Original Research

# Using 5S Lean Management Tool to Assess the Impact of Good Housekeeping on Productivity in Manufacturing Processes

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**Abstract**
Good housekeeping can be considered as a workplace standard developed to create safe and productive work environment. Its implementation is expected to reduce wastes and defects, increase productivity, safety, and workers' morale. As there is a lack of sufficient evidence to show the positive impact of good housekeeping on production performance and the importance of the role of continuous improvement in manufacturing industries, this paper is aimed to identify the effectiveness of good housekeeping implementation on manufacturing performance. Three different plastic manufacturing factories were considered in this study. Two of them were facing problems in meeting customer delivery due dates and in running their daily operations, whereas the third factory handled well their production system. To assess the effects of the implementation of good housekeeping, the 5S management tool was used to shed the light on the inconsistencies in implementing good housekeeping in different work areas within the factories. The outcomes of this study obtained from a comparative analysis demonstrated the efficient implementation of good housekeeping led to subsequent improvement in productivity of the factory. These outcomes also suggested that 5S is an effective technique that can be used to improve housekeeping, working environmental, and health and safety standards.

**Keywords** - 5S; Housekeeping; Lean manufacturing; Manufacturing problems

## INTRODUCTION

Manufacturing industries strive to improve their performance. Good housekeeping is one of initiatives that result in cost reduction in production. Good housekeeping is easy to implement because it doesn't need resources in terms of money, infrastructure, and work force. Therefore, many manufacturing companies may need to practice good housekeeping as means of improving trade competitiveness in order to compete with the larger manufacturer.

5S is a lean management tool that can be used to assess cleaning, sorting, and tidying in order to provide a basic housekeeping needed for workplace improvement. 5S is a process of five stages of housekeeping was originally developed by Hirano [1]; Seiri (Sort), Seiton (Set in Order), Seiso (Shine), Seiketsu (Standardize), and Shitsuke (Sustain), to help in eliminating waste. The 5S tool was used in this study to compare the effect of implementing good housekeeping to create valuable end production with no scraps, waste materials, and surplus finish items unduly generated. The outcomes of this study exposed the influence of good housekeeping implementation on the operational and financial performances of three different

plastic manufacturing factories. The 5S lean management tool helped in improving the working system and acted like a first step towards the approach of lean manufacturing.

## LITERATURE REVIEW

5S is a Japanese systematic technique used to organize a workplace for efficiency, decrease waste and optimize quality and productivity via monitoring an organized environment. Several research showed positive results on enhancing quality of production by implementing 5S as a housekeeping tool [2]-[5]**.** Chapman [6] reported that 5S has been used in the clean houses design of efficient facilities. Hough [7] described housekeeping operations as sorting. While Howell [8] referred housekeeping to equipment or anything else that is not of use, should be discarded as refuse to be thrown out. Bayo-Moriones et al. [9] described the help of 5S to reduce non-value adding time, increase productivity and improve quality. Patel and Thakkar [10] reported that by using 5S to optimize spaces, workforce and the work areas, they were able to achieve visible result in terms of increasing in the net inventory within a short period of time. Sharma and Singh [11] confirmed that 5S is an effective tool for achieving continuous improvement and higher performance in terms of productivity, quality, cost, delivery, safety and morale.

Gapp et al. [12] noted that some critical decisions of 5S activity, especially which related to budget and time performance must have management approval and support. Ablanedo-Rosas et al. [13] asserted 5S implementation must involve teamwork and active participation of employees. Nizam Ab Rahman et al. [14] showed that the 5S practice is an effective technique that can improve housekeeping, environmental performance, health and safety standards in their workplace. Hence, effort and participation from top management is a key factor that determines the success of the 5S practice.

Dudek-Burlikowska [15] reported that 5S should not be implemented only in the typical operational processes but also in the administrative processes. Ishijima et al. [16] presented the significant impact of 5S on patients' waiting time reduction in hospitals. Alva et al. [13] showed that 5S implementation in restaurant resulted in better utilization of space and increased profit. Siahaan et al. [17] reported that 5S implementation in maintaining the cleanliness of the work environment in schools has improved the performance of teachers and employees.

Jaca et al. [18] affirmed that the most important benefits of the 5S implementation are safe work environment, stronger ethics, and motivation of the employees, as well as waste elimination, time savings and improved efficiency. Bin Ashraf et al. [19] studied the continuous improvement to overcome challenges to retain prosperous position of factories facing an uprising of new competitors both in the national and international market. Improvement proposals were made based on 5S approach and lots of benefits such as space saving, money saving, increasing productivity, decreasing rejection of components and many more were achieved.

Ghodrati and Zulkifli [20] showed that 5S is an effective tool for improvement of organizational performance, regardless of the organization type, its size, production or service. Their results were obtained from a comparative measurement of organizational performance before and after 5S implementation. Mali and Bhongade [21] used 5S tool in the small scale-manufacturing firm as a basic tool for cleaning, sorting, organizing and providing necessary groundwork for workplace improvement. Omogbai and Salonitis [22] studied the effect of sorting activity on manufacturing throughput and revealed some interesting relationships between between 5S and system performance. Rizkya and co-workers [23] and Gupta and Chandna, [24] illustrated the benefits of implementation of 5S in improving productivity by minimizing the total area used and reducing tool searching time. Makwana and Patange [25] presented a case study of improving work culture and morale of the workers, and effective and efficient utilization of resources through 5S in plastic manufacturing company. Hence, via monitoring an organized environment, implementation of 5S will help to organize the workplace for efficiency and productivity.

## RESEARCH METHODS

### *I. Case Study*

This study was carried out on three different plastic manufacturing factories in Lebanon. Managers of factory A and factory B were facing problems in meeting customer delivery due dates and in running their daily operations. On the other hand, factory C handled well their production system. From a general observation, lack of systematic procedures and knowledge of housekeeping in factory A and factory B were claimed to be the main reasons underlying these problems. Whereas factory C was generally neat and tidy, and most items and tools were properly labelled, organized, and stored. This study aimed to investigate the impact of 5S practices on the performance of the selected factories. The main objective of this study was to measure and compare the effect of 5S practice, and to identify the effectiveness of 5S implementation on the factory performance.

*II. Data Collection*

This study was carried out for a period of one month to study the system, collect data and observe the flow of information within the factory. The number of employees participated in this study from the factory A was 20; from factory B was 18, and from factory C was 22. These numbers represented all the employees at the factories, including managers and clerical staffs.

The impact of implementing 5S method was in the terms of the following measures: work environment during production, tidiness of storage areas, cleanness of the workplace, work housekeeping standard, and the ability of employees and managers to maintain housekeeping. Two methods of data collection, survey and observations were conducted to find out the current situation of the factory. As such, all the areas where 5S would be implemented were visited and data were collected. The survey was anonymous, and the observations were based on what was detected during the time spent at the factory

Structured and predetermined sets of questions were used to determine the level of lean implementation of these factories. Questions were designed to find out the current situation at the factory and the perceptions of attainment on each of the measures. Each S stage has a specific set of questions that serviced a specific aim and presented in the following section.

## RESULTS AND ANALYSES

This study was presented to employees as part of their learning and improvement process. Since the results obtained from the survey play a crucial part in setting future directions, it was important that the employees understood the questions clearly and answered accurately. Therefore, respondents were provided an outlook on how to respond to the questions given. Discussions were held with the respondents to check on clarity of each question and to provide unbiased answers about what they have to say in their response.

A numerical scale was used in this study to allow statistical analysis. Answers obtained based on the response to each question addressed were analyzed and discussed. The answers were based on a Liker scale (5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, and 1=Strongly Disagree). The value of mean score was fixed at '3.5', which corresponded to the moderate value in the five-point Liker scale used in this research. The population means that are greater than 3.5 represent the opinion of respondents that are in the range of 'agree' and 'strongly agree'. The outcomes of the survey and observations are as follow:

*I. Sort (Seiri) - 1S*

Table I displays the average values of 1S stage derived from the study. Table I shows good attainment of 1S activity at factory C, as it scores an average 4. The outcomes of question 1 shows tools those were not used to complete a work process were removed from the work area, as it scores an average 4. However, there were missing efforts required for any unnecessary needed materials and items to be removed out of the way, since the score of question 2 is as low as 3. This action involved going through all the contents of a workspace and determined which are needed and which can be removed, and to retain only the essential items needed to complete tasks. Furthermore, factory C rarely faced any problems with preparation for production.

TABLE I
AVERAGE VALUE FOR EACH QUESTION RELATED TO 1S - WORK ENVIRONMENT DURING PRODUCTION

| Question | Comp A | Comp B | Comp C |
|---|---|---|---|
| Q1. Unnecessary tools are left next to the machines during production. | 2 | 2 | 4 |
| Q2. Scraps, raw materials, and surplus finish items are left next to the machines after production. | 2 | 2 | 3 |
| Q3. Needed tools are prepared and ready before production. | 2 | 1 | 4 |
| Q4. Raw materials are prepared and ready before production. | 4 | 1 | 5 |
| **Average** | 2.5 | 1.5 | 4 |

According to Table I, the 1S implementation at factory A and factory B was at poor level. From the assessment of work environment during production, the study found that the deficiency lied in the work area and production preparation. All observations used in evaluating work environment during production at factories A and B showed the production area to be untidy. The low scores were due to the inadequate work preparation and ineffective removing of unnecessary tools and materials from the work area. Even though some efforts were observed in material preparation before production at factory A, however,

still not enough efforts were made to ensure that all needed items were accounted for, and that item not required for production were removed out of the way.

Based on the results presented in Table I, factory A and factory B have serious problems and enhanced procedures must be implemented to provide a better work environment and turn the work areas into comfortable workspaces for the employees. For the 1S, managers must make sure that the production team must separate the required tools and materials for each process from those that are not needed. Unnecessary tools and scraps, or raw materials and surplus finish items, which are not needed for the immediate consecutive product, must be removed from the production area. Furthermore, managers must sort, organize, label, and place all tools for quick use. Production team needs to know what scraps should be discarded as waste or stored as recycle materials. Raw materials and surplus finish items must be removed from the work area, labelled, and stored in their storage areas.

*II. Set in Order (Seiton) - 2S*

Table II displays the average values of 2S stage derived from the study. Table II shows overall satisfactory attainment of 2S activity at factory C, as it scores an average 3.6. Passages and storage areas indicates excellent results. These areas were clearly marked and have rarely faced problems with movement within the factory. On the other hand, there were still many rooms of improvement in storage management; the tools and items were not stored as they were supposed to. Also, tools, items, and materials visibility were very low, since the score is 3. It can be deduced that improvement in storage management will give more comfort to the production team and less fatigue. This action involved the production team to know where the tools and materials are, what the production requirements are, and when they are to be used. When these actions are satisfied it usually doesn't take long before workers can select tools and materials with little guidance.

TABLE II
AVERAGE VALUE FOR EACH QUESTION RELATED TO 2S - TIDINESS OF STORAGE AREAS

| Question | Comp A | Comp B | Comp C |
|---|---|---|---|
| Q5. Main passages are clearly marked. | 4 | 3 | 4 |
| Q6. Storage areas are properly marked. | 4 | 3 | 5 |
| Q7. Tools are stored based on their uses. | 2 | 1 | 3 |
| Q8. Final products can be easily identified in their storage areas. | 4 | 1 | 3 |
| Q9. Raw materials can be easily identified in their storage areas. | 2 | 1 | 3 |
| **Average** | 2.8 | 1.8 | 3.6 |

According to Table II, the 2S implementation at factory A and factory B was at poor level as compared to factory C. From the assessment of tidiness of storage areas, the study found that the weaknesses lied in storage management. All the observations used in evaluating tidiness of storage areas at factories A and B showed that the storage area was untidy and messy. The low scores were due to the inadequate storage of needed tools, items, and materials in the storage area. Most of the tools and materials were scattered around the factory, there were no definite and fixed places for all tools, items, and materials. Providing definite and fixed locations for tools and materials reduces the need for visual search and eye-hand coordination.

Some efforts were observed at factory A in ensuring that adequate spaces are marked out and allocated for placing materials in storage areas, and appropriate markings of passageways to eliminate interference with work or passage. However, there were no commitments from the production team to follow the rules set by the factory in the allocation and designation of passages and storage areas. On the other hand, factory B showed little effort in designing the storage areas and passageways, although some storage areas and passages were marked out, there was no adherence to these areas, where tools, items, and materials were scattered everywhere in the factory. Beside the high risk of accidents from obstacles that might be workers collided with, these obstacles negatively affected production time and quality, and played an important role in increasing the amount of waste and scraps.

Based on the results presented in Table II, factory A and factory B have serious problems and improvement must be implemented for better storage areas. For the 2S, managers must make sure proper design and allocation of passageways and work areas in the factory are adopted. Also, must ensure that all tools, items, and materials are labelled, dated, and stored in a designated place. Furthermore, they must make sure that the production team must be aware on how to organize all the items left in the workplace in a logical way, so they make their tasks easier to complete. Finally, the management team must make sure that tools, items, and materials must be stored, clearly visible and placed close to where they best support the production.

*III. Shine (Seiso) - 3S*

Table III displays the average values of 3S stage derived from the study. Table III shows excellent attainment of 3S activity at factory C, as it scores an average 4.33. It was observed that, cleanliness of workplace provided more comfort and satisfaction to the production team. This action involved routine tasks such as mopping and dusting, and performing regular cleaning and maintenance on tools, equipment, and machines.

TABLE III
AVERAGE VALUE FOR EACH QUESTION RELATED TO 3S - CLEANLINESS OF WORKPLACE

| Question | Comp A | Comp B | Comp C |
|---|---|---|---|
| Q10. The workplace floor is clean. | 3 | 2 | 4 |
| Q11. Machines are cleaned and maintained regularly. | 3 | 2 | 4 |
| Q12. The factory is well ventilated. | 3 | 3 | 5 |
| **Average** | 3 | 2.33 | 4.33 |

According to Table III, the 3S implementation at factory A and factory B was at poor level. All the observations used in evaluating cleanliness of workplace at factories A and B showed the factory was unclean and messy. From the assessment of cleanliness of workplace, the work areas were covered with dusts, trash, grease, grime, and other substances created by production processes. In addition, most of the tools and materials were scattered around the work areas. Other problem with ventilation was observed, air quality within the factory were an issue due to a buildup of odors, excessive humidity and heat, and carbon dioxide when workers used a facility.

Based on the results presented in Table III, factory A and factory B have serious problems and new processes must be implemented for cleanliness of work areas. For the 3S, managers must make sure proper cleaning routine are set and housekeeping duties are part of regular work routines. Also, they must ensure that the production teams are aware of the importance of cleanliness. Clean work areas result in safe working environment and makes possible problems noticeable, such as: machine leaks, loose parts, unclean tools, loose materials, etc. The management team must make sure all tools, items, and materials must be clean, tidy, and neatly placed in their designated locations. Likewise, Air quality can be improved by good housekeeping practices and proper ventilation systems.

When these actions are satisfied, tasks become easier to complete. A clean production area can quickly show when things are going wrong and always ensure quality and efficiency of production. Regular cleaning and maintenance ensure that machines can operate properly for longer periods, reduces chances of a break down, and reduces costs of repair, and leads to an overall reduction in the cost of production. Workers must thoroughly remove mess and reduce the causes of waste, dirt and damage as well as maintain the machines. This cleanliness will allow for better control and consistency of production. Keeping the work environment clean and tidy in its appearance allows better focus.

*IV. Standardize (Seiketsu) - 4S*

Table IV displays the average values of 4S stage derived from the study. Table IV shows excellent attainment of 4S activity at factory C, as it scores an average 4.35. This result shows clearly that a housekeeping standard was applied everywhere in the factory. All the observations used in evaluating the implementation of the housekeeping standard showed that all employees knew exactly what their responsibilities are.

TABLE IV
AVERAGE VALUE FOR EACH QUESTION RELATED TO 4S - FACTORY'S HOUSEKEEPING STANDARD IS FOLLOWED

| Question | Comp A | Comp B | Comp C |
|---|---|---|---|
| Q13. Workers had the induction of the factory housekeeping standard. | 2.4 | 2.1 | 4.05 |
| Q14. Workers understood factory housekeeping standard. | 2.2 | 2 | 3.75 |
| Q15. Workers follow factory housekeeping standard. | 1.5 | 1.6 | 4 |
| Q16. Workers are aware of the importance of housekeeping. | 3 | 2.8 | 4.7 |

| | | | |
|---|---|---|---|
| Q17. The supervisors oversee the implementation of housekeeping standard at the production areas. | 2.3<br>3 | 2.8<br>2 | 4.3<br>4 |
| Q18. The housekeeping standard is implemented in the production areas. | 5 | 4 | 5 |
| Q19. The housekeeping standard is implemented in the clerical areas. | 5 | 2 | 5 |
| Q20. The factory housekeeping standard is clear and easy to understand. | | | |
| **Average** | 3.05 | 2.41 | 4.35 |

Table IV shows that the 4S implementation at factory A and factory B was at poor level as compared to factory C. the outcomes of questions 19 and 20 show clearly that factory A has a housekeeping standard, which is clear and easy to understand but it was only implemented in the clerical areas. Even though factory A had invested in defining a good housekeeping standard, there were little, or no efforts made to ensure its implementation. Factory B showed little effort in setting housekeeping standard. However, some personal efforts from the clerical staff to keep their offices clean have been observed.

Both factories A and B revealed that workers haven't been introduced to the housekeeping standard when they started their jobs, hence, they cannot be blamed for not applying the standard in the production areas. The outcomes of question 16 showed that some workers are aware of the importance of housekeeping, and they used their own initiative to keep some of their production areas as clean as possible, this is shown in the outcomes of question 18. The outcome of question 17 shows the lack of the supervisors' knowledge in housekeeping, which also contributed to the poor results.

Based on the results presented in Table IV, factory A and factory B have serious problems in the implementation of housekeeping standards within the factory. For the 4S, major efforts must be considered by the management team to make sure that the factory has a minimum acceptance level in housekeeping. Managers are obliged to define a simple and clear housekeeping standard so that everyone in the factory can follow. This standard can involve housekeeping worksheets, such as schedules, charts, and/or lists, specifically prepared for cleanliness of the work areas, storage areas, and machines. These worksheets must be visible clearly and posted close to where they best support the production and storage. Furthermore, managers have the responsibility to make sure workers understood the importance of a housekeeping standard and production supervisors have the responsibility oversee its implementation. Good housekeeping practices can give the factory huge benefits regarding production efficiency and lead time reduction.

*V. Sustain (Shitsuke) - 5S*

Table V displays the average values of 5S stage derived from the study. Tab. 5 shows an overall very good attainment of 5S activity at factory C, as it scores an average 4.04. This result shows clearly that employees and managers maintain a good housekeeping standard within the factory. Question 23 shows a score as low as 3.3, this was because the factory had introduced a few new products, which required rearrangement of the production work and storage areas. The management considered the existing housekeeping standard still valid and did not take any action to update it. However, this rearrangement resulted in tools and items being no longer stored where they were supposed to, which shown in the outcomes of assessing the 2S activity. The overall results of the study that carried out at factory C showed the positive impact of a control team and housekeeping audit worksheets.

TABLE V
AVERAGE VALUE FOR EACH QUESTION RELATED TO 5S - EMPLOYEES AND MANAGERS MAINTAIN HOUSEKEEPING

| Question | Comp A | Comp B | Comp C |
|---|---|---|---|
| Q21. The factory has a control team. | 2 | 2 | 4 |
| Q22. The factory has housekeeping audit worksheets. | 2 | 2 | 5 |
| Q23. The management team regularly assesses workplace environment. | 2 | 1 | 3.3 |
| Q24. The management team measures the awareness of staff members. | 2 | 1.5 | 3.8 |
| Q25. The management team does train workers to achieve self-discipline. | 2 | 1.5 | 4.1 |
| **Average** | 2 | 1.6 | 4.04 |

According to Table V, the 5S implementation at factory A and factory B was at very poor level. Even though factory A had invested in defining a good housekeeping standard, but this standard was not fully implementation. Both factories considered that one the duty of the production supervisors was to oversee the application of housekeeping. Bearing in mind, these supervisors were promoted internally because of their age or years of experience but with no or little knowledge of housekeeping. This also resulted in the absence of housekeeping audit worksheets within the factories. Furthermore, it is well clear from the outcomes of questions 24 and 25 there is a lack of commitment from the management team to build self-discipline in their employees in relation to applying and following the factory housekeeping standard.

Based on the results presented in Table V, factory A and factory B have serious problems in maintaining a housekeeping standard within the factory. For the 5S, major efforts must be considered by the management team to make sure that the factory has and maintains a good housekeeping standard. Managers are obliged to increase the awareness and commitment of workers, and to minimize the number of non-conforming products and processes. This can be achieved through improvements in the internal communication. Also, the management team must define a control team that is responsible in maintaining good housekeeping and is aware of the necessity of performing regular inspections of the factory housekeeping audit worksheets.

Managers and supervisors must sustain new practices and conduct audits to maintain discipline to maintain the workplace in perfect condition as a standard process. Furthermore, the management team must carry out training for workers to develop and achieve a sense of self-discipline. The control team must make sure that each production process has a housekeeping audit worksheet, which can be posted for workers to follow and sign at the start and end of each production. This worksheet helps everyone to do its part in maintaining mess-free workplace.
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## DISCUSSIONS

Good housekeeping can reduce worker fatigue and strain from repetitive motions and over exertion, in addition to reduce unnecessary storage areas, reduces missing tools, and increase the lifetime of tools, machines, and equipment. Keeping a clean manufacturing facility has numerous advantages can be listed which include: machines are being processed with a better efficiency, workers are fully utilized (less idling), workplace is safer, fewer human accidents are occurring, more defects are now being detected before proceeding into the system, less waste is produced, production is maximized taking full advantage of time available (minor stoppage times for maintenance, cleaning and checkups), and process parameters were optimized leading to better quality products. Ultimately, all these benefits have positive effect on enhancing productivity and improving the quality of products being produced.

The results of this study showed that good housekeeping plays an important role on the performance of the selected factories. From the observation carried out, it can be concluded that factory C, which has excellent good housekeeping, is standing towards the excellence level as compared to factory A and factory B, which both show weaknesses in several aspects. In comparison to factory C, which has good share in the national and local market, both factories A and B were unable to strengthen their position in the national market and only competing in the local market.

From the observation, both factory A and factory B do not seem to have an established background in lean, production, and operation management. Good housekeeping is a useful practice can be used to improve the productivity of any industry without any limitation. However, the management teams of both factories have little knowledge on the benefits of good housekeeping practices as working culture. Some members of the management teams showed some resistance to implementing good housekeeping practices, as they were content with their current attainment. Besides, there were several obstacles that led to an ineffective implementation of good housekeeping practices for improvement purpose. The most significant obstacle identified in factory B was related to the absence of housekeeping standard. Other significant deficiencies observed in both factories included the gap in communication between the management team and production workers, and the lack of training and awareness of housekeeping amongst workers. Poor communication played an important role for the poor results in managing the production i.e., time, cost and materials. Consequently, without proper training, the workers were not able to understand the benefits of good housekeeping practices properly and accepted it as working culture. In addition, these obstacles lowered the morale and motivation amongst workers.

On the other hand, the results presented in this study indicated factory C is very content with utilizing good housekeeping practices as a practical and beneficial quality method in their processes. Tidiness and cleanliness of storage and working areas were very vital to promote factory performance. Meeting with the management team showed their knowledge and experiences in lean, production, and operation management. Also, they were aware that good housekeeping has an effective impact on performance of factory, and a useful tool used without any limitation on products or services. This is probably because factory C is certified by ISO as a company with products and services that meet quality standards.

## CONCLUSIONS

In this paper, the important of housekeeping in plastic industry were demonstrated using 5S management tool. The benefits of the first four activities of 5S were significant, easy to implement and simply measured. However, without self-discipline, success of 5-S is temporary and could revert back to the prior messy and untidy state. Hence, both management team and control team have an important role to play to increase the awareness of their workers toward housekeeping.

The outcome of the study demonstrates clearly how good housekeeping helped to take a step forward to improve its manufacturing process performance. The implemented actions could be applied in all production factories. If good housekeeping standard is applied, a huge positive impact will dominate the work environment and it will lead to maximizing profit and customer satisfaction. 5S management tool was proved in this study to be an effective technique that can be used to assess housekeeping in an integrated holistic way.

Finally, a general recommendation for the management team is to make housekeeping a part of the factory culture and to incorporate it into their production philosophy. Also, to build managerial commitment so that housekeeping becomes one of the factory values. The outcome of this study must encourage manufacturing managers to adopt 5S tool to improve and monitor all housekeeping aspects within the factory. Good housekeeping has positive impact on production performance, and it can be applied to any industry.

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