is any activity that does not add value to the resulting product. Lean strategy is a holistic model to coordinate internal functions and supply chain partners that improves responses to customers' requirements and plays a vital role in enhancing energy and resource efficiency, effectiveness, productivity, and quality. The five important Lean principles used to assist organisations in eliminating waste, are shown in Figure 1.

The five Lean principles aim to optimize efficiency and customer value (Davim, 2018). First, define value by understanding customer needs. Second, map the value stream, identifying and eliminating waste. Third, create flow by streamlining processes and removing interruptions. Fourth, establish a pull system, reducing inventory and ensuring resources are available when needed. Finally, pursue perfection through continuous improvement and fostering a culture of learning. These principles focus on reducing waste, enhancing processes, and delivering greater value to customers with fewer resources, ultimately improving organizational performance and customer satisfaction. Lean identifies eight types of waste ("Muda"): waiting, overproduction, inventory, transportation, rework, overprocessing, motion, and underutilization (Rifqi et al., 2020). By addressing these wastes, organizations can streamline operations, improve product quality, and maximize resource utilization. Lean is a continuous improvement process, similar to Kaizen, requiring constant adaptation. Various tools like Kanban, TPM, 5S, and Jidoka are used in manufacturing, while Value Stream Mapping and visual management are critical for service industries. The 5S methodology which an important tool of Lean engineering is worth mentioning here. It emphasizes cleanliness, orderliness, and sustained improvements. The 5S principles are: Sort: involves separating waste from essential processes, removing unnecessary items, and creating more space; Set in order: items are organized based on importance and frequency of use, ensuring that tools and materials are easily accessible within 30 seconds; Shine: focuses on maintaining a clean, safe work environment, free of hazards and waste; Standardize: standardizes work processes to prevent unsafe or unproductive practices, ensuring consistency and efficiency; Sustain: ensures ongoing adherence to the improvements, with regular inspections to maintain the new processes (Kanabar et al., 2024).

In the past, the implementation of the 5S and other techniques equipped Lean engineering in various commercial scenarios and service sector, was studied by researchers and engineers. Table 1 reviews some of the important past studies showcasing Lean engineering impact across industries to eliminate waste and improve efficiency.

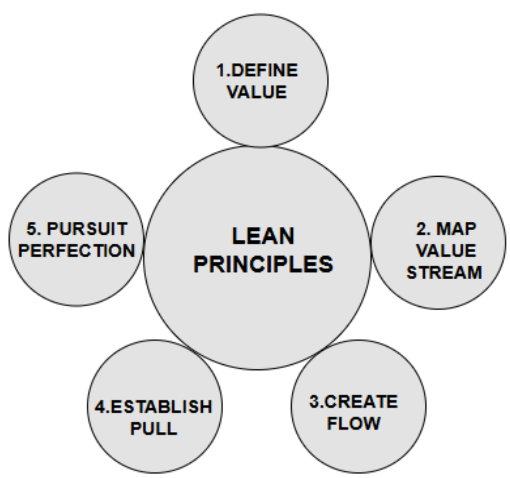

Figure 1. Lean engineering principles

Table 1. Review of important past studies

Author	**Main objective**	**Result**
(Shukla & Ganvir, 2018)	To improve organizational productivity can reduce the processing time for sales orders.	Kaizen and 5S reduce sales order lead times by 4-5%, increasing overall efficiency. Deleting non-value-added, time-consuming items reduces cycle time by 3-4 per cent. The 5S approach improves production flow by ensuring proper tool and equipment placement and arrangement.
(Subburaman, 2019)	To rearrange the working environment and enhance process flow	the implementation of 5S in the inspection department saved 36.60% of its time and reduced the process waste
(Makwana & Patange, 2019)	To investigate and improve the efficiency by cutting down the assembly and search times and implementation of 5S to organise the storage space.	The findings show that 5S techniques have improved staff morale and work culture while reducing the assembling and search times from 8.6 hours to 3.1 while raising productivity to 101% from 75%.
(Vora et al.,2021)	To reduce scrap, rework also management issues in a business	They were able to develop a special purpose machine (SPM) based on the 5S methodology.
(Senthil Kumar et al., 2022)	To apply 5S in small-scale manufacturing sectors and to increase productivity by eliminating Muda (waste).	This paper proved that the adoption of 5S at the small scale manufacturing industry resulted in a 68% rise in productivity and a significant reduction in time consumption.
(Afeez et al., 2023).	To investigate the implementation of Lean manufacturing and Six Sigma techniques among Malaysian manufacturing SMEs toward achieving sustainable performance.	Roughly 86% of Malaysian manufacturing SMEs use 6S techniques. Lean manufacturing and Six Sigma improved the long-term performance of the SMEs (Small and Medium Enterprise).
(Nilda Tri Putri et al., (2023)	To utilise PDCA (Plan-Do-Check-Act) to eliminate waste to adopt the 5S concept at the Madani Bakery	The results showed a reduction in motion, there was a reduction of 11.773 minutes in working time from 784.34 minutes and improved workplace cleanliness.
(Alarcón et al.,2023)	To analyse the effects of applying Lean manufacturing tools to a construction project that involves underground mining. .	The outcomes showed that the indicators under the research had improved in terms of mean, and some indicators' variance had reduced, which indicated the processes were more stable, the time lost had decreased, and significant attributes had improved.
(Sharma et al., 2024)	To assess the awareness of lean principles, barriers to and enablers of lean, providing information about lean acceptance and finding areas of improvement.	They found that knowledge or awareness of lean is still in its initial phase, but organizations show interest in implementing it.

Literature review indicated that implementing Lean and its tools have enhanced productivity, and efficiency, eliminated waste, and promoted employee satisfaction and engagement. Lean benefits can be maximized by having a high priority on managerial support, ongoing training, and modern technology integration.

2. Problem Statement and Research Objectives

This study has been carried out in a computer lab of an engineering department at a university, a crucial and frequently utilized space for engineering students and technicians. The lab faced multiple operational challenges, including malfunctioning computers, broken chairs, disorganized spaces, and an inefficient layout, which negatively impacted user productivity. The lab's poor maintenance schedule and lack of proper labelling contributed to long walking distances, further hindering efficiency.

The aim of this research is to investigate the implementation of Lean techniques in a computer laboratory of an engineering department to improve efficiency, reduce waste, enhance productivity, and ensure a safer working environment for users and technicians. The study will focus on addressing key issues, including the cluttered lab, malfunctioning equipment, long waiting times, and improper space utilization. By applying Lean tools and techniques, the research intends to develop a more streamlined, organized, and functional laboratory environment. This research has the following objectives:

- Reduce Distance for Operational Computers: To minimize travel distance for users to access functional computers, reducing downtime.
- Eliminate Waste: To identify and reduce waste from improper disposal, malfunctioning equipment, and unused resources using Lean tools.
- Conduct Time Studies: To measure time spent searching for operational computers to identify inefficiencies and propose improvements.
- Establish an Efficient, Safe, and Healthy Environment: To enhance safety, organize space, and ensure proper equipment maintenance to reduce accidents and enhance user experience.

3. Methodology

Various Lean tools and techniques were applied to identify and address lab issues, including Fishbone diagrams, 5 Whys, Pareto analysis, and 5S (Gupta et al., 2025). The data was collected through observations, and time studies. The Fishbone Diagram identified issues like malfunctioning computers, broken chairs, and disorganized spaces. The 5 Whys Analysis uncovered root causes such as irregular maintenance and insufficient inspections. The Pareto Diagram prioritized key problems, such as malfunctioning computers and unclear labeling. Time Studies revealed inefficiencies in movement and accessibility. Identified wastes (Muda) included defects, inventory, motion, waiting, transportation, overprocessing, and unused talent.

The solution involved several steps given below to address the identified inefficiencies and improve lab operations.
Step 1: Root Cause Identification (Fishbone & 5 Whys): The Fishbone diagram categorized the issues into key areas, and the 5 Whys technique delved deeper into the root causes. This helped identify problems such as malfunctioning computers due to irregular maintenance schedules and broken chairs from improper disposal practices.
Step 2: Time Study: Time studies were conducted to assess the amount of time users spent walking to find a functional computer. Measurements were taken for tasks such as walking to computers in different rows and fixing broken machines, allowing the identification of areas that wasted significant time.

Step 3: Pareto Analysis: The Pareto analysis highlighted the primary issues impacting lab efficiency. Malfunctioning computers, broken chairs, and lack of labeling were the most significant contributors to inefficiency, reinforcing the need for prioritized action on these areas.

Step 4: Layout Optimization: Using tools like Draw IO and Layout IQ, the lab layout was visually mapped to optimize space and reduce unnecessary walking. This ensured that users could easily access computers without wasting time.

Step 5: Implementation of 5S: The 5S methodology (Sort, Set in Order, Shine, Standardize, Sustain) was applied to improve organization and cleanliness:

- **Sort**: Unnecessary items like broken chairs were removed.

- **Set in Order**: Remaining items were arranged logically for easy access.
- **Shine**: Regular cleaning schedules were established.
- **Standardize**: Clear guidelines for organization and maintenance were created.
- **Sustain**: Continuous monitoring was set in place to ensure long-term improvements.

Step 6: Continuous Improvement (Kaizen): A Kaizen approach was introduced, promoting ongoing small improvements based on user feedback. This encouraged engagement from lab users and technicians in maintaining the improvements and suggesting further changes.

4. Results and Discussion

As per the Fishbone diagram which was used to identify the root causes and effects of inefficiencies, the main findings were categorized into environmental, people, material, measurement, equipment, and method factors, and discussed as below in Figure 2:

- Environmental Factors: Poor waste management and cluttered floor space.
- People Factors: Lack of awareness, improper use of lab facilities, and improper waste disposal.
- Material Factors: Damaged chairs, malfunctioning keyboards and mice, and inadequate seating.
- Measurement Factors: Lack of regular inspections and no labelling system for functional/non-functional computers.
- Equipment Factors: Broken chair parts and malfunctioning computers.
- Method Factors: Inefficient waste disposal and inadequate computer maintenance.

The effects of these issues included wasted time searching for a functional computer, long distances traveled due to unorganized chairs and cluttered floor space, a poor lab environment, increased accident risks, and interruptions caused by users searching for seating or moving obstructing chairs. Figure 2 presents the Fishbone diagram of the computer lab, illustrating these issues.

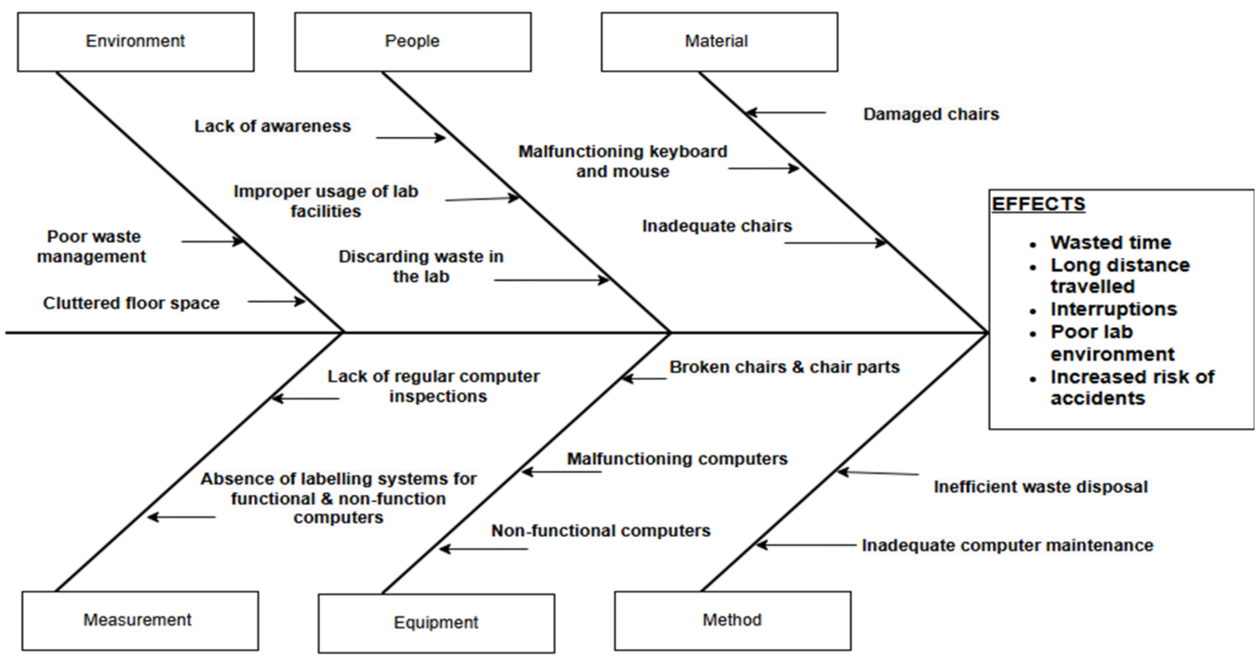

Figure 2. Fishbone diagram for root causes and effects of inefficiencies in the computer lab

The 5 Whys technique was used to drill deeper into the root causes of the inefficiencies in the lab. The problem statement identified inefficiencies that led to wasted waiting time, interruptions, increased risks of accidents, long distances travel, and a poor lab environment. The 5 Whys questions revealed the following:

1.Why were there inefficiencies? Inadequate maintenance, malfunctioning computers, broken chairs, and cluttered spaces.
2.Why were the computers malfunctioning, chairs broken, and workspace cluttered? There was inadequate maintenance, improper handling by users, and poor waste management.
3.Why was there inadequate maintenance, improper handling, and poor waste management? No scheduled maintenance, lack of proper training for users, and no waste disposal system.
4.Why were there no inspections, training, and waste disposal system? The lab lacked a structured management system with clear responsibility allocation.
5.Why was there no structured management system? The lab was established without a defined set of operational guidelines.

A time study was conducted in the computer lab, which has a capacity of 65 students, and the alternate or secondary lab, which accommodates up to 120 students. The study revealed several issues in both labs. In the main lab, via the main computer system 64 out of 65 computers were accessed, but only 58 were found functional. Several computers required manual operation, while others were frozen and needed restarting. The disorganized chairs made it difficult for users to move around efficiently, particularly from the main door to the middle row. Table 2 summarizes the time study results, showing time taken to find a functional computer from different rows, and the time to turn computers on both manually and automatically.

Table 2. Time study results for main computer lab

Task description	**Time observed (seconds)**
The time it took to find a functional computer from the main door to the first row	26.073
The time it took to find a functional computer from the main door to the middle row	50.068
The time it took to find a functional computer from the main door to the last row	26.004
The time it took to turn the computers both Manually and Automatically	619.047

The time study highlighted that the system was incorrectly reading some computers as functional, and the process of turning on the computers manually added extra time. The time it took to move between the main and alternate computer labs was 6 minutes, 22 seconds, 34 milliseconds. This significant time loss further underlined the inefficiencies in the lab's layout and equipment.

In the alternate computer lab, time study results, as given in Table 3, revealed issues such as computers not connected to the network, improperly connected power supplies, and some computers freezing or requiring manual startup

Table 3. Time study results for secondary computer lab

Task description	**Time observed**
The time it took to find a functional computer from the main door to the first row.	19.013
The time it took to find a functional computer from the main door to the middle row.	29.091
The time it took to find a functional computer from the main door to the last row.	28.088
The time it took to fix a malfunctioning computer.	277.053
The time it took to turn all the functional computers automatically with a command from the main computer.	523.017
The time it took to turn all functional computers automatically and manually.	1049.067

Lab users also caused issues, such as turning off screens or manually powering down computers, which interfered with the automatic system, requiring manual intervention and further time delays.

The Pareto principle (80/20 rule) was applied to the time study results from both labs to identify the tasks that consumed the most time. In the main computer lab (Figure 3), turning on the computers and finding functional ones were the most time-consuming tasks, accounting for 80% of the total time. Other tasks, while important, had less impact on the overall time.

In the alternative lab (Figure 4), turning on all computers, both manually and automatically, consumed the majority of the time (over 80%). This suggests that streamlining the computer startup process would be the most effective way to improve efficiency in the alternative lab.

Pie charts were developed to visualize the distribution of time spent on various tasks in both labs. In the main computer lab (Figure 5), turning on all functional computers manually and automatically accounted for 85.8% of the total time. Finding functional computers in the middle row was the second most time-consuming task at 6.9%, while the other tasks contributed less significantly.

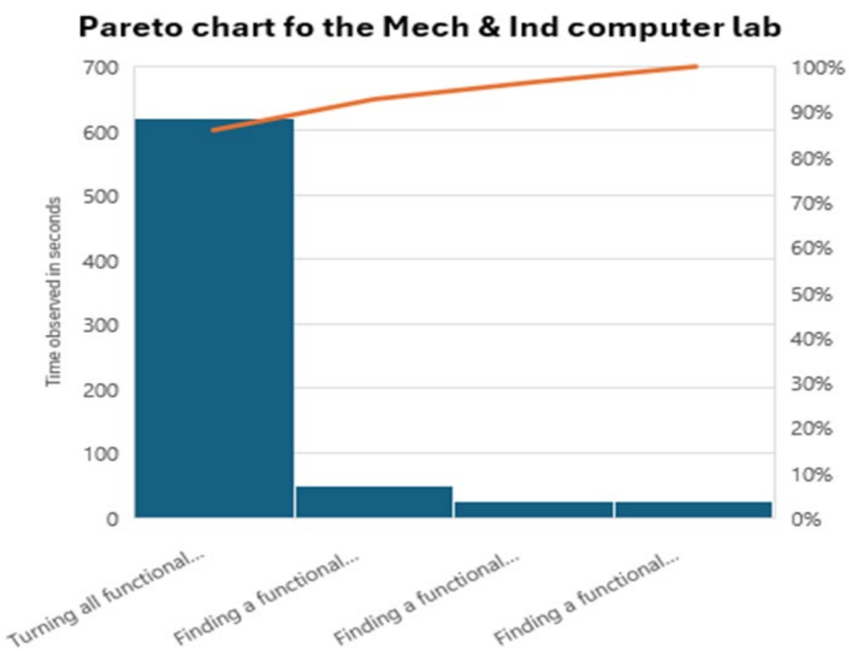

Figure 3. Pareto analysis for the main computer lab

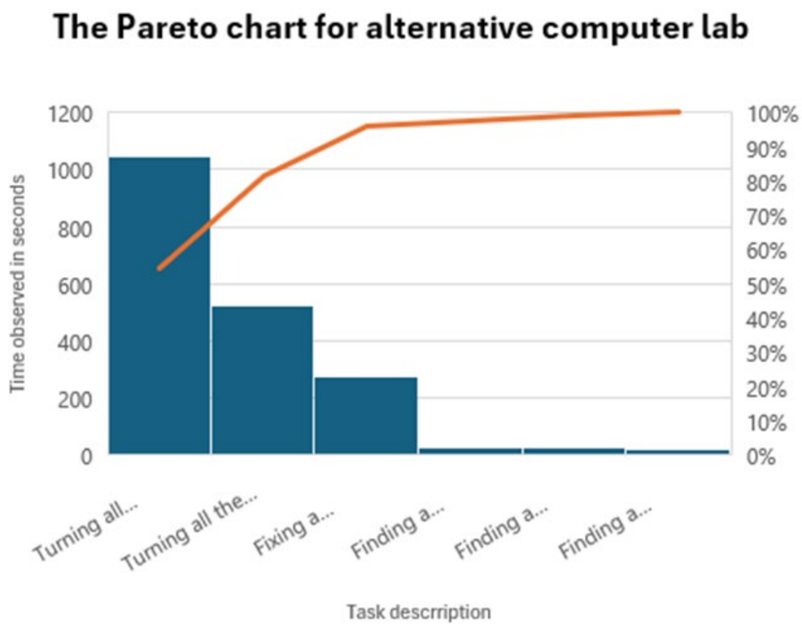

Figure 4. Pareto analysis for the alternative computer lab

In the alternative lab (Figure 6), turning on all functional computers manually and automatically took up 54.5% of the total time, followed by turning them on automatically (27%). Fixing malfunctioning computers took 14.4%, and the remaining tasks, such as finding a functional computer, contributed minimally to the total time.

To visualize the lab layout before and after the implementation of Lean tools, specially 5S technique, the Draw IO software was used. Before Lean implementation, the layout was messy, with waste and clutter throughout the floor space (Figure 7). After the Lean tools were applied, the layout became more organized, with clear pathways and no waste (Figure 8).

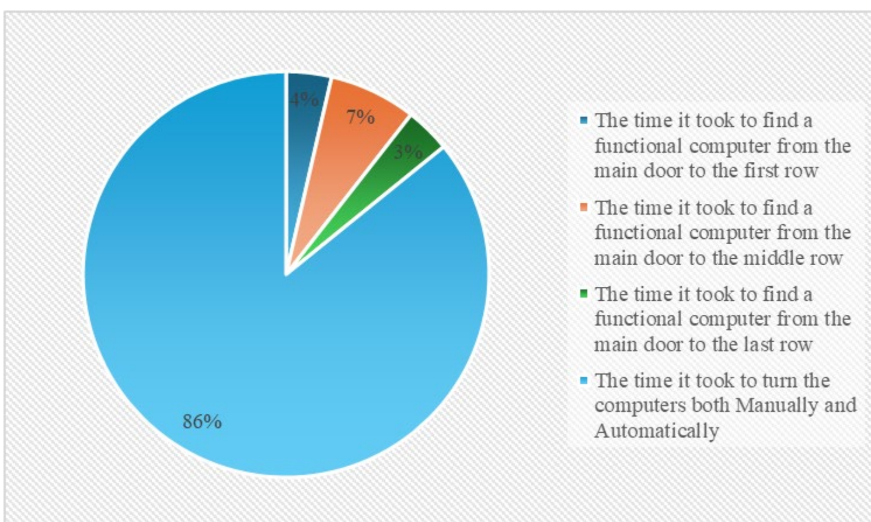

Figure 5. Pie chart of tasks and times for the main computer lab

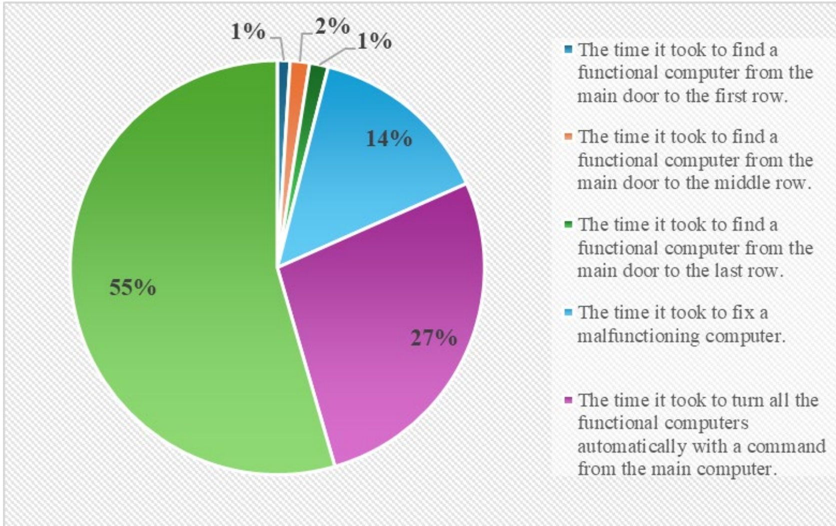

Figure 6. Pie chart of tasks and time for the alternative computer lab

The Layout IQ software assisted in creating a From-to chart (Figure 9), which visualized the movement of people around the lab. The goal was to reduce the distance travelled by users, as unnecessary movement is a non-value-adding activity that wastes both time and resources.

The Activity Relationship Diagram (Figure 10) showed the relationship between different areas in the lab. By focusing on the movement of people, the diagram helped identify inefficiencies in the lab's layout and the flow of activities. Table 4 explains the code definitions and the code reasons used to explain the importance of each area relative to the other.

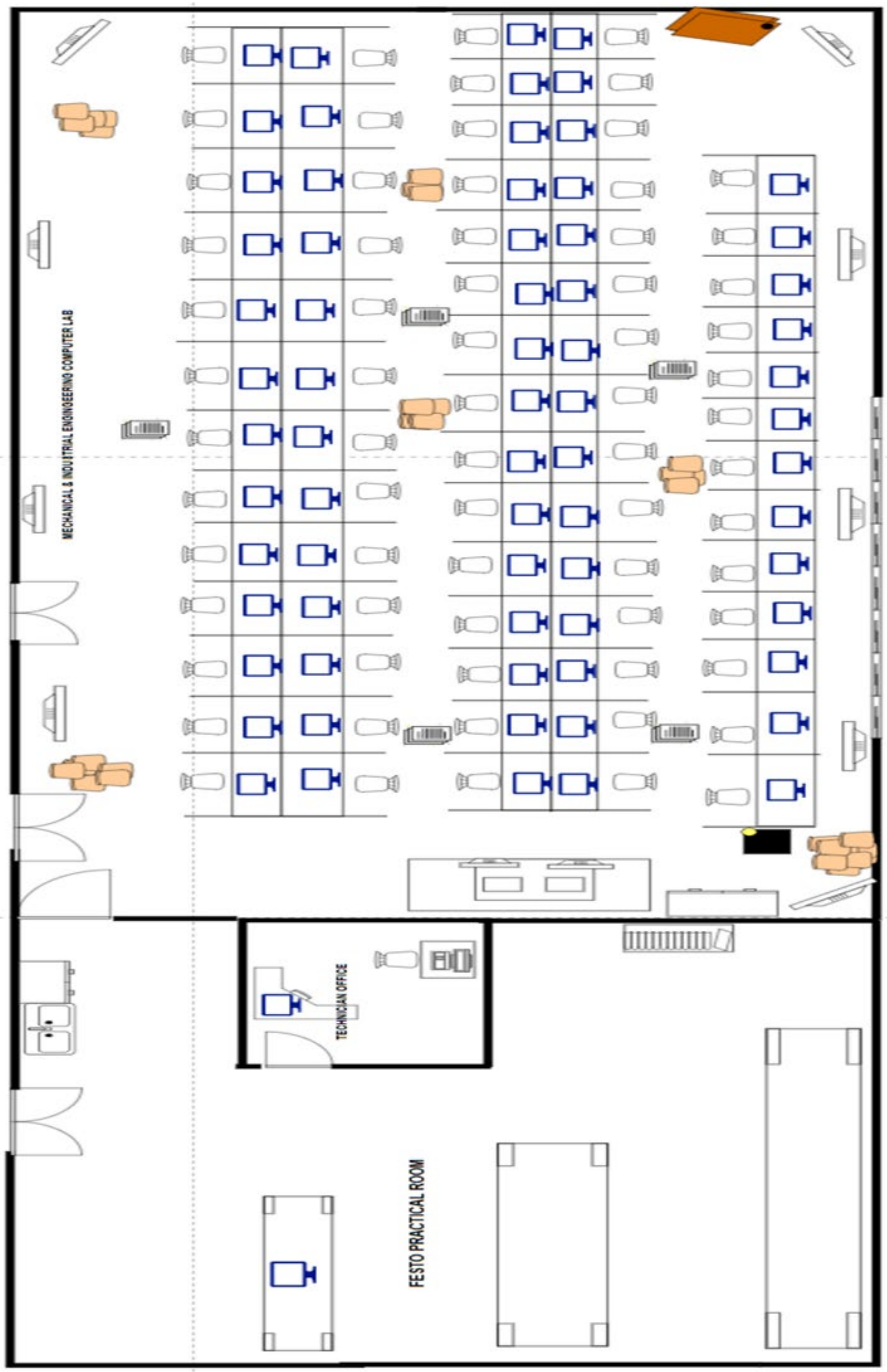

Figure 7. Computer lab before implementation of 5S

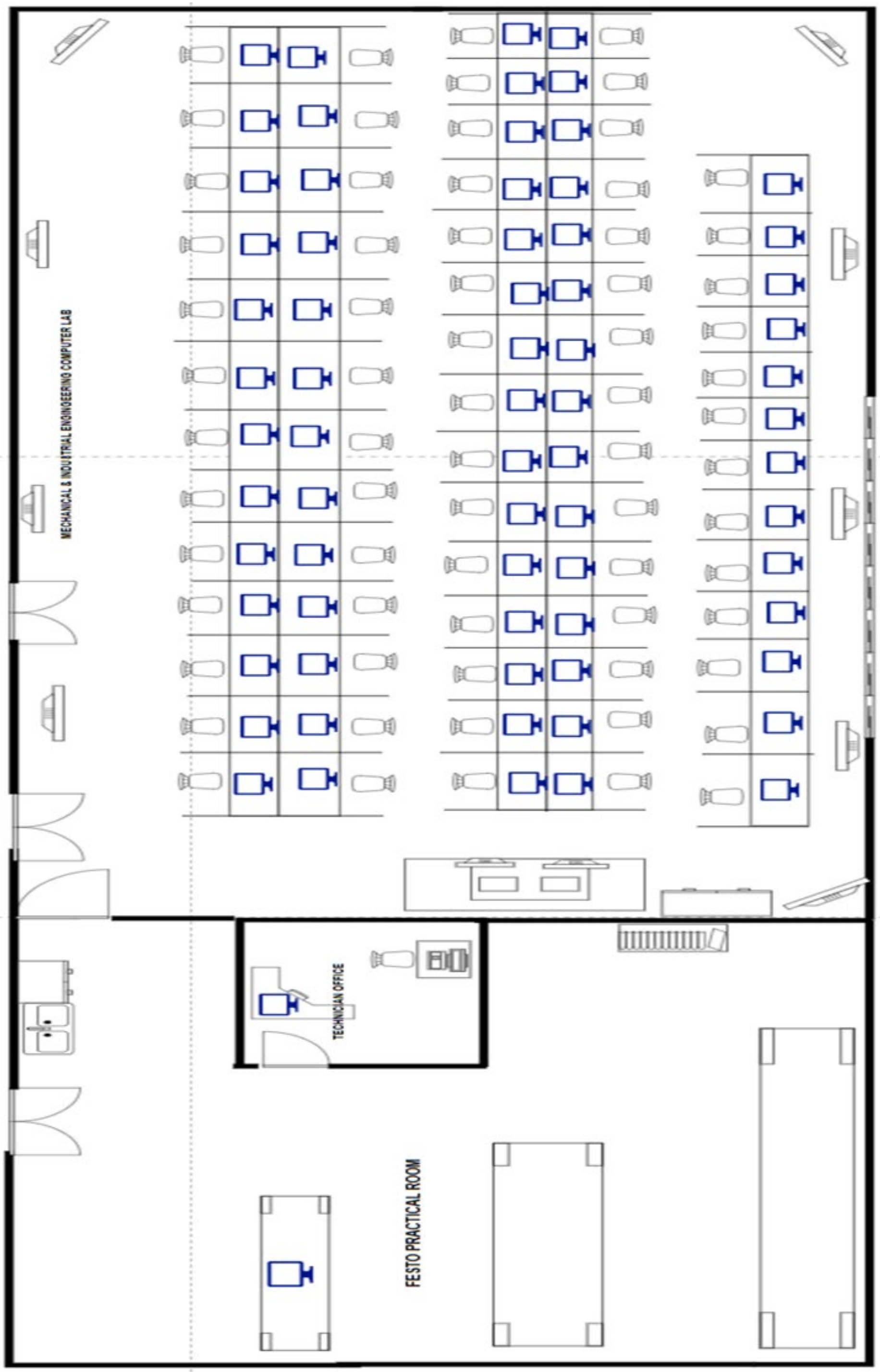

Figure 8. Computer lab after implementation of 5S

TO

FROM

	podium	Last row to t	Last row to t	Last row	Middle row t	Middle row t	Middle row	First row to t	First row to t	First row	Single door	Main door
Main door	20	39	24	11	44	29	7	34	14	9	4	
Single door	7											
First row	5											
First row to th	10											
First row to th	30											
Middle row	3											
Middle row to	25											
Middle row to	40											
Last row	7											
Last row to th	20											
Last row to th	35											
podium		35	20	7	40	25	3	30	10	5	7	20

Figure 9. From to chart of the computer lab

	podium	Last row to t	Last row to t	Last row	Middle row t	Middle row t	Middle row	First row to t	First row to t	First row	Single door
Main door	E4	A4	A4	A4	A4	A4	A4	A4	A4	A4	A4
Single door	E4	A4	A4	A4	A4	A4	A4	A4	A4	A4	
First row	I4	I4	I4	I4	I4	I4	I4	I4	I4		
First row to th	14	I4	I4	I4	I4	I4	I4	A4			
First row to th	14	I4	I4	I4	I4	I4	I4				
Middle row	A4	I4	I4	I4	I4	I4					
Middle row to	A4	I4	I4	I4	I4						
Middle row to	A4	I4	I4	I4							
Last row	A4	A4	A4								
Last row to th	A4	A4									
Last row to th	A4										

Figure 10. Activity relationship diagram

Table 4. Code reasons and definition

Code	**Definition**	**Code**	**Reason**
A	Absolutely essential	1	Expensive movement
E	Especially important	2	Better flow
I	Important	3	Material moves b/w department
O	Ordinary	4	People movement
U	Un important	5	Safety
X	Closeness undesirable		

The distance travelled in the lab (Figure 11) was calculated, with 1 step equal to 1 meter. It became evident that significant unnecessary movement was occurring, particularly when users searched for functional computers, which resulted in wasted time and disruptions.

	podium	Last row to t	Last row to t	Last row	Middle row t	Middle row t	Middle row	First row to t	First row to t	First row	Single door
Main door	20	39	24	11	44	29	7	34	14	9	4
Single door	7										
First row	5										
First row to th	10										
First row to th	30										
Middle row	3										
Middle row to	25										
Middle row to	40										
Last row	7										
Last row to th	20										
Last row to th	35										

Figure 11. Distance traveled

The Layout IQ software also illustrates the movement patterns before the 5S implementation (Figure 12). Users often moved long distances to find a functional computer, and the lab technician had to be troubleshoot problems, adding to the inefficiencies. After the 5S implementation, the movement was more streamlined, reducing wasted time and improving efficiency (Figure 13).

Through the application of Lean tools, including the Fishbone diagram, 5 Whys, time study, Pareto analysis, and layout optimization, several inefficiencies in the Mechanical and Industrial computer lab were identified and addressed. By focusing on streamlining key tasks, such as turning on computers and improving lab layout, significant improvements in operational efficiency can be achieved, ultimately enhancing the lab environment and reducing wasted time.

The 5S methodology was applied to the main computer lab to improve organization, safety, and efficiency. The stepwise results are as follows:

- Sort: Unnecessary items (e.g., broken chairs, extra equipment) were removed. Figures 14 and 15 show the items found in the lab, while Figure 16 shows them gathered in one place for removal. Figure 17 shows the lab after the unnecessary items were removed.
- Set in Order: The lab was organized, with items placed for easy access and pathways cleared. Figure 18 illustrates the lab after this step.
- Shine: The lab was cleaned thoroughly, and a regular cleaning schedule was established. Figures 19 and 20 show the cleaning process, and Figure 21 shows the lab after cleaning.
- Standardize: Computers were labeled as functional or faulty, ensuring users knew which ones were unreliable. This step aimed to prevent misuse.
- Sustain: A cleaning schedule was introduced with clear responsibilities. Table 5 shows the proposed cleaning schedule to ensure ongoing maintenance and continuous improvement.

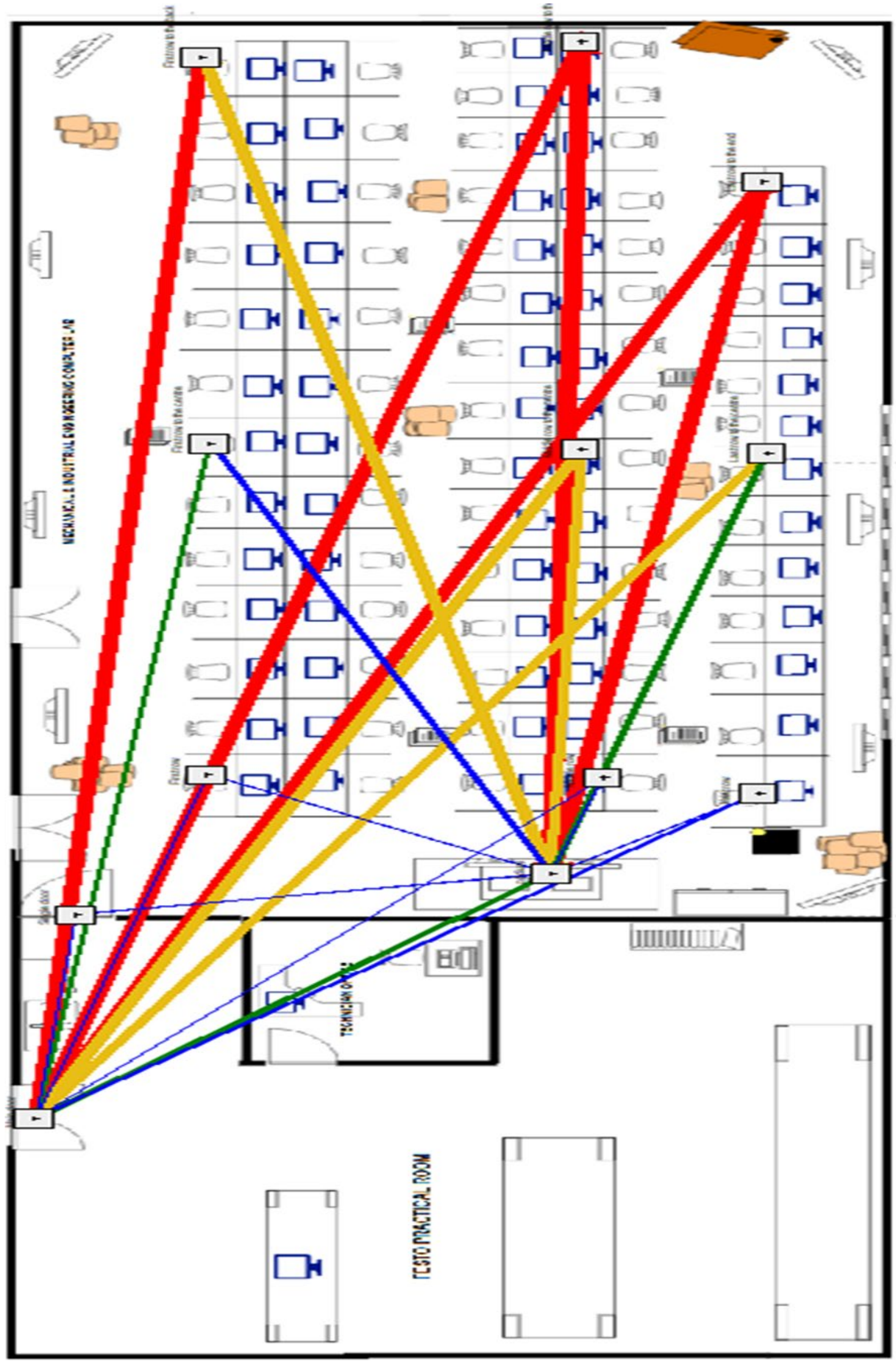

Figure 12. Movement of people before 5S implementation

Figure 13. Movement of people after 5S implementation

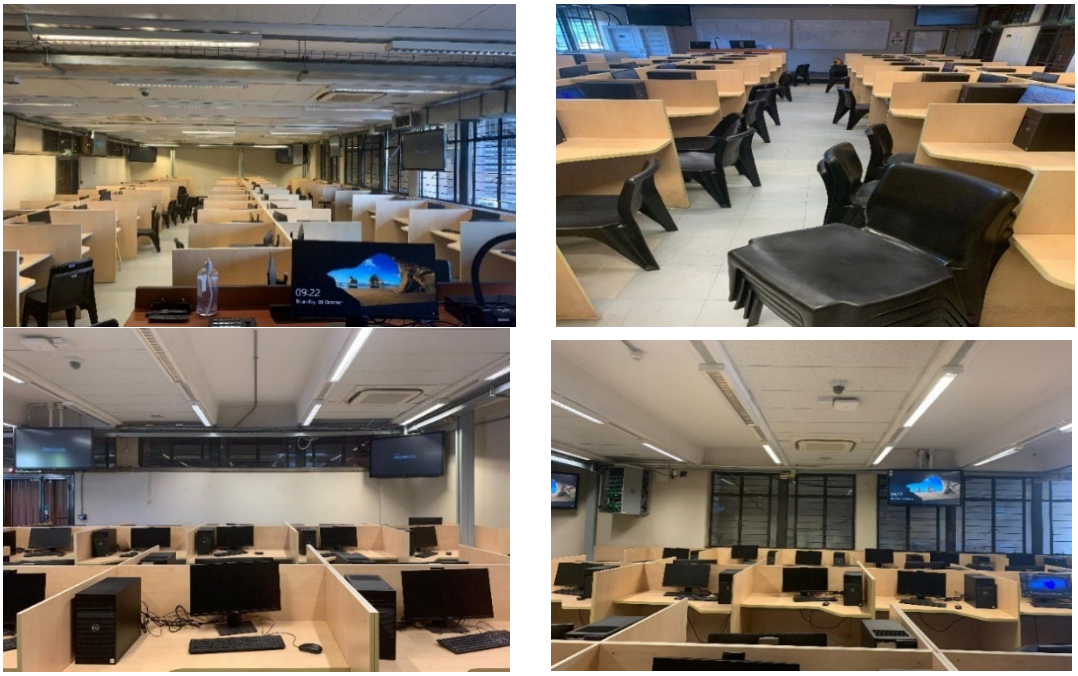

Figure 14. Pictures of the different views of the computer lab after Sort

Figure 15. Pictures of the wastes found in the computer lab after Sort

Figure 16. Unnecessary items put in one area after Sort

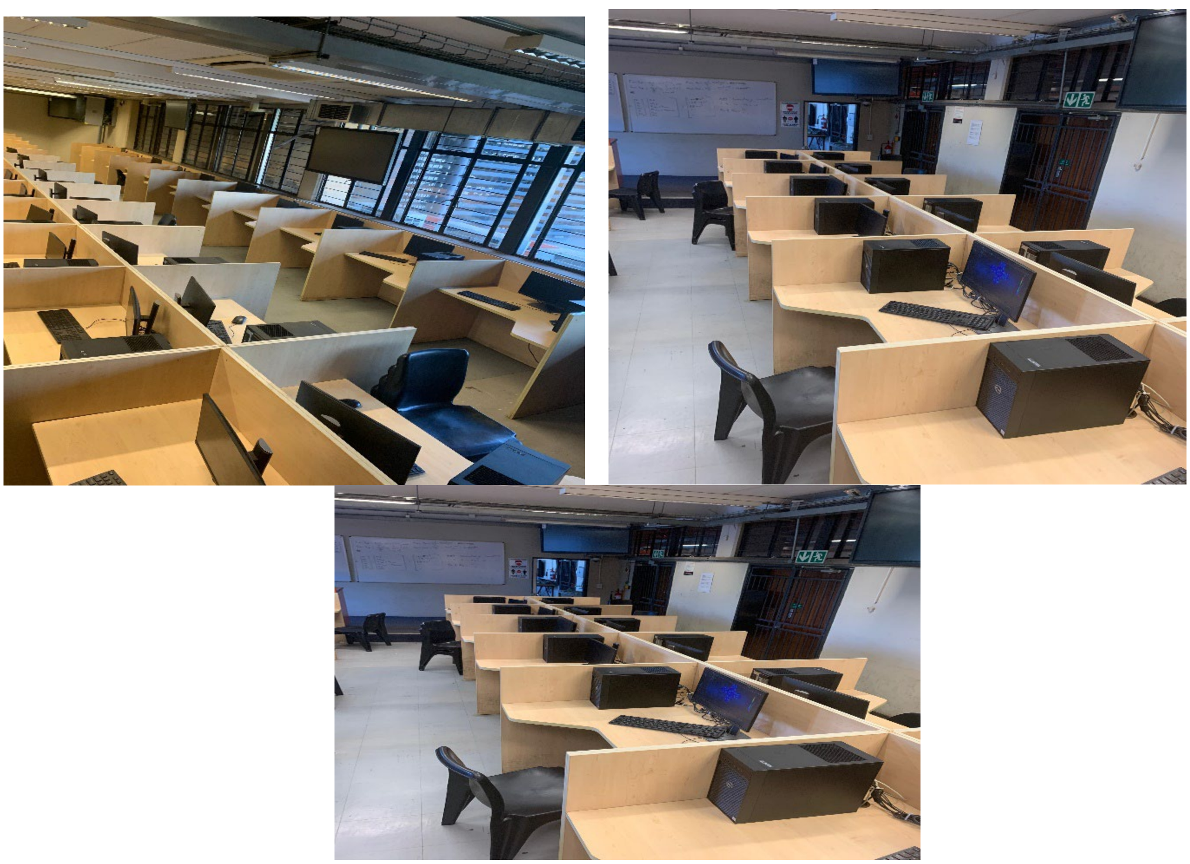

Figure 17. Lab after removing unnecessary items

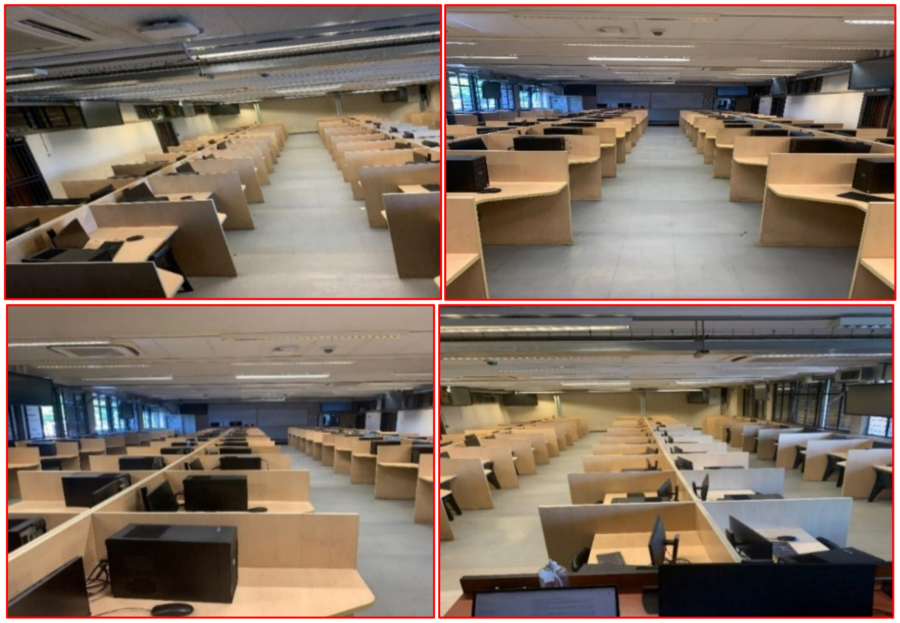

Figure 18. Organized computer lab after Set in order

Figure 19. Pictures of dust and papers found in the lab during Shine

Figure 20. Materials used to clean the lab during Shine

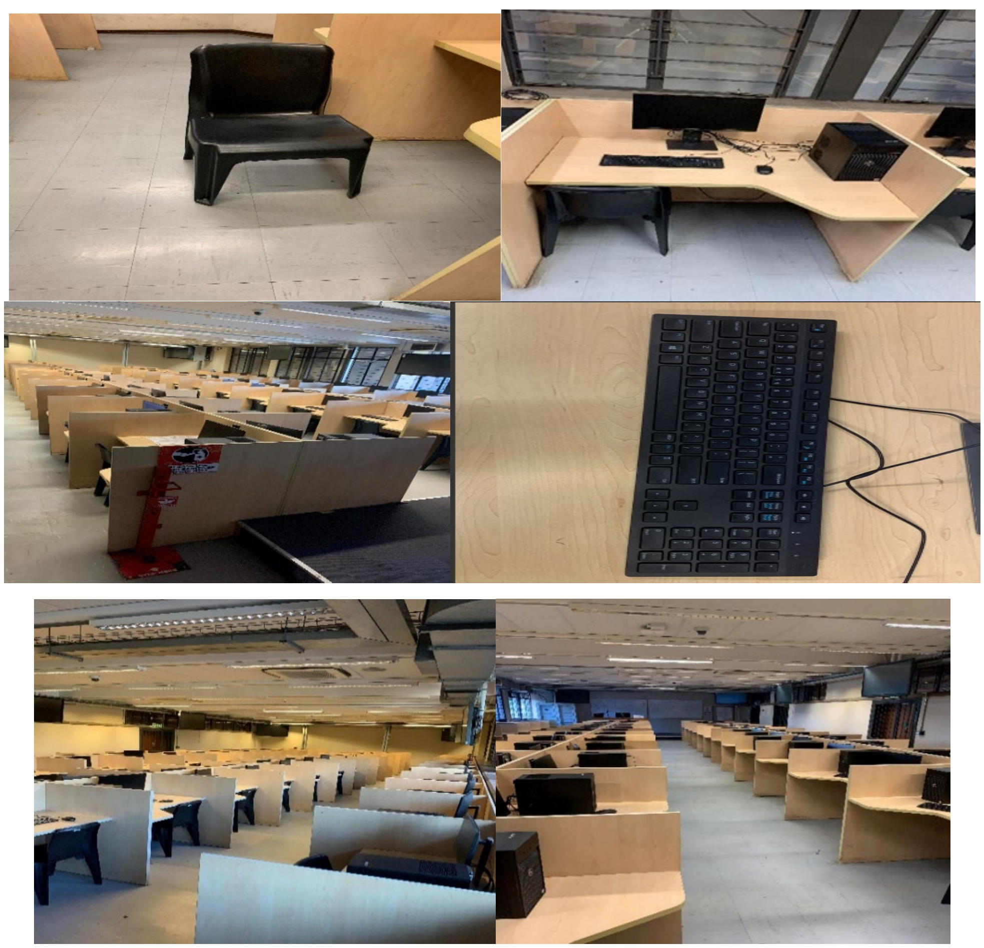

Figure 21. Pictures of the computer lab after Shine

Table 5. Proposed cleaning schedule for the computer lab as a result of Sustain

Task	Assigned Person	Frequency of cleaning	Area/Description
Sort & Organize	Lab Assistant	Weekly	Sort through computers and materials, remove unnecessary items.
Floor Cleaning	Cleaning Staff	Daily	Sweep and mop the floor to maintain cleanliness.
Chairs and Tables Organization	Lab Monitors	Daily	Organize and arrange chairs and tables to their proper positions.
Computers and Screens Cleaning	IT Staff	Weekly	Dust and clean monitors, keyboards, and CPUs.
Trash Disposal	Cleaning Staff	Daily	Empty trash bins and ensure no waste is left in the lab.
Window Cleaning	Cleaning Staff	Monthly	Wipe and clean windows to allow natural light.
Whiteboard Cleaning	Lab users	End of Each Use	Ensure the whiteboard is wiped clean after use.
Inspection of Equipment	IT Staff	Weekly	Inspect all computers for functionality and report any faults.
Reset Layout & Maintenance	Lab Assistants	End of Each Day	Reset any displaced equipment and ensure proper placement.
Deep Clean	Cleaning Staff	Monthly	Deep cleaning of the entire lab, including walls and under tables.

The 5S implementation led to a cleaner, safer, and more efficient lab environment.
The Activity Relationship Diagram (Figure 10) identified inefficiencies in the lab's workflow, revealing the movement patterns of users and resources. Time studies and movement analysis quantified the distance users travelled, highlighting issues caused by disorganization (Figures 11-12). After implementing 5S, Figure 13 showed improved movement and reduced travel distance. The 5S methodology involved sorting unnecessary items (Figures 15-17), organizing the remaining materials (Figure 18), cleaning the space (Figures 19-21), labelling computers, and training users to maintain improvements. A Time study and Fishbone diagram helped pinpoint root causes, while tools like Layout IQ optimized the lab layout, resulting in a more efficient environment.

5. Conclusion and Recommendations

The implementation of the 5S equipped Lean engineering in the computer lab significantly improved operational efficiency, safety, and user experience. By addressing inefficiencies caused by clutter, disorganization, and malfunctioning equipment, the lab saw reduced travel distances, enhanced access to functional computers, and a safer, cleaner environment. The 5S framework—Sort, Set in Order, Shine, Standardise, and Sustain—successfully eliminated waste, organized the space, and created a system for maintaining cleanliness. As a result, user productivity and satisfaction improved, and safety hazards were minimized.
The important recommendations for sustaining these improvements include:

- Continuous Training: Regular sessions for lab users and technicians to reinforce the importance of cleanliness, organization, and equipment usage.
- Regular Audits: Periodic checks to assess adherence to 5S standards and identify areas for improvement.
- Feedback Mechanism: A system for users to report issues anonymously, promoting continuous improvement.
- Investment in Equipment: Budget allocation for regular upgrades and maintenance of computers to improve functionality.
- Ergonomic Assessment: Evaluating lab furniture and layout to ensure comfort and reduce strain for users.
- Lean Improvement Culture: Promoting Kaizen practices to engage users in identifying improvements and fostering accountability.
- Use of Technology: Implementing digital tracking for computer functionality and user traffic to optimize resource allocation and lab management.

These measures will ensure the lab remains efficient, safe, and conducive to learning.

References

Alarcón, L.F., Baladrón, C., Gahona, P., and Long, D., "Lean Methodologies and Productivity in Mining Development – A Case in a Public Company," Revista Ingeniería de Construcción, vol. 38, pp. 66–82, 2023. https://doi.org/10.7764/RIC.00085.21.

Brooker, P. and Hayward, M., Toyota: Ohno's Toyota Production System, Oxford Scholarship Online, Oxford University Press, 2018. https://doi.org/10.1093/oso/9780198825395.003.0003.

Davim, J.P., Progress in Lean Manufacturing, Springer, 2018.

Silva, F. and Ferreira, L.P., Lean Manufacturing: Implementation, Opportunities and Challenges, Nova Science Publishers, 2019.

Gupta, K., Sarmah, P., Gqibani, S.L., "A Review on the Implementation and Effectiveness of Lean Manufacturing Strategies for Industrial and Service Sectors," Science, Engineering and Technology, vol. 5, no. 1, pp. 304–315, 2025. https://doi.org/10.54327/set2025/v5.i1.157.

Ibikunle, A.K., Rajemi, M.F., Zahari, F.M., "Implementation of lean manufacturing practices and six-sigma among Malaysian manufacturing SMEs: intention to implement IR 4.0 technologies," International Journal of Quality & Reliability Management, 2023. https://doi.org/10.1108/ijqrm-03-2022-0086.

Kanabar, B., Piparva, K.G., Pandya, D., and Kanabar, R.B., "The Impact and Challenges of the Implementation of 5S Methodology in Healthcare Settings: A Systematic Review," Cureus, vol. 16, no. 7, p. e64634, Jul. 2024. https://doi.org/10.7759/cureus.64634.

Loyd, N., Harris, G., Gholston, S., and Berkowitz, D., "Development of a lean assessment tool and measuring the effect of culture from employee perception," Journal of Manufacturing Technology Management, vol. 31, no. 7, pp. 1439–1456, 2020.

Makwana, A.D. and Patange, G.S., "Strategic implementation of 5S and its effect on productivity of plastic machinery manufacturing company," Australian Journal of Mechanical Engineering, pp. 1–10, 2019. https://doi.org/10.1080/14484846.2019.1676112.

Pereira, L. and Tortorella, G., "A review on Lean Manufacturing in small manufacturing companies," Progress in Lean Manufacturing, vol. 1, no. 1, pp. 77–102, 2018.

Putri, N.T., Fatrias, D., and Rosa, S., "5S Implementation to Minimize Waste in Bread Production Process (Case Study: Madani Bakery)," Lecture Notes in Mechanical Engineering, pp. 357–363, 2023. https://doi.org/10.1007/978-3-031-28839-5_40.

Rifqi, H., Ben Souda, S., Zamma, A., Kassami, S., "Lean Facility Management 4.0: A Case Study," International Journal of Emerging Trends in Engineering Research, vol. 8, no. 10, pp. 7363–7370, 2020. https://doi.org/10.30534/ijeter/2020/1138102020.

Senthil Kumar, K.M., Akila, K., Arun, K.K., Prabhu, S., Selvakumar, C., "Implementation of 5S practices in a small-scale manufacturing industries," Materials Today: Proceedings, vol. 62, no. 4, pp. 1913–1916, 2022. https://doi.org/10.1016/j.matpr.2022.01.402.

Sharma, R., Harish, V., and Rana, G., "Lean Horizons: Overcoming Barriers and Embracing Enablers in Construction Industry Adoption," Migration Letters, vol. 21, no. S7, pp. 751–762, 2024. https://migrationletters.com/index.php/ml/article/view/8807.

Shukla, H.M. and Ganvir, K.D., "Implementation of Kaizen and 5S in Plastic Pipe Manufacturing Unit," International Journal of Applied Science and Engineering, vol. 6, no. 1, pp. 11, 2018.

Subburaman, K., "A Case Study of 5S Implementation in Inspection Process," Proceedings of the IEOM Annual International Conference, Bangkok, Thailand, May 5–7, 2019.

Vora, G., Umat, H., Soni Kumari, D., Rajput, C., and Abhishek, K., "Reduction of Scrap and Rework Cost by Implementing 5S Methodology: A Case Study," in Recent Advances in Mechanical Infrastructure: Proceedings of ICRAM 2020, pp. 183, 2021.

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