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Implementation of 5s in Small and Medium Enterprises (SME)

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ABSTRACT

There have been many studies carried out on Lean manufacturing implementation in larger organizations with specific focus such as sig sigma, kaizen, just-in-time and many others lean tools. Many of these studies shows that Lean manufacturing implementation has driven the organization with tremendous improvement. Lean implementation among Small and Medium Enterprises (SME) has not been so extensively researched or even implemented among the SME companies. This project was a case study which attempts to bridge this gap by implementing the Lean manufacturing principles in SME with a perspective of identifying the benefits of the implementation. A company was chosen and agreed to took part in this case study. After getting the agreement from the company, a selected lean manufacturing tool (5S practices) was implemented. This aim of this project is to determine the outcome after the implementation of 5S practices.

1. Introduction

Many of the large manufacturer has taken part in lean implementation in order to improve their performance. Lean manufacturing is one of these initiatives that focuses on the cost reduction by eliminating wastes. Therefore, the small and medium enterprises may need to practice the lean principle in order to compete with the larger manufacturer.

Research at Lean Enterprise Research Centre (LERC) U.K. indicates that for a typical manufacturing company the ratio for activity could be broken down as value added activity-5%, non-value-added activity (waste)-60% and necessary non value added activity-35%. This implies that up to 60% of the activity at a typical manufacturing company could potentially be eliminated. All Lean manufacturing tools are not possible to implement in small medium enterprise company because of limited resources in terms of finance, infrastructure and work force. The 5S, potential Lean manufacturing tool selected to be applying for performance improvement of company and related environmental investigations, environmental performance evaluation, environmental labelling, life cycle assessment, environmental communication, environmental aspects of product design and

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development, environmental aspects in product standards, terms and definitions, greenhouse gas management and related activities, and finally, measuring the carbon footprint of products.

This study focuses on the manufacturing industry. The purpose of this project is to describe the analysis of the case company's productivity before and after the implementation of lean philosophy, which also aimed to improve productivity of the company by using lean principle.

The research questions were set as follows:

a) What is the current level of lean implementation of the company?
b) How can lean manufacturing implementation benefits the company?

The research questions are addressed through literature findings and empirical analysis. The empirical data was collected from survey and included observation, and interviews with employees. The project is structured as follows: for the background of the empirical study, the literature on lean manufacturing and lean manufacturing development is reviewed. Then, the research method is explained. The case description and analyses are presented in the results section. Finally, the outcomes are discussed from theoretical perspectives and the study conclusions are presented.

Although lean manufacturing implementation was originated from manufacturing origin, but it also has also been applied in many other sectors, including, for example, software, construction and healthcare. Over the years, the body of knowledge on lean manufacturing and related areas has expanded. According to Jasti *et al.*, [1], most of the studies have been conceptual. A conceptual review of lean production was presented by Papadopoulou [2]. The review covered a few aspects in terms of definitions, the key elements, and criticism of lean manufacturing. According to Pettersen [3], a combined review of the conceptual and practical issues of lean production. Finally, a review of empirical research on lean manufacturing was conducted by Sohal *et al*., [4].

2. Literature review

The focus of lean manufacturing was to reduce the cost and to improve productivity by eliminating wastes or non-value-added activities. Womack and Jones in their book "Machine that changed the world" [5] argue that the adoption of lean approach will change almost everything in every industry- choices for consumers, the nature of work, and fortune of industry by combining the advantages of craft and mass production. The lean approach consists of various practices, which aim to improve efficiency, quality and responsiveness to customers.

2.1 *Implementation of 5S*

The strategy devised by Hirano depicts that the implementation should be carried in such an order that the simpler and basic methodologies should be installed first. Hirano describes the sequence of implementation in the following Figure 1.

2.2 *Problem in Implementation*

According to Womack *et al*., [6], in order to implement the concept of lean manufacturing successfully, many researchers emphasize commitment by top management and the companies should utilize strong leadership capable of exhibiting excellent project management styles. These qualities would facilitate the integration of all infrastructures within an organization through strong leadership and management vision and strategy.

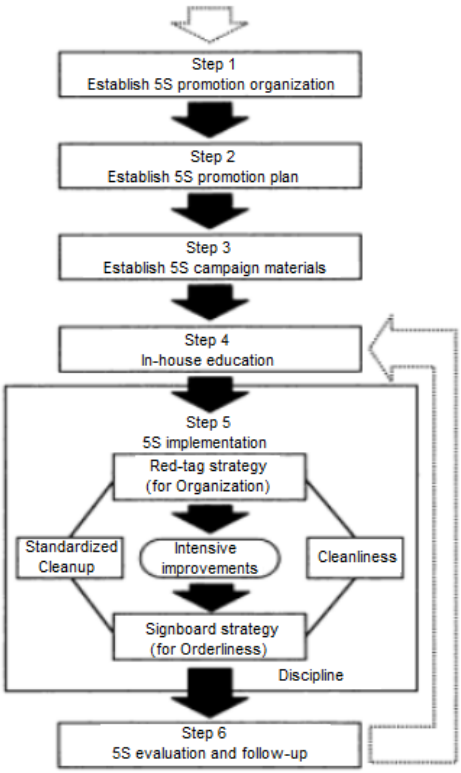


Fig. 1. Hirano's 5S Implementation Strategy

Good leadership ultimately promotes effective skills and knowledge enhancement amongst its workforce and minimizes the non-value activities in order to eliminate the wastes. The manager should also work to create interest in the implementation and communicate the change to everyone within the organization, specifically, the needed information related worker in shop floor should be updated respectfully. Worley and Doolen [7] stated that, the failures attributable to management support shared some common characteristics: First, executive management must provide employees with more information on the lean manufacturing initiative and why it is needed. Second, executive management must provide employees with resources such as time and materials to allow the employees to successfully participate in the lean manufacturing effort. If employees make plans for changes but do not see results, discouragement may occur, and future lean manufacturing activities may not be supported. Though it is often desirable to drive change from the factory floor, it is important that a transition to lean manufacturing be driven by the executive management team. Of course, while some success was achieved at the customer level, more success was realized from the employee perspective. Though the executive management team did not initially set out to implement lean manufacturing to create better relationships with employees on the manufacturing floor, strong evidence suggests this did occur. Employees expressed more positive feelings towards management. Many of the employees also expressed satisfaction with the lean manufacturing implementation, which may aid the organization as it continues to introduce lean practices. Finally, the executive management team must create an implementation plan and pre-described projects that includes all members of the organization in order to moving together towards a common goal. Management must be visibly connected to the project and participate in the lean manufacturing events [7].

In other side, the manager's behaviours and rewards should be focused on the management of a continuous series of short-term turning points, whilst the implementation of lean manufacturing that could create a firmer base for success by reducing costs and improving use of resources can be subject to continuous postponements "until better times". These companies would then be able to

implement the concept of lean manufacturing successfully. But unfortunately, some other owner managers who may not have the lean management know-how and knows the least information about procedure of lean implementation disturb the flow of improvements. Consequently, because of the lack of specific procedure to lean implementation, managers should learn to think and see lean through their making decisions.

2.3 *Strategies of implementation*

Bhasin and Burcher [8] agreed that there is general lean procedure consistent to any company, but each one should find their way through their conceptions from lean manufacturing. Bicheno and Liker are strong in suggesting that a key component of lean thinking is to identify all the value adding time and reduce the non-value-added activities. Bicheno [9] claimed that in batch production about 98 percent of time activities is not value adding time; in the USA, Sheridan [10] indicated that less than 2 per cent of all manufacturing jobs are in companies that are truly lean; that they have completed at least 80 percent of the conversion process. Also, Womack *et al*., [11] in their survey of automotive manufacturers, suggested that only 41 percent were assessed as having a high level of lean adoption. So, having a comprehensive knowledge of lean tools and being familiar with lean culture in adoption of right implementation and changes through incremental improvements and steeply projects by the reciprocal cooperation with workers until the completion of implementation is essential. Sheridan [10] proposed that lean implementation takes: "three years to become competent in applying such tools as set-up reduction, standard work or cell building and five years to introduce gradually a firm belief in all the tools". A key player is Liker [12] who is clear in promoting a total approach; that lean cannot work with isolated tools [12]. Shingo [13] also implied this policy. Securing the full benefits of lean requires the need to concentrate on the whole value chain suggest Command Mathaisel Allen, insist that for the Toyota production system to work effectively, it needs to be adopted completely, not into pieces; Allen claims: "that lean management is a system approach". Allen argue that lean is an entire business philosophy, as instigated by Ohno [13].

In equally, Karlson and Ahlstrom [14], admitted that a total philosophy is needed. Chase considers that getting lean: "also means that the business is examined in its entirety, including how orders are processed, the way materials are purchased, and the way manufacturing is done". Whilst Lathin and Mitchell [15] subscribed to the total approach, the issue they stress is the need to combine the "socio-technical systems"; that all work organizations combine a technical, i.e. technology, and a social system, i.e. people and organizational structures. Convis [16] proposed that the TPS is an interlocking set of three underlying elements: the philosophical underpinnings, the managerial culture and the technical tools. Pullin [17] insisted that to earn these benefits fully, it need to view lean not as an abstract philosophy but one which includes both concepts – a philosophy of management, and practices, tools or processes.

George Koenigsaecker, in Sheridan [10], who has directed lean conversion initiatives in 18 manufacturing plants comments: "often people who attempt a lean conversion start with one of the tools, or a couple, and they push them through the organization. They then wonder why things are not flowing in the total value stream. The problem is that there are about a dozen key tools in lean manufacturing and you have to move them all ahead somewhat simultaneously"; he continues, "it is a long learning curve". Pullin [17] insisted that Land Rover, winners of the MX2002 "Manufacturing Excellence Award", showed that not only had it adopted the lean philosophy but that it had adapted it to deal with certain local conditions.

Little published work, contest Jina *et al*., [18] mentioned that explicitly addresses the issue of whether lean methods are suitable and applicable in industrial sectors which are characterized by

high variety, low volume and low repeatability of production. Needy *et al*., [19] suggested that the pioneering work within the automobile industry is misleading to draw correlations from as the conditions differ in many other industries. Prabhu [20], in his study of three different industries and non-Japanese companies located in the north-east of England suggested that lean is not restricted to only Japanese companies or mass production firms or larger organizations. Allen [21] insisted that there is no "cookbook" to explain each step of the lean process and exactly how to apply the tools. Lathin and Mitchell [15] insist that quality improvements are only possible if companies implement comprehensive change management programs addressing "both the organizational and technological aspects of quality management". Bicheno [9] argued that lean needs to apply to every aspect of the value chain.

Karlson and Ahlstrom [14] stated: "the important point to note, however, is that lean should be seen as a direction, rather than as a state to be reached after a certain time". Moreover, all the determinants might not point in the right direction all the time; "there could be instances where they can send mixed signals". Emiliani [22] documented how the Wiremold Company achieved outstanding success by using lean as a comprehensive management system, rather than a group of tools. Henderson *et al*., [23] explained how to employ techniques pioneered by Toyota including cultural issues should an organization wish to succeed in becoming a lean enterprise.

3. Formulating Research Hypothesis

Many enterprises have been introduced to lean manufacturing system and have made significant achievement. According to Pingyu and Yu [24], a few of small medium enterprises have get profit from the implementing lean manufacturing. SME play a significant role in the economic growth of developing countries, typically accounting for over 90% of business establishments and about half or more of output and export shares. In yet another relevant study, the impact of LM is vividly depicted in steel industries. The authors, in this case, provided an in-depth analysis regarding lean implementation using a simulation approach to show the benefits observed in the steel industry. After applying LM, lead time was reduced at a significant percent- around ~70%- of total production time [25]. In a survey about the influence of LM on food, chemical and textile industries conducted by Koumanakos [26], it was demonstrated that organizations without lean implementation had lower profits due to maintaining higher inventories. On the contrary, the improvement of financial performance was evidenced when the process industries of that type utilized and implemented LM. Lean manufacturing not only assists in enhancing manufacturing performance through removing different types of wastes in the process industry, but it also works as an impetus to compete efficiently in the present days, where quintessential priorities such as product quality, feedback capability and customer satisfaction are prevalent [26]. Perceived in the cases from previous research the hypothesis is formulated as follows:

1. After implementing 5S, efficiency will increase
2. After implementing 5S, workspace will increase.
3. After implementing 5S, equipment search time will be reduced.
4. After implementing 5S, laboratory working environment will be improved.
5. After implementing 5S, safety will be improved.

4. Methodology

The case method was first used in modern times in 1905 by Harvard Business School. This method examines a situation in narrative form by providing background, details, and a problem or problems. Then, the case is analysed and solutions are proposed as part of the learning process. It is a popular method of teaching in many business schools today. As Yin [27] described, a case study is a tool used to answer a question: what, why, how? In the context of this thesis, a case study is utilized to answer the question what: "What is the impact Lean Manufacturing has on small medium enterprise?".

Interviews are useful to collect information based on research question of the study. There are different types of interviews, such as structured interviews, semi-structured interviews and unstructured interviews [28]. In this research a structured interview was conducted to the upper management which is the manager of the company. Structured interviews involve questionnaires based on a predetermined set of questions. The purpose of this interview is to determine the level of Lean implementation of this company and are there any necessity to implement any of the lean philosophy [28].

The survey will be distributed one times for the relevant respondent before the 5S implementation and another one is after implementation of 5S. After the implementation there will be four consecutive times survey given to the same respondents, consists of one survey for each month. Survey is set up on a five-point Likert Scale to measure satisfactory of the respondent. The scale ranges from 1 to 5 where 1= Unsatisfactory, 2= Poor, 3=Satisfactory, 4=Good, 5=Excellent. The result of the all surveys will be analyses and compare after the 5S project is executed. The survey is basically focus on five areas which includes the evaluation of performance, workspace, equipment search time, working environment and work safety.

The process of making a stainless table undergo three process which include cutting, folding and assembly process. Each of the process duration were recorded every week and the observe time, OT represent the average time taken in a month. Based on the book which was written by Elizabeth (1998), the formulation for normal time, NT it represents the time which the experienced employee and freshmen were taken in consideration to estimate of time required which will probably be less than what can initially be achieved. Next is to obtain the standard time, ST for the whole process in making the stainless-steel table. A 10% of allowance factor, AF were considered to obtain the standard time, ST. AF represent the personal needs time which includes breaks, delays (equipment downtime), and fatigue [29]. The formula is given as follows:

Observe time, $$OT = \frac{1}{n}\sum_{i=1}^{n} x_i \quad (1)$$

Normal time, $$NT = OT \times PR \quad (2)$$

Standard time, $$ST = \left[\frac{1}{1-AF}\right]\sum_{i=1}^{n} NT \quad (3)$$

Data obtained based on the response given will be analysed and discussed. This part is crucial to provide a general outlook on how the respondents responded to the questions given. Each question addressed in the survey will be analysed and presented in the form of standard chart graphical expressions by using Microsoft Excel.

5. Results

The result will be divided into two sections which include the employee's performances data and the 5S survey data over the 5 months of this project.

5.1 Employee's Performances

The employees were observed over the 5 months to obtain their performances in the process of making the stainless-steel table as mentioned in methodology section. The employee's normal time (NT) performances is shown Table 1.

Table 1
Employee's normal time (NT) performance

Element	Before 5S	1st Month of 5S	2nd Month of 5S	3rd Month of 5S	4th Month of 5S
	NT, (min)	NT, (min)	NT, (min)	NT, (min)	NT, (min)
Cutting Process	127.25	119.75	119	117.25	114
Folding Process	154.75	150.75	147	147.25	146
Assembly Process	258.83	238.88	233.1	232.31	231.53

Standard time, ST of the whole process in making the stainless-steel table were recorded and calculated by using Eq.3 that was mentioned in methodology section. The employee's standard time (ST) performances is shown in Table 2.

Table 2
Employee's standard time (NT) performance

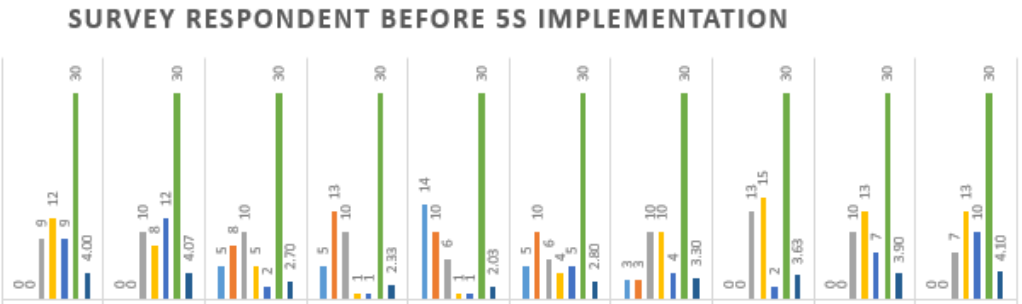
	Before 5S	1st Month of 5S	2nd Month of 5S	3rd Month of 5S	4th Month of 5S
Standard Time, ST (min)	600.92	565.98	554.56	552.01	546.14

5.2 5S survey

The survey held in two-way surveys which is one before implementing 5S and another one is after the implementation of 5S. The respondents were randomly handpicked from different positions within the company and the company's client. The survey is basically focus on five areas which includes the evaluation of productivity, workspace, equipment search time, working environment and work safety.

The first survey was kept before implementing 5S into the company. In all surveys thirty respondents were asked to answer the survey. For the five surveys over the 5 months, the response rate was 100%. There were ten questions in the survey and the rating scale was from one to five, one being unsatisfactory and five being excellent. The result for the first survey is shown in Figure 2, for

the green bar represents the total number of respondents and the other colours represent the respondents' answers, while the dark blue on the right side represent the average score for the particular question.



	1. How often is the final product finish within the deadline?	2. Is there any defect on the final product?	3. Is there any excessive items or products in the area?	4. In your opinion, what is the level of area utilized?	5. Are those tools or items visually presented?	6. Are all work related tools easily reachable?	7. How would you evaluate the level of cleanliness of the area?	8. Are there any instructions available in work units, where instructions are required?	9. How would you evaluate the work safety in the area?	10. Is the area safe to move by foot?
1= Unsatisfactory	0	0	5	5	14	5	3	0	0	0
2= Poor	0	0	8	13	10	10	3	0	0	0
3=Satisfactory	9	10	10	10	6	6	10	13	10	7
4=Good	12	8	5	1	1	4	10	15	13	13
5=Excellent	9	12	2	1	1	5	4	2	7	10
TOTAL Respondent	30	30	30	30	30	30	30	30	30	30
Average	4.00	4.07	2.70	2.33	2.03	2.80	3.30	3.63	3.90	4.10

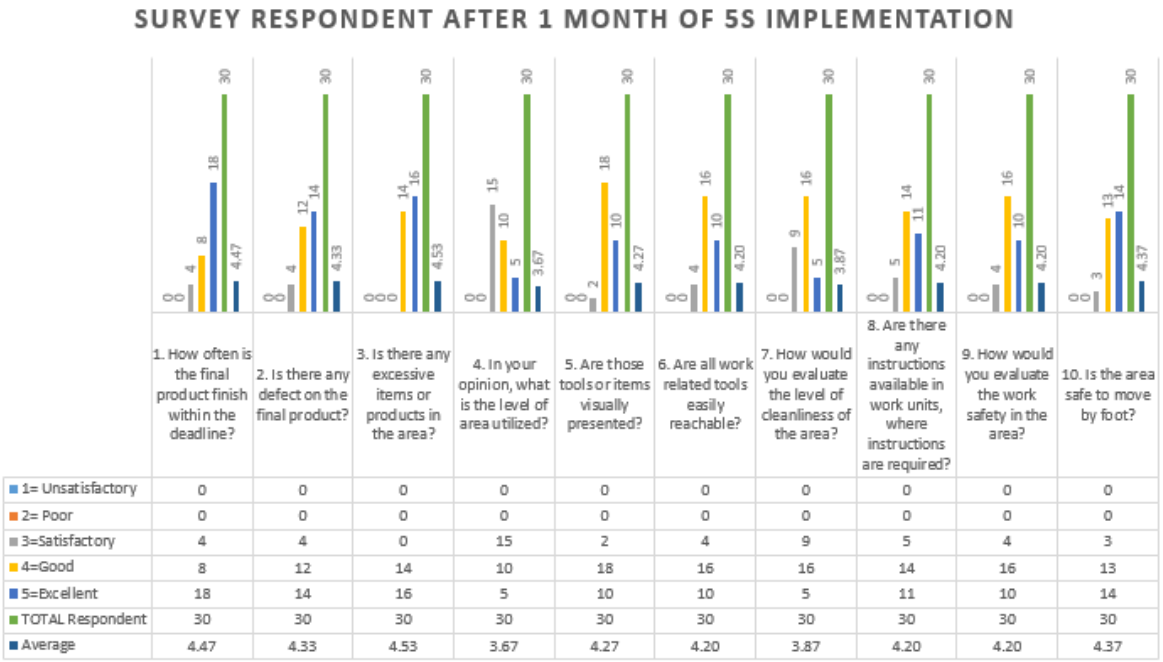
Fig. 2. Result of survey respondent before 5S Implementation

The employees seem to be satisfied with Question 10 the overall safety of the area move by foot, as it scores on average of 4.10. On the other hand, respondents consider that question number five the tools and items were not visually presented as they were supposed, tools and items visibility were very low, since the score is as low as 2.03 on average. The area of utilization is the most crucial thing on every industry in order to increase their productivity. In the first survey, for Question 4 the level of area utilized scored is as low as 2.33 on average, which is not acceptable, as these utilized areas will gives the employee a comfortable workspace. The respondents consider for Question 3 that there are somewhat too much excessive items and products in the area, as the score for this is as low as 2.70, this might also reflect to the visibility of the tools and items. For Question 6 are all work related tool reachable scores on average 2.80, which still leaves room for improvement.

All respondents seem to be somewhat satisfied with Question 2 which related to the quality of product as they consider to be good. This question on average scores as high as 4.07 on average, followed with an average of 4.00 on question number one which considered to be satisfied which related to the product finish on time. The main reason for delay on finishing product were usually due to insufficient of raw material as the company doesn't have any spare storage for the raw material, for that reason, product that were requested by customer were not be able to run for process of making. For Question 8 which related to the instruction availability in the work station scored on average of 3.63, it seems that there's still a lot of instruction needed to be provided by the company all over the work place. The next question is Question 9 which related to the work safety. It seems that there were still many rooms of improvement in the safety area scored on average of 3.90. The last one is the question number seven which the survey is about the cleanliness of the area, it seems this area could also be improved, as the question scores just above the average of 3.30.

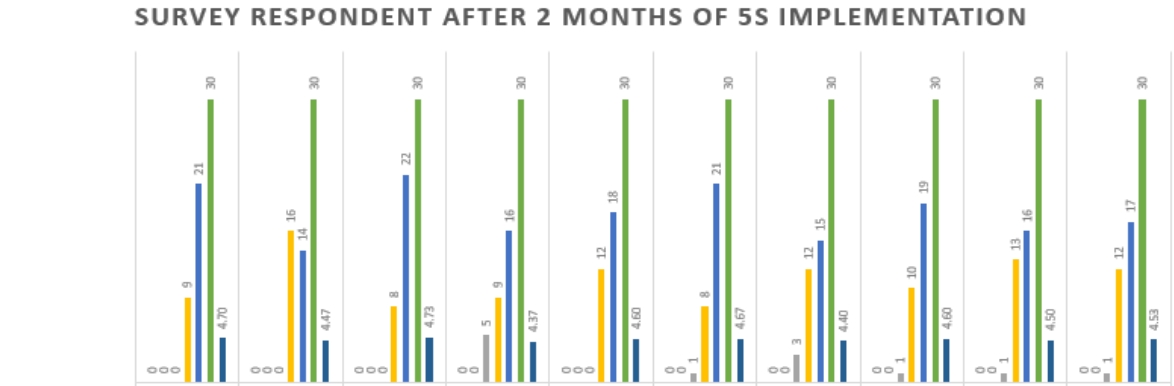
Figure 3, Figure 4, Figure 5 and Figure 6 shows the results of the respondents after implementing 5S which respective month of 1, 2, 3 and 4. These surveys were kept to the same respondents, to get

as accurate results as possible. Like in the first survey which was before the 5S implementation, also in the followed surveys thirty respondents, were asked to answer the survey and all respondents answered the survey. This means that the overall response rate for all surveys reached 100%.



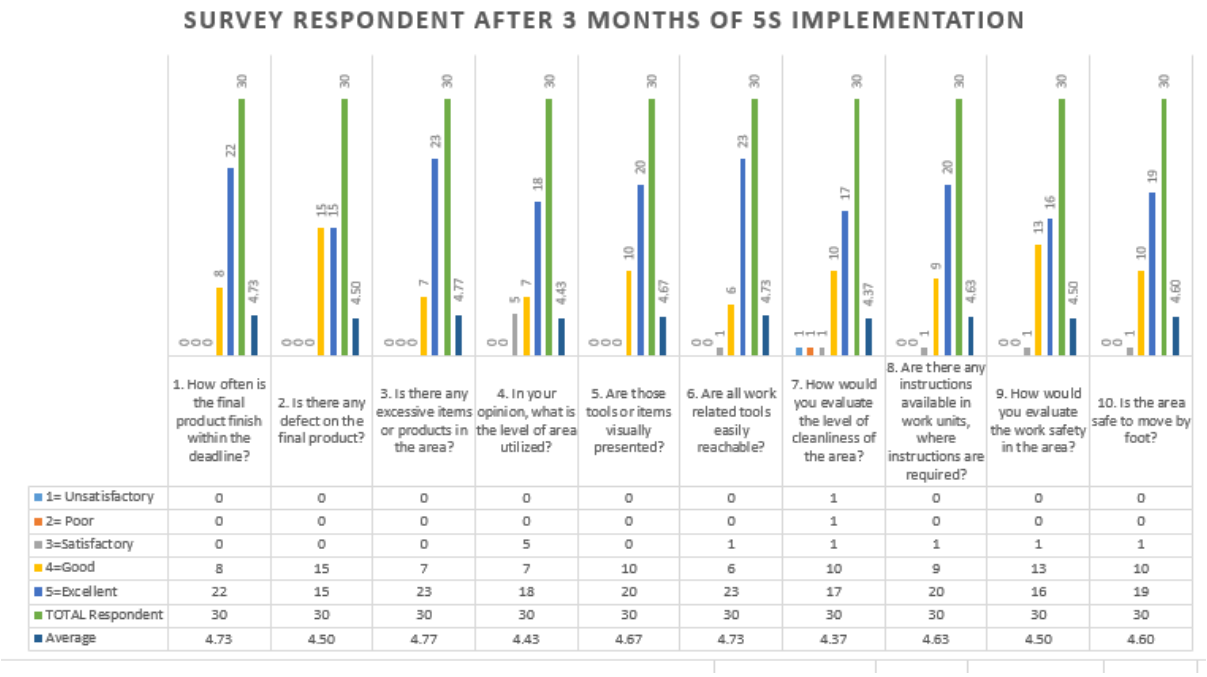
	1. How often is the final product finish within the deadline?	2. Is there any defect on the final product?	3. Is there any excessive items or products in the area?	4. In your opinion, what is the level of area utilized?	5. Are those tools or items visually presented?	6. Are all work related tools easily reachable?	7. How would you evaluate the level of cleanliness of the area?	8. Are there any instructions available in work units, where instructions are required?	9. How would you evaluate the work safety in the area?	10. Is the area safe to move by foot?
1= Unsatisfactory	0	0	0	0	0	0	0	0	0	0
2= Poor	0	0	0	0	0	0	0	0	0	0
3=Satisfactory	4	4	0	15	2	4	9	5	4	3
4=Good	8	12	14	10	18	16	16	14	16	13
5=Excellent	18	14	16	5	10	10	5	11	10	14
TOTAL Respondent	30	30	30	30	30	30	30	30	30	30
Average	4.47	4.33	4.53	3.67	4.27	4.20	3.87	4.20	4.20	4.37

Fig. 3. Result of survey respondent after one month of 5S Implementation



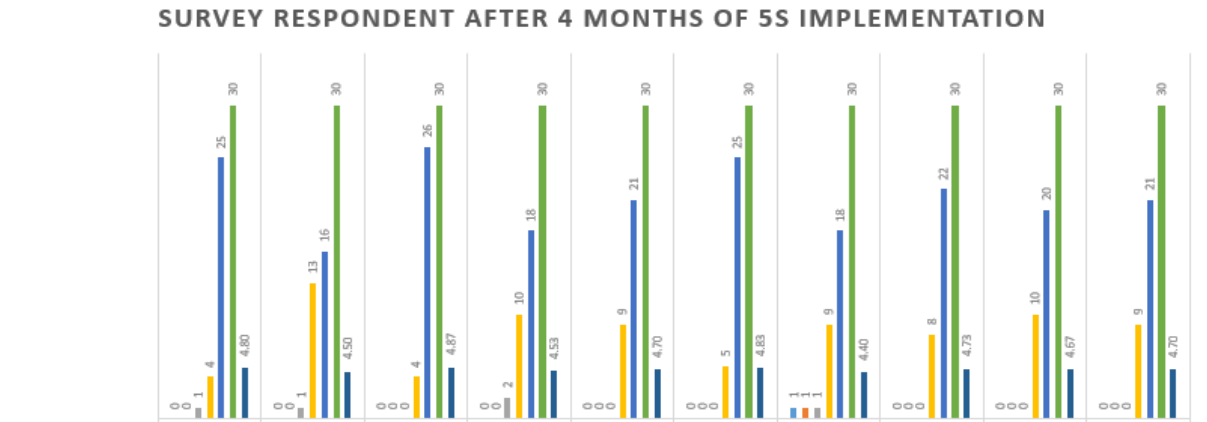
	1. How often is the final product finish within the deadline?	2. Is there any defect on the final product?	3. Is there any excessive items or products in the area?	4. In your opinion, what is the level of area utilized?	5. Are those tools or items visually presented?	6. Are all work related tools easily reachable?	7. How would you evaluate the level of cleanliness of the area?	8. Are there any instructions available in work units, where instructions are required?	9. How would you evaluate the work safety in the area?	10. Is the area safe to move by foot?
1= Unsatisfactory	0	0	0	0	0	0	0	0	0	0
2= Poor	0	0	0	0	0	0	0	0	0	0
3=Satisfactory	0	0	0	5	0	1	3	1	1	1
4=Good	9	16	8	9	12	8	12	10	13	12
5=Excellent	21	14	22	16	18	21	15	19	16	17
TOTAL Respondent	30	30	30	30	30	30	30	30	30	30
Average	4.70	4.47	4.73	4.37	4.60	4.67	4.40	4.60	4.50	4.53

Fig. 4. Result of survey respondent after two months of 5S Implementation



	1. How often is the final product finish within the deadline?	2. Is there any defect on the final product?	3. Is there any excessive items or products in the area?	4. In your opinion, what is the level of area utilized?	5. Are those tools or items visually presented?	6. Are all work related tools easily reachable?	7. How would you evaluate the level of cleanliness of the area?	8. Are there any instructions available in work units, where instructions are required?	9. How would you evaluate the work safety in the area?	10. Is the area safe to move by foot?
1= Unsatisfactory	0	0	0	0	0	0	1	0	0	0
2= Poor	0	0	0	0	0	0	1	0	0	0
3=Satisfactory	0	0	0	5	0	1	1	1	1	1
4=Good	8	15	7	7	10	6	10	9	13	10
5=Excellent	22	15	23	18	20	23	17	20	16	19
TOTAL Respondent	30	30	30	30	30	30	30	30	30	30
Average	4.73	4.50	4.77	4.43	4.67	4.73	4.37	4.63	4.50	4.60

Fig. 5. Result of survey respondent after three months of 5S Implementation



	1. How often is the final product finish within the deadline?	2. Is there any defect on the final product?	3. Is there any excessive items or products in the area?	4. In your opinion, what is the level of area utilized?	5. Are those tools or items visually presented?	6. Are all work related tools easily reachable?	7. How would you evaluate the level of cleanliness of the area?	8. Are there any instructions available in work units, where instructions are required?	9. How would you evaluate the work safety in the area?	10. Is the area safe to move by foot?
1= Unsatisfactory	0	0	0	0	0	0	1	0	0	0
2= Poor	0	0	0	0	0	0	1	0	0	0
3=Satisfactory	1	1	0	2	0	0	1	0	0	0
4=Good	4	13	4	10	9	5	9	8	10	9
5=Excellent	25	16	26	18	21	25	18	22	20	21
TOTAL Respondent	30	30	30	30	30	30	30	30	30	30
Average	4.80	4.50	4.87	4.53	4.70	4.83	4.40	4.73	4.67	4.70

Fig. 6. Result of survey respondent after four months of 5S Implementation

6. Discussion

The survey is basically focus on five areas which includes the evaluation of productivity, workspace, equipment search time, working environment and work safety.

6.1 Evaluation of Productivity

The efficiency will be evaluated in two ways, one is through observation and the second one is through the survey respondent. Based on Figure 7, it seems that the assembly process's normal time has a significant change from 258.83 minutes to 231.53 minutes which has 27.3 minutes faster in comparison over the five months. The significant change in assembly process were probably due to the improvement in the tools and items that were well organized. Besides, the changed that were made in the area utilization were also partially contributed to this improvement of time change due to more workspace for the employee. While for folding process and assembly process has 8.75 minutes and 13.25 minutes of change over the five months. It may seem that these two processes were only slightly improved, it may due to these processes were mostly being done by operating machine.

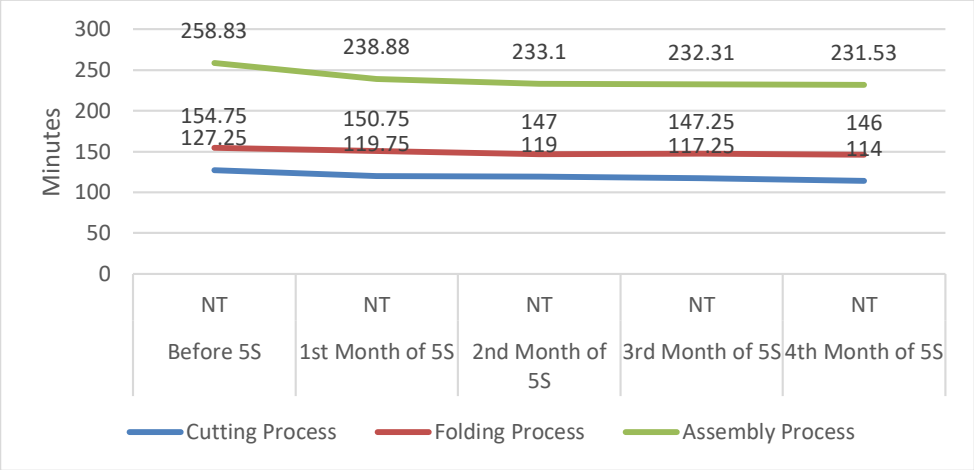


Fig. 7. Graph of employee's normal time (NT) performances over five months

In Figure 8, a standard time of the whole stainless-steel table making process were analysis over the five months from before the 5S implementation until the following months. The graph shows a major change from 600.92 minutes to 546.14 minutes which has a total of 54.78 minutes of change. The improvement in this area has increase the satisfaction towards the customer and employee throughout the survey that has been given after the 5S implementation.

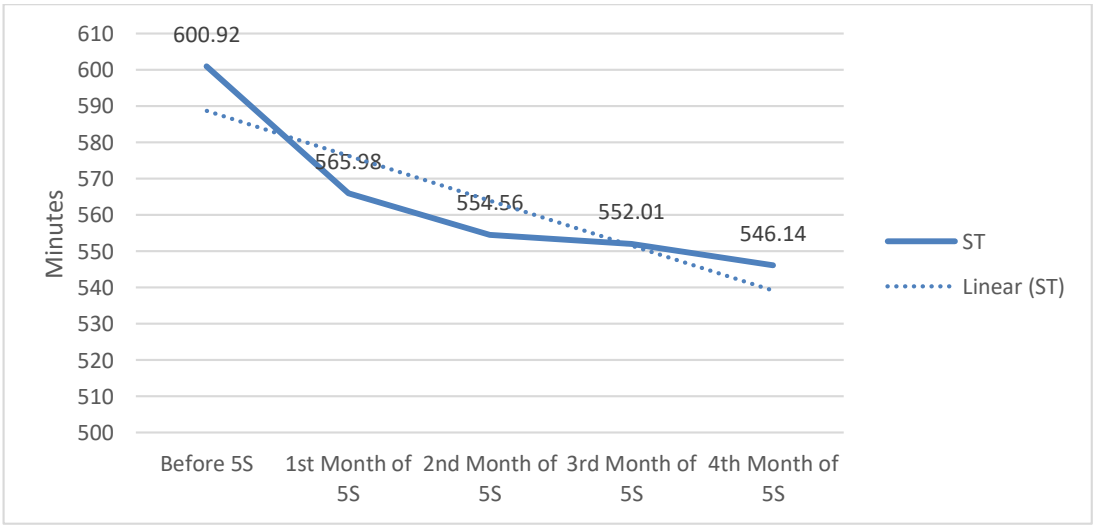


Fig. 8. Graph of employee's standard time (ST) performances over five months

Figure 9 shows the graph analysis for Question 1 which considered to be satisfied scored at an average of 4.00 for the first survey. After the 5S implementation, the score increased by 0.80. This may due to the spare storage were utilized by the company after the 5S implementation.

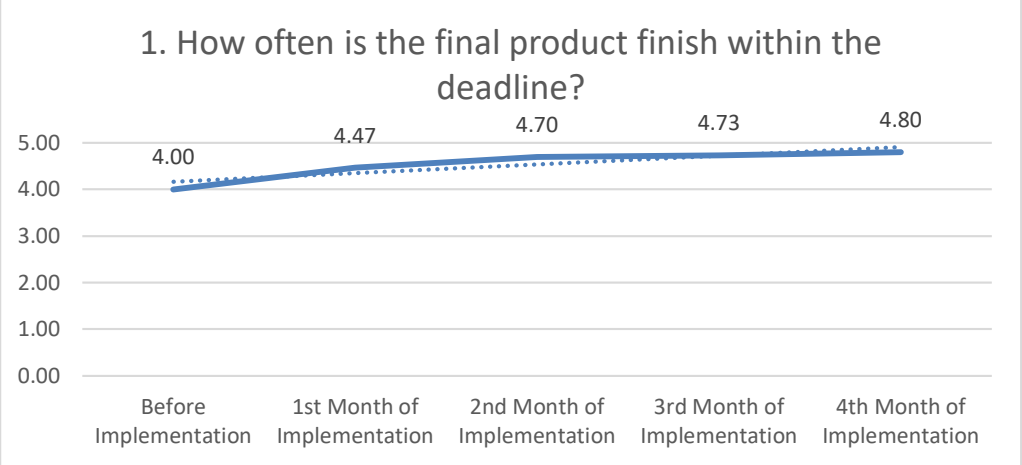


Fig. 9. Result comparison over five months for Question 1

Figure 10 shows the graph analysis for Question 2 which related to the quality of product. It has shown in the graph that the product's quality also has improved from time to time after the 5S implementation. The score has 0.43 of score in overall improvement. The main reason in this improvement may due to the improvement in workspace. The greater the workspace, it will give more comfortable to the employee and less fatigue. Thus, product quality will increase.

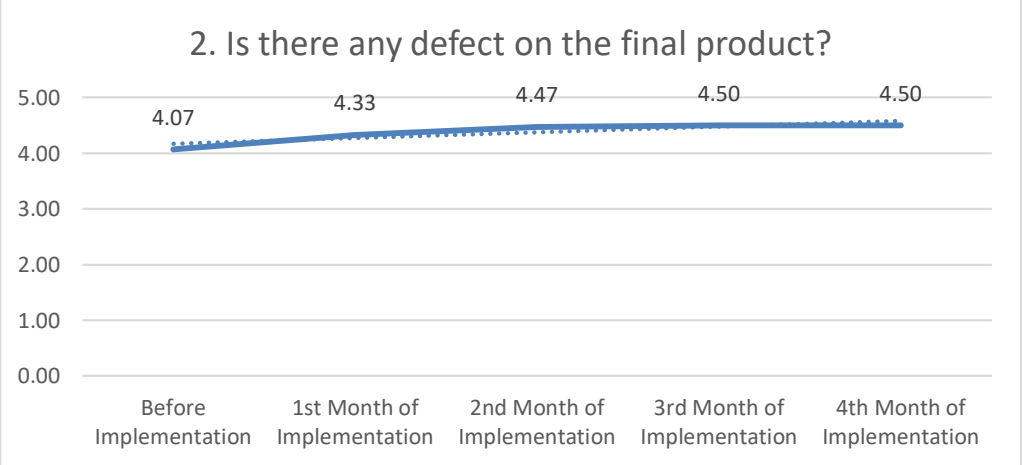


Fig. 10. Result comparison over five months for Question 2

6.2 Evaluation of Workspace

Figure 11 shows the graph analysis for Question 3 that there are somewhat too much excessive items and products in the area, as the score for this is as low as 2.70 at the first survey. After the 5S implementation, excessive items and products that were usually surrounded the workspace were well organized. With this adjustment more workspace available. It has a significant change of score from 2.70 to 4.53 at first month of implementation which has 1.83 of improvement in score. By the fourth month of implementation it has another 0.34 of improvement which gives a total of 2.17 improvement in score.

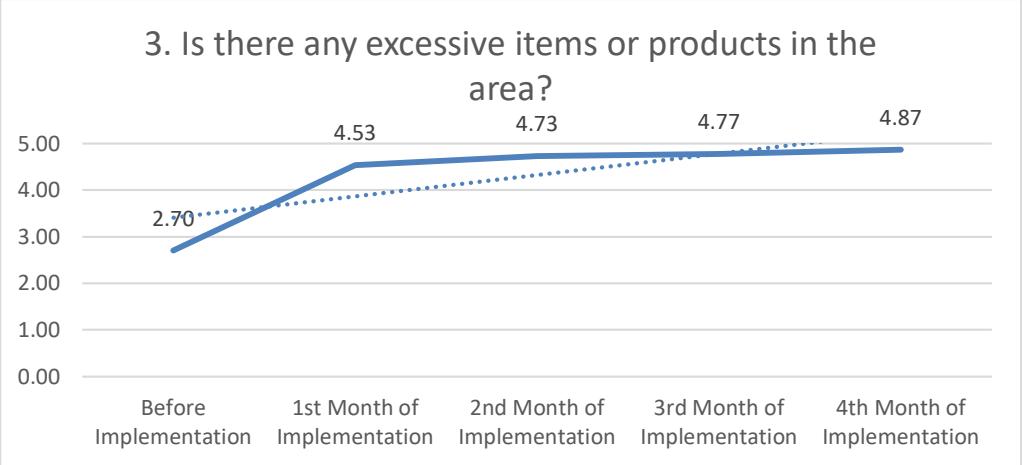


Fig. 11. Result comparison over five months for Question 3

Figure 12 shows the graph analysis for Question 4 the level of area utilized, and this question scored as low as 2.33 on average, which is not acceptable, as these utilized areas will gives the employee a comfortable workspace. After the implementation of 5S many of the work space were utilized, and some of the area which were abandoned for long are now being utilized. Some of area are used as storage. After these adjustments, with 5S implementation the score increases from 2.33 to score of 4.53.

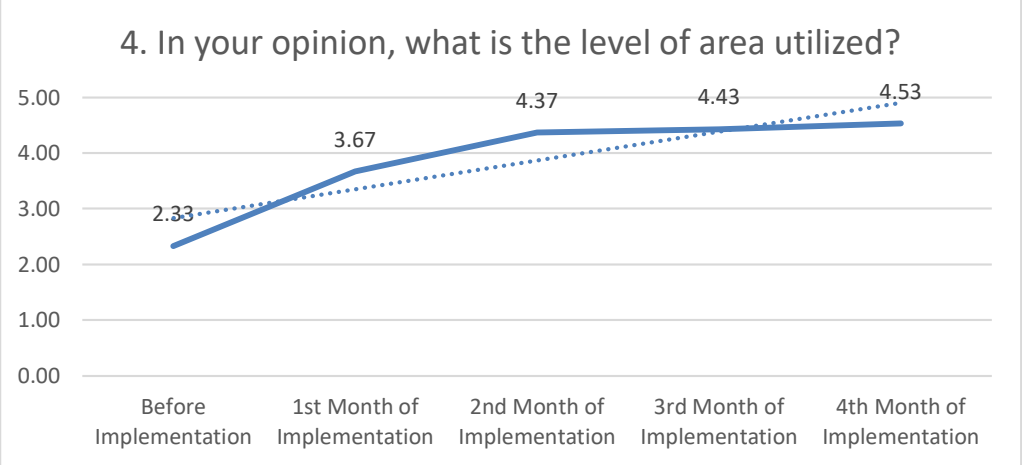


Fig. 12. Result comparison over five months for Question 4

6.3 Evaluation of equipment search time

Figure 13 shows the graph analysis for Question 5 which asked if the tools and items were visually presented as they were supposed, and the score is as low as 2.03 on average before the 5S implementation. At the fourth months after the implementation of 5S, this is most notable improvement which has a total of 2.67 scores increments. Employees are satisfied with the well managed and organized tool and easy to find. This adjustment also contributed to improvement in efficiency and safety rather than just search time will be reduced.

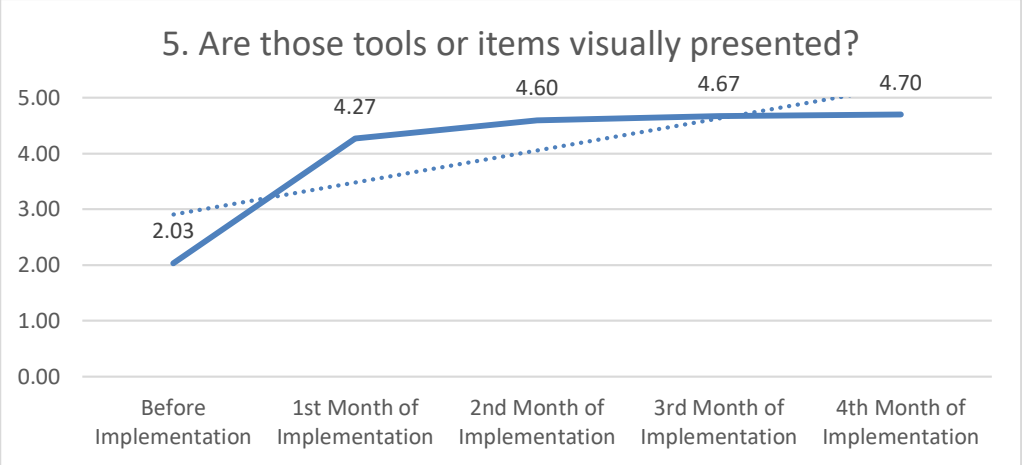


Fig. 13. Result comparison over five months for Question 5

Figure 14 shows the graph analysis for Question 6 which are also related to Question 5. This question scores on average 2.80 before the 5S implementation. This question also shows a major increment of score which has score of 2.03 improvement. Employee easily acquire the work-related tools after the adjustment on the tool placement. This proven that implementation of 5S reduce the equipment search time.

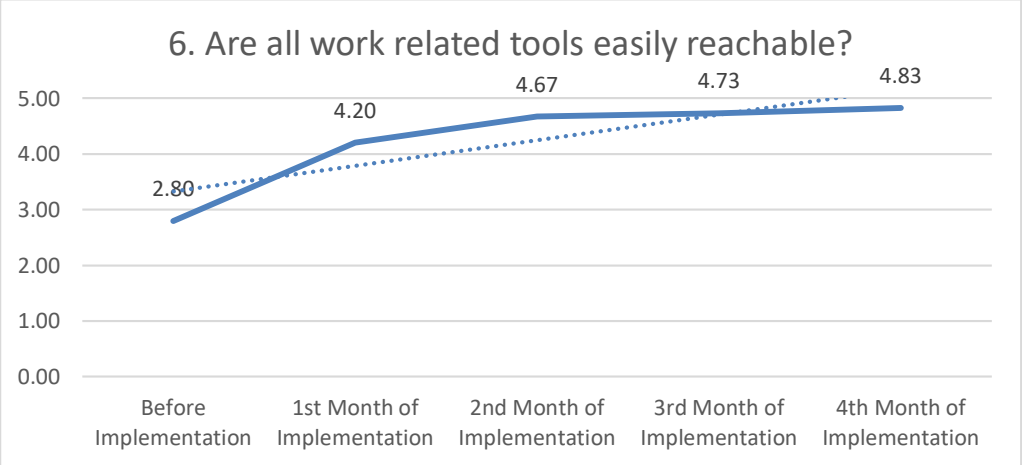


Fig. 14. Result comparison over five months for Question 6

6.4 Evaluation of laboratory working environment

Figure 15 shows the graph analysis for the Question 7 which the survey is about the cleanliness of the area, it seems this area could also be improved, as the question scores just above the average of 3.30 before the 5S implementation. The cleanliness of company may seem to be gradually increase after the 5S implementation and stay fluctuate from second month to fourth month. The cleanliness of the company will require the cooperation from every of the employees in order to sustain this process. The work place should be as clean as it was after using it. The reason that the score remains fluctuate might be due disobedience from some of the employee in the company. However, it still has a total of 1.10 increase in score after 5S implementation at fourth month in compare with before the 5S implementation.

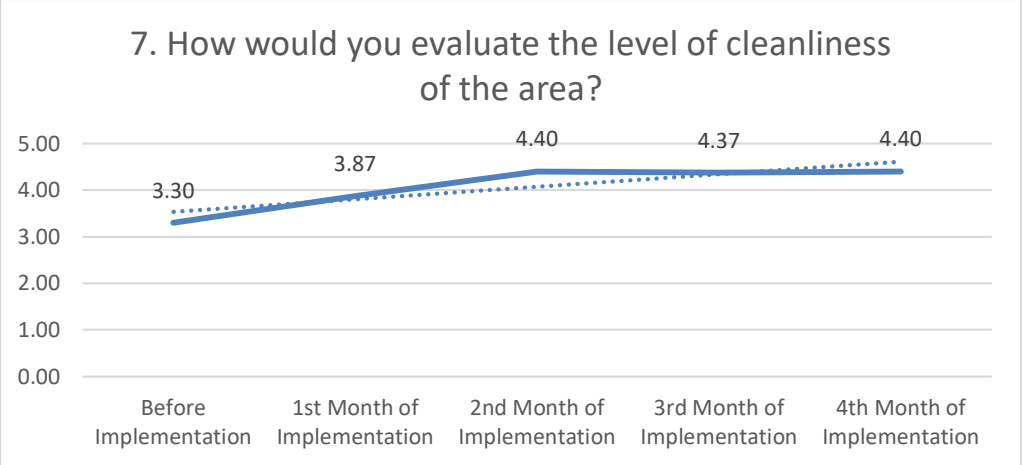


Fig. 15. Result comparison over five months for Question 7

Figure 16 shows the graph analysis for the Question 8 which related to the instruction availability in the work station scored on average of 3.63, it seems that there's still a lot of instruction needed to be provided by the company all over the work place at the first survey. After the 5S implementation, it has shown that there is an outstanding improvement from score of 3.63 to 4.73 which has a 1.10 improvement of score. As there is more instruction in the work place, the employee will also be cautious of environment in the laboratory. This will also beneficial to the safety environment.

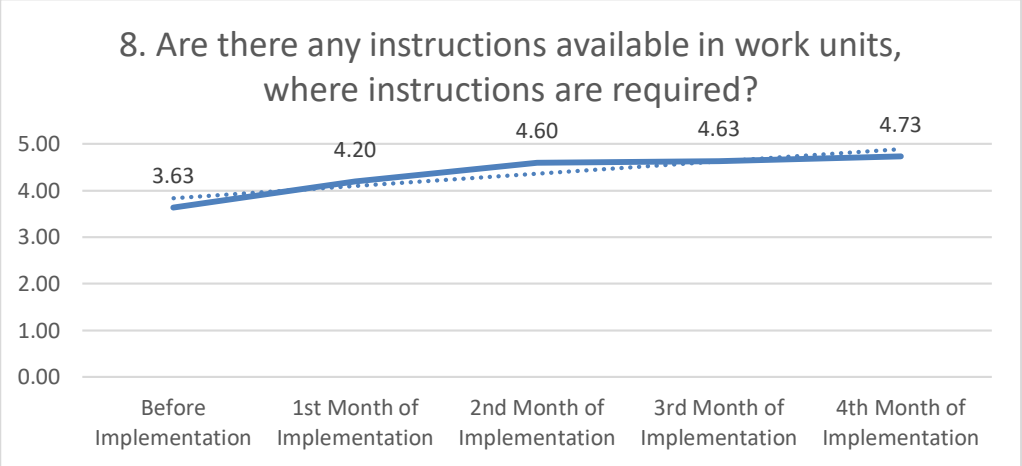


Fig. 16. Result comparison over five months for Question 8

6.5 Evaluation of work safety

Figure 17 shows the graph analysis for Question 9 which related to the work safety. It seems that there were still many rooms of improvement in the safety area scored on average of 3.90 at first survey but improved to score of 4.67 which has 0.77 increases in the score at the fourth month of 5S implementation. Safety is linked to work management. As 5S is one of the management enhancement methodology, the application of 5S will greatly benefits the safety of work place.

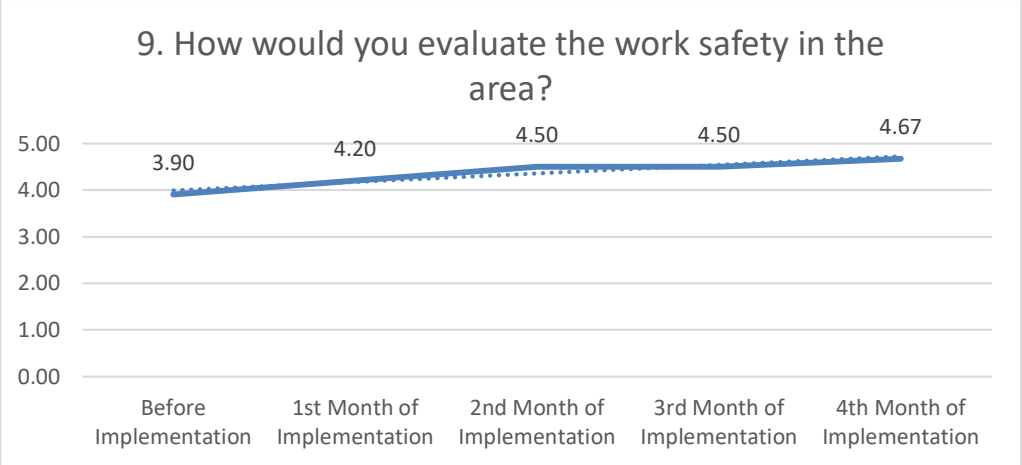


Fig. 17. Result comparison over five months for Question 9

The employees seem to be satisfied with Question 10, the overall safety of the area move by foot, as it scores on average a 4.10 at the first survey nevertheless. Figure 18 shows that it has improved to score of 4.70 over the 5 months of 5S implementation which has a great improvement of 0.60 scores. This may have linked to question number three which the excessive product and items were well organized and due to this the excessive item on floor were removed for foot to move safely. It has proven that 5S implementation improves safety.

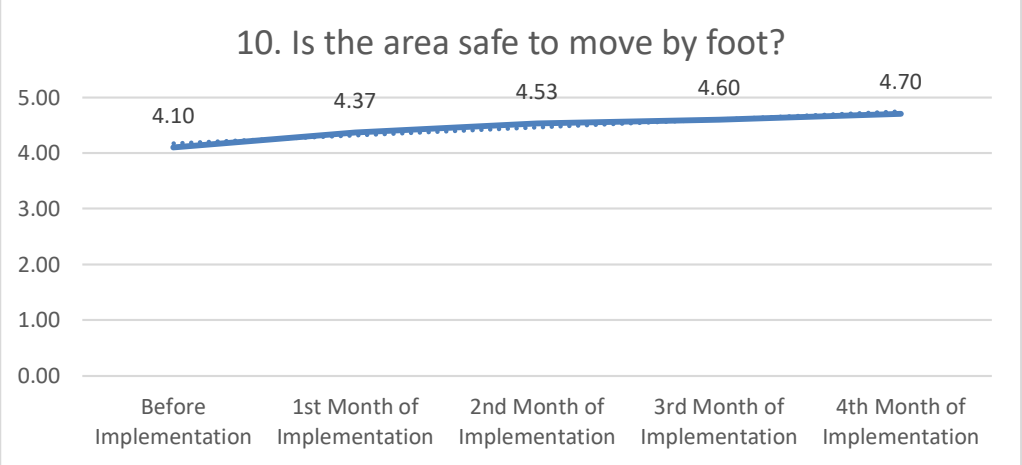


Fig. 18. Result comparison over five months for Question 10

7. Conclusion

The project of this study reveals that lean implementation has seriously improved the company in many areas. Despite, the lean manufacturing usually only implemented by most of the large industry, but the project shows that lean implementation towards SME is additionally beneficial. The 5S system is a good starting point for all improvement efforts aiming to drive out waste from the manufacturing process and ultimately improving a company's bottom line production by improving products, services and lowering costs.

Many manufacturing facilities have opted to follow the path towards a "5S" work-place organizational and housekeeping methodology as part Lean Manufacturing processes in order to achieve higher levels of quality through minimization of waste. On other hands, 5S methodology has found increase in productivity and hence profit levels.

During the 5S implementation, a lot of valuable and important observations were made and many of them were implement in order to have a complete 5S environment. The area, in which the implementation was taken into action are mostly of the issues were related in organizing and cleaning. For now, it seems that 5S has become a part of every employee's daily working habits, but it is still too early to state this for sure, as there might be change in the future. Some employees and other staff members still, so to say, are somewhat against the idea of 5S, which is of course understandable. However, the possibility of ignoring the changes and going back to the way it was before, still appears.

The changes that 5S brought, according to the survey over the five months, was all positive. None of the areas reached the maximum total score, but the improvement was remarkable in each area. The survey was given only for thirty respondents, which of course does give a little thorough opinion of the company. The most remarkable change was related to tools visibility. This factor increased by 2.67 in comparison from the fourth months of 5S implementation with before the 5S were held, which proofs that the respondents are satisfied with the tool placement. However, the least change was question 2 which was related to the evaluation of performance. This factor increased by 0.43, which might because product's quality is a factor that change over with skills and experiences of the employee. Now that the employees are getting more familiar with the concept of 5S, improvement ideas are more likely to raise. In addition, after the 5S implementation, the standard time in making one of the products has a total of 54.78 minutes of change. Thus, this will aid the company to produce one extra product for every eleven productions of this product in comparison with before the 5S implementation. Unfortunately, due to the time constraint in conducting this case study, only one product was observed and measured the change in duration of production time.

In short, it was found that after the 5S implementation, the evaluation in the five areas have increased which includes performance, workspace, equipment search time, working environment and work safety. However, some areas still need improvements, but that is what lean is about, continuous improvement. Continuous improvements have become especially important in the industrial field.

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