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Analysis of Energy Conservation and Effectiveness Improvement by 5s Implementation: A Case Study

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ABSTRACT: This article is mainly focused on the implementation of 5S in educational institutions, a Japanese Technique in order to manage the waste and improve the cleanness of the Institution. 5S is an approach to make the workplace a better organization with an efficient and managed production. It is not only used to identify and eliminate the waste but also to work with improved methods where many teams get involved in the process. In this study, we concentrated the enactment in the Francis Xavier Engineering College Boys Hostel Facility. Firstly, the student rooms, space utilization, arrangement of things energy consumption and food wastage were identified and sorted according to their requirement. Later, they were arranged in a systematic order and standard operating procedure for each process was created considering safety and rules and regulations of the institution. Awareness was created among the members of the hostel students. The successful implementation of 5S transformed the organization by increasing the interest of the students in their studies and staff work satisfaction. It creates cleaner, safer and well organized working environment and saving electrical energy consumption.

KEY WORDS: 5s, Safety, Energy consumption, Energy audit

I. INTRODUCTION

Since it was introduced by Takashi Osada from Japan in the early 1980s, it is believed that applying the 5S techniques could considerably raise the environmental performance in production line including housekeeping, health, safety and more. 5S is a technique that originated from Japan, audit was first developed by heroyuki hirano. there are five words in 5S Seri (Sorting), Seiton (Set In Order), Seiso (Shine, Clean Up), Seiketsu (Standardize) And Shitsukue (Sustain). 5S technique is included in "Kaizen" Which Means "Changes For Better" allows for increased efficiency and productivity. 5S technologies is a structured program to achieve the total organization Cleanliness, and standardization in the workplace. the advantage of 5S techniques is improvement in productivity, quality, health and safety.

II. LITERATURE REVIEW

The 5S system helps to organize a workplace for efficiency and optimize quality and productivity by monitoring an organized environment. It also provides useful visual evidences to obtain more firm results. This paper identifies the effectiveness of 5S implementation on organizational performance.[1]. The aim of this paper is to review the implementation of 5S methodology as one of the tools of lean management in the services sector. It is one of the fastest-growing sectors of the Indian economy. The 5S process is most fundamental component of lean philosophy. It is widely applied in various manufacturing and business sectors. The system helps to organize a workplace for increased efficiency, decrease waste, optimize quality, improves productivity and more satisfied customers. Results have shown

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that 5S can be applied to the service industry with beneficial effects[.3]. Ansari presented the benefits of 5S in maintaining safety standards, a significant decrease in number of injuries were observed after the implementation of this technique [4]. Nilipour shows the importance of 5S in lean manufacturing in the form of a tool which helped to reduce waste and decrease time spent on non-value added activities . A great amount of emphasis is given on training, for effective implementation training employees to sustain this technique is the key.[5]

III. HISTORY AND CONCEPT OF 5S

During the time of World War II, it virtually destroyed the production capability of Europe and Asia. On the contrary, the United States (U.S) production capability greatly expanded since their major emphasis was on quantity and not quality production. However, as poor as it was in quality, the U.S still produced the best in the world compared to other nations. In late 1940s, Dr. W. Edwards Deming, a U.S quality control expert began working with the Japanese and continued doing so periodically for several years. The Japanese developed the quality circle concept during the early 1960 and 20 years later, the concept had expanded to more than a million organizations. At the same time, Dr.Genichi Taguchi, a Japanese quality expert, introduced new statistical concept that was invaluable in improving process and product quality. Due to this improvement, Japanese industry ultimately has developed in various technologies all over the world. Following in their footsteps, U.S made some drastic changes in strengthening their power in the global age. Besides all kinds of quality improvement techniques developed, one of the most famous is the 5S concept developed by the Japanese.

IV. CASE STUDY

The Francis Xavier Engineering College popularly known as fx engineering college, was established in the year 2000 with the vision to empower budding engineers in technical and entrepreneurial training and to contribute to the socio-economic augmentation of the nation. The college is located the heart of the city of tirunelveli heralded worldwide as the oxford of south india, and is well connected by road, rail and air. Students of Fix engineering college are given the opportunity to pursue first-rate and advanced technical education regardless of background, gender or financial constraints. The necessity to promote most advantageous learning and service is well harmonized and clearly expressed by allowing students to successfully plan their education and competently achieve the education they need. Curricular and co-curricular programs form an integral part of the curriculum and help students to have commanding incorporation of theory and practical knowledge. Each individual is motivated to increase the gravity of responsibility and be committed to serve the nation. The college is full of opportunities where students' talents can thrive and it systematically transforms a graduate to a future ready professional. The institution is open to the exchange of ideas, where discovery, creativity, and personal and professional development can flourish. It is a responsive, student-oriented institution that is committed to the creation, dissemination, and acquisition of knowledge through teaching, research and service.

The FX Engineering College Common Zones/Location area are,

1. Main Office and Reception
2. Central library
3. Sports
4. Auditorium
5. Common seminar/Conference hall
6. Canteen
7. Parking area
8. Security system
9. Central stores
10. Transport
11. Civil Maintenance
12. Generator, UPS and Electrical maintenance
13. Hostel and mess
14. Common toilets
15. Campus cleaning
16. Visitor protocols
17. Swimming pool
18. RO plant and water supply
19. Fire extinguishers and safety measures
20. Common hoardings and display

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Fig -1:FX Engineering College

V. PROBLEM IDENTIFIED IN BOYS HOSTEL

Identification of Problems was done by generating a list of problems using the brainstorming technique. For problem identification, the problems has to defined correctly first and collect the data about the boys hostel. The college has a separate hostel for boys and girls. In the boys hostel has 55 rooms is used by the 200 students. The 200 students are monitoring by 2 Warden and 2 staff in the boys hostel. The hostels are well furnished, airy and have 24 hours power back up and an RO plant for safe drinking water. The hostel has a well-planned during facility as well that serves vegetarian and non vegetarian fare for the students. Main problem in the hostel are the student rooms, space utilization, arrangement of things, energy and food wastage were identified. It can be solve and effectiveness improvement by 5s implementation.

VI. IMPLEMENTING 5S TECHNIQUE IN HOSTED AND MESS

Seiri (Sort)

Seiri is concerned with sorting the items and finding out the necessary and unnecessary items.

This is an action to identify and eliminate all unnecessary items from different places in the zone 13 (Hostel and Mess). This refers to the practice of sorting all the items in the zone 13 and keeping only essential items. Everything else is stored or discarded. This leads to lesser hazards and less clutter to affect the productive work. Through the suitable sorting the necessary items required for a good performance of the zone 13 can be identified and the wastage or the un required items which can be eliminated from the zone 13 and make it waste free and create a good working environment.

The red tag is a useful tool to help the sorting process in the hostel. These tags are used to identify the unnecessary items that need to be either thrown out, recycled, relocated. The red tag follows the 5R method. The 5R method are

- Reject
- Repair
- Reuse
- Restore
- Resale.

The red tag is been used to ask the following question

- Is the item needed?
- If it is needed, is it needed in that much of quantity?
- If it is needed, how frequently it is been used?
- If it is needed, should it be kept there?
- Who is ultimately taking care for this item?
- Area there any material left on the floor with no use?

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Red Tag Area items are register in the Red Tag Register Book.

S.No	Date	Material/item discarded	Reason for Discarded	Quantity/weight	Status/Action	Authorised Signatory
1	19/03/19	Chair	Damage	4	Reject	Paulraj
2	22/03/19	Study table	Damage	3	Repair	Paulraj
3	27/03/19	Cot	Damage one leg	1	Reject	Paulraj

While sorting



Fig-2(a)

Red tag area



Fig-2(b)

Seition (Set in Order)

Seition is the second step of 5s and is namely a process to put orderliness in every workplace for better work efficiency and visualization for all workforces which have to collaborate as team for achieving a specific target. The process has to be commenced under the perfection in removing clutter and other unnecessary items for the work from their workplace. Seition focused on PEEP method is known as Place for everything and everything in its place. It helps to know the people correct place to find the item and searching time is reduce. In this phase every necessary items are kept in a good order and focus on more effective and efficient way of saving the storage space. The systematic arrangement can be follows through the visual boards, visual stickers, floor marking, summary sheets and individual responsibility chart.

For implementing the 2s in hostel undergo the following steps:

- The clear list of items and their locations are listed down and kept in lockers, cabinets.
- Each drawer lockers, cabinets should be labeled with the name of the item kept in it.
- Use labels, colour codes to identify the location of the items and use index for indicating the place for files, records.
- Different lines of different colors give different indications.
- Take photographs before and after implementation for analysis of the improvement

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Before



Fig-3(a)

After



Fig-3(b)

Seiso (Shine)

We know the cleanliness is next to God, this step indicates to keep the place. Regular cleaning in a proper way helps to identify and eliminate the wastes. During cleaning of the floors, toilets, dining place, store places etc. Cleaning properly and also implementing it by all the members of the hostel provides a very good study environment for the students and also better way. This cleanliness also gives a good image to the institute in the eye of its customers those are the students looking for admission in college. Awareness about shine cleaning is the self discipline and not a work. This step deals with not only cleaning the toilets, floors, dining place and other places but it also concerned with cleaning with cleaning the items that are been daily used in zone13 like the fan, light, heater, study table, cot so that these item can perform in the best possible way for a long time without getting break. My room concept is follow in the hostel. Each room allocating the incharge and responsibility of the room can be taken and maintain it.

For implementing the 3s in hostel undergo the following steps

- Determine the cleaning targets
- Determine whom to assign for cleaning what
- Determine the cleaning method
- Determine the 5s minutes shine activity
- Start the cleaning process

Before



Fig-4(a)

After



Fig-4(b)

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Seiketsu (standardize)

Seiketsu involves in creating visual controls and guidelines for keeping the hostel in an organized and orderly place and also keep it clean. In this step very high standard of housekeeping is been followed seiketsu helps to return back and work in a standard order or way. In the hostel the human nature being so variable, there is always a change that the members in the college divert from the practices and go back to their original way of working Seiketsu is used to prevent all the members of the hostel from diverting. Basically this technique is to keep revising the whole process on a regular basis. Standardizing refers to standardized work practice. It refers to not only standardized fashion. Everyone knows exactly what responsibilities are. Standardization is the condition that exists when the first three pillar sort, set in order and shine are properly implemented. The basic purpose of standardize is to prevent setbacks in first three pillars to make implementing these practice as a daily habit and to make sure that all pillars are maintained and practices in full flow.

For implementing the 4s in hostel undergo the following steps

- To decide who is responsible for which particular activity with regard to the maintaining the above 3s.
- Energy conservation
- To prevent the members from returning back to their old practices and implementing those duties into regular day to day activities.
- Check how the 3s are well maintained.
- Scheduling the 5s meeting

Before



Fig-5(a)

After



Fig-5(b)

Before



Fig-5(c)

After



Fig-5(d)

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Analysis Energy conservation

Energy conservation is the effort made to reduce the consumption of energy by using less of an energy service. Energy can be conserved by reducing the wastage and losses, improving efficiency through technological upgrades and improved operation and maintenance. Analysis energy conservation by using current technology in the hostel.

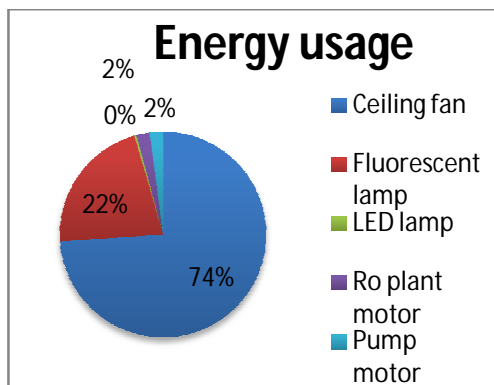


Table 1: Total energy required per(kilowatt-hour) in boys hostel

S.NO	Name of appliance	Quantity	Power (watts)	Total power in watts	Hours used per day	Energy kilowatt-hours
1	Ceiling fan	133	75	9975	16	159600
2	Fluorescent lamp	146	40	5840	8	46720
3	LED lamp	67	5	335	2	670
4	RO plant motor	1	1hp	746	2	1492
5	Pump motor	2	3hp	2238	2	4476
				19134		212.958

Total energy required per(kilowatt-hour) =212.958 kwh

Total load or Rated load =19.134 kwh

In hostel more energy usage is taken by the ceiling fan and fluorescent lamp by using the current technology ceiling fan is replaced by the BDLC ceiling fan and the fluorescent lamp is replace by the LED lamp. Energy can be conserved by reducing the wastage and losses, improving efficiency through technological upgrades and improved operation can be analysis and saving of the energy tabulated below

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Table 2: Ceiling fan total saving energy required per(kilowatt-hour) in boys hotel

S.NO	Name of appliance	Quantity	Power (watts)	Total power in watts	Hours used per day	Energy (kilowatt-hours)	Saving energy (kilowatt-hours)
1	Normal induction Ceiling fan	133	75	9975	16	159.600	100.016
2	BLDC ceiling fan	133	28	3724	16	595.84	

Ceiling fan total saving energy required per(kilowatt-hour) =100.016 kwh

Table 3: Fluorescent lamp total saving energy required per(kilowatt-hour) in boys hostel

S.NO	Name of appliance	Quantity	Power (watts)	Total power in watts	Hours used per day	Energy (kilowatt-hours)	Saving energy (kilowatt-hours)
1	Fluorescent lamp	146	40	5840	8	47.720	36.040
2	LED lamp	146	10	1460	8	11.680	

Fluorescent lamp total saving energy required per(kilowatt-hour) =36.040 kwh

Total saving energy required per =100.016 + 36.040
=136.056 kw

Total saving energy required per =136.056 kw

5s Meeting

Type	Participants	Frequency
Zone Meeting	Zone Members Zone Leader	Weekly
Area Council Meeting	Zone Leaders 5S Coordinator 5S Facilitator	Weekly
Committee Meeting	Zone Leaders 5S Coordinator 5S Facilitator Management	Bi Monthly / Monthly

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Shitsuke (Sustain)

The final stage of that of being discipline. To retain the initial use of S it is needed to sustain and be self-discipline. The way in which management achieves this establishment of on going commitment within the workforce depends on the culture and discipline they follow from starting. This step increase the consciousness of staff and decrease the number of waste goods and process, it brings in improvements in the internal communication and also helps in improving the human relations. The regular inspection can be done using check sheets on the basis of which radar graph of %s can be drawn and the estimation of the amount of improvement in the hostel can be known which can be executed by a selected learn in every month to have check on the process.

Table 4:5s Audit

Location name: FX boys hostel

Date : 26.03.2019

Auditor name: Paul raj(warden)

Score : 0= very bad 1= bad 2= Average 3=Good 4=very Good
--

S.NO	Checklist item	Criteria	Score				
			0	1	2	3	4
Sort- Seiri							
1	Cabinets and shelves	No irrelevant reference material, clothes, foot wears etc					✓
2	Tables & study table	No irrelevant reference material, paper, documents, notes etc					✓
3	Drawer	No excess pieces of material, paper ,document etc					✓
4	Furniture	No excess furniture in the room					✓
5	Red tag	Red tag area are used and proper maintain the register					✓
• Set in order- Seition							
6	Tables, shelves,& cabinets	Free of accumulations of papers and other object					✓
7	Different places	Whether different places are always clean and arranged					✓
8	Area identification	There are labels to indicate dedicated storage areas					✓
9	Storage labels	Labeling of shelves, cabinets, drawer, register etc					✓
10	Display boards	Displays boards for study time, mess time can be noticed					✓
11	Safety	Safety equipment easily accessible and in good condition					✓
• Shine- Seiso							
12	Floor	The floor is kept clean and no signs of damage					✓
13	Building structure	Walls and ceiling are good condition and free from dirt/dust					✓

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14	Shelves, Racks & lockers	Racks, shelves, lockers are kept in clean						✓
15	Furniture	Tables, cot, study table, chair are kept in clean						✓
16	Trash container	Trash containers and emptied on a regular basis						✓
17	Cleaning tools	Cleaning tools and material are easy accessible						✓
18	Shine activity	5s minutes cleaning activities can be done						✓
19	Cleaning responsibilities	The responsibilities for cleaning & checking are maintained by one						✓
20	Cleaning and checking	Cleaning is done based on a checklist						✓
• Standardize- Seiketsu								
21	Visual controls	Visual control such as color coding and labels are established						✓
22	Procedures	Maintaining the first 3s are properly						✓
23	5s documentation	5s checklists, schedules and routines are defined and being used						✓
24	Uniform	Whether all are in uniform						✓
25	Responsibilities	Everyone knows his responsibilities when and how						✓
26	Regular Audits	Regular audits are taking place using checklist and measure						✓
• Sustain- Shitsuke								
27	5s system	5s seems to be the way of life rather than just a routine						✓
28	Success	Students achievements and awards can be displaced						✓
29	Punctuality	Whether all are punctual to college						✓
30	Meeting	5s Meeting properly done						✓

VII. CONCLUSION

Thus from looking at the benefits of implementing 5S in the college and analysis of energy conservation . The institute must look toward, implementing 5S in the college for having a organized and proper place of education. This would also improve the working of each individual as the implementation will make their work easier and it will become easy for them to locate the items they require at the correct time. The implementation 5S in the college will improve its effectiveness and also give a create image in the eyes of the parents, upcoming students and also recruiters and other bodies.

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