

Case Study on Lean Manufacturing System Implementation in Batch Printing Industry Malaysia

Tang Saihong¹, Ng Tanching^{1,2}, Chong Weijian², Chen Kahpin²

¹Department of Engineering, Universiti Putra Malaysia, Malaysia

²Department of Mechanical and Material Engineering, Universiti Tunku Abdul Rahman, Malaysia

Abstract. Lean Manufacturing is a popular tool to be implemented in printing industry fields for the purpose of achieving the successful production goals and it is a well-organized method used to eliminate the waste or non-value added activities. Lean Manufacturing consists of several tools like 5S, TPM, Kanban, Kaizen and others. In this paper, the researcher is focus on TPM (Total Productive Maintenance). TPM is a concept used for maintaining plants and equipment with the involvement of all employees in the company in order to increase the overall equipment effectiveness (OEE). In this paper, the researcher will identify the problem faced in company's production line and then implement lean tools in order to improve the productivity. Afterward, the researcher will carry out time study on company's production line. The purpose of time study is to getting the result for OEE and the time taken for producing one piece of product. The researcher is then designed and suggested one-piece flow system to the management with showing the result on simulation that getting improvement in productivity. The result was simulated by using Flexsim and shows that 7.59 seconds was saved in producing one piece of calendar. At the end, the result shows that OEE increase from 34.3% to 60% and the company total save around 6 hours per month by implement one-piece flow. At last, by verifying the distribution of collected data, the researcher will perform Anderson Darling Normality test to ensure the distribution of data are normal.

1 Introduction

The company that involved in this study is ABC Sdn Bhd. There are several problems faced by ABC SdnBhd which included low productivity, untidy working environment that affect the effectiveness of process flow, lack of labeling for tools, inventory that cause the space not enough, wastes such as defect, unnecessary motion and lastly is lack of multi-skill workers. Therefore, the researcher aims to overcome the problem faced by introducing the lean concept.

In this research, the company's production flow was identified and 5S was implemented in the production floor for effective flow. Besides that, the company's Overall Equipment Effectiveness (OEE) in production layout and redesign layout by using Flexsim software were analyzed. The scope of this research involves areas within the factory focusing on cleanliness and tidiness criteria. Also, this study will focus on the assembly line by combining the part of stand, coil and content of calendar together. Meanwhile, the distance between the stations is far apart from each other which extend the cycle time production as well as the overall transportation distance of work.

2 Literature review

Total Productive Maintenance (TPM). In order to implement TPM successfully, there are 5 important pillars to be followed for the purpose of getting improvement in performance or outcome. They are (i) training and Education, (ii) Autonomous Maintenance, (iii) Equipment Effectiveness Improve, (iv) Maintenance Efficiency and Effectiveness Improve and (v) Early Equipment Management and Maintenance.

For first aspect, all employees were ensured have the skills and knowledge which able to build up a TPM environment. Thus, training for employees is compulsory. Secondary, autonomous maintenance is one of the key factors which lead to the successful of TPM. Autonomous maintenance refer activities of worker to carry out daily check, lubrication, inspections, repair and so forth on equipment for the purpose of keeping equipment always in perfect condition. This aims the equipment which in design state to ensure all the equipment developed reliable, user friendly and easy to maintain or repair it [1]. Meanwhile, by improve on equipment effectiveness which means to ensure that the equipment performs itself to achieve its design specification. In addition, maintenance efficiency and effectiveness improve is important to reduce wastes in maintenance process. This improvement can lead to minimal impact on up time and unavailability of equipment. Lastly, total maintenance costs which

equipment exactly needs can be reduced by early equipment management and maintenance prevention. The overall maintenance cost will increase at the end due to unnecessary maintenance without awareness on this aspect.

The benefit which can gain by organization after implement TPM is to ensure a better quality for products, reduce the equipment breakdown, reduce the total costs, able to create a working environment which full with motivate, and improve the working attitude of employees [2]. Most of the organizations able to achieve the result of getting improvement on reduce any breakdowns of equipment, minimize the idle time, increase the productivity, reduce numbers of accident case, and encourage the involvement of employee [3].

3 Types of wastes

The main goal of lean manufacturing is eliminate wastes by identifying seven types of waste. They are overproduction, waiting times, unnecessary transportation, unnecessary processing, unnecessary motion, waiting inventory and defected products [4], [5]. There is no any doubt that elimination of wastes is important in today's world. All companies were fight for high quality product together with low production cost. Production cost can be reduced by elimination of wastes.

4 One-Piece flow

The objective of one piece flow is to build up the parts of product one at a time in a more organizing and sequencing processes in order to avoid the problem of long queue times or producing in batches. In addition, another objectives of one-piece flow is used to avoid the non-value added movement which means the unnecessary movement [6].

5 Methodology

This research begins with choosing a suitable manufacturing company in Malaysia after sufficient amount of literature has been reviewed. ABC SdnBhd was chosen in this research. After that, the company chosen was pays a visit for the purpose of problem identification and investigate the whole layouts of the entire factory. During factory visitation, data needed was collected via time measurement for each working processes. This data was used further in calculating the Overall Equipment Effectiveness (OEE) before and after lean implementation. After investigation, one-piece-flow system was suggested with other lean tools implementation such as 5S, Kanban, TPM and kaizen. Flexsim, simulation software, was chosen for data analysis. For data analysis, mathematical operation such as OEE calculation and time taken for producing one

piece of calendar in production line was applied. Afterward, comparison among current production line with the simulated one-piece flow designed was done. Further recommendations were proposed afterward.

6 Results and discussion

TPM focused on solving problem for wastes that related with production system. Overall Equipment Effectiveness (OEE) was employed to measure the performance of productive system. OEE is an improvement process that focused on productivity. It started from the management awareness of total productive manufactured and commitment from management to be more focus on the factory worker training to work as a team and cross functional equipment problem solving.

As result, OEE was increased gigantically from 34.3% to 60%. This can conclude that TPM produced significant result in raising the productivity and improve the performance of machine by lower down the breakdown time for the machine. The overall equipment effectiveness still can be improved by enhancing the TPM and to avoid this current situation return back to original situation.

Besides TPM implementation, one-piece flow layout that designed by researcher was simulated using Flexsim software. The purpose of implementing one-piece flow is to reduce the unnecessary transportation time and unnecessary process. In addition, waiting time, queue time and total distance moved by operators can be reduced with this layout. Originally, the punching process for the content and caser was separately. With the help of one-piece flow, these two processes can be combined together and carried out on the same time. As mentioned, those unnecessary transportation times can be reduced with the help of conveyor. As the result from simulation on Flexsim, the result obtained for processing one piece of calendar in 67.41 seconds.

Total time save with implementing one-piece flow was calculated as shown as Table 2. As the result shown, time save for producing each piece of calendar is 7.59 second. Researcher has set 50 as targeted amount to be produced in this one-piece flow production line per hour. Thus, this can help in saving 6.325 minutes in producing targeted amount. As monthly working hour, one-piece flow save nearly 6 working hours compare with implementing batching production.

Lastly, Minitab was used to plot Anderson Darling Normality test based on the data collected. This test was used for data validation. Theoretically, when P-value > 0.05 means the null hypothesis is accepted and the distribution is normal or vice-versa. The test result was shows that the P-value for machine1, machine2, machine3, machine4 and machine5 is 0.808, 0.336, 0.573, 0.861 and 0.52. This represent the normal distribution of data collected and hypothesis is accepted.

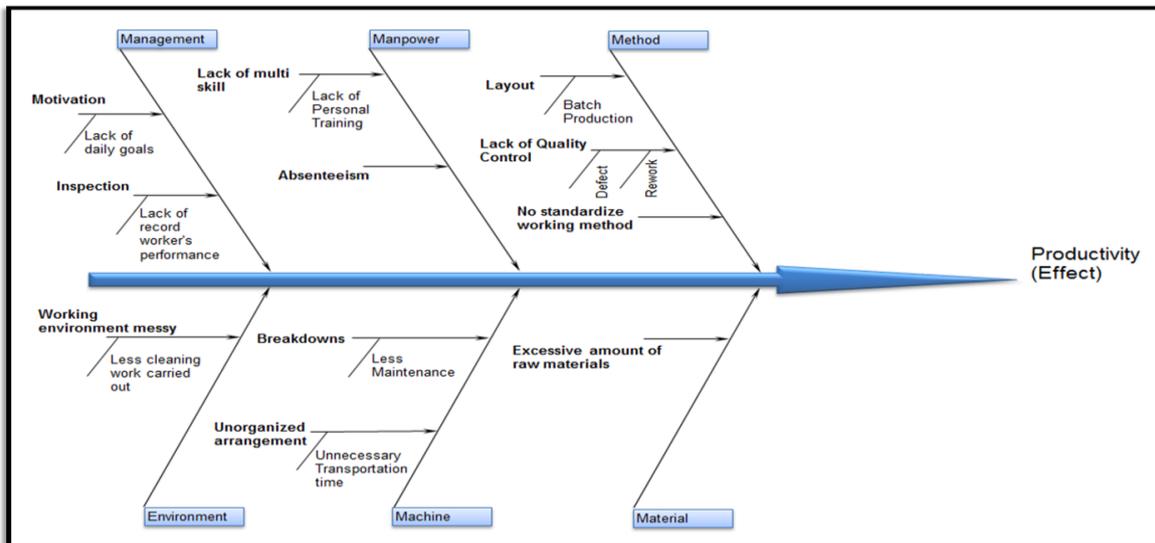


Figure 1. Fishbone diagram of problems faced by Company ABC's productivity.

Table 1. Calculation of TPM.

Elements	Before TPM Implementation	After TPM Implementation
Kolbus –DAS case maker breakdown	39 hours	22.5 hours
Paper Gluing Machine breakdown	13 hours	7.5 hours
Double Coil Binding Machine breakdown	19.5 hours	12.5 hours
Paper Hole Punching Machine breakdown	6.5 hours	2.5 hours
Set-up and others conditions	52 hours	52 hours
Total loss (sum of all breakdown)	130 hours	97 hours
Management loss	26 hours	26 hours
Start up loss	13 hours	13 hours
Total working hours	312 hours	312 hours
Net loss (total working hours – total loss)	312 – 78 = 182 hours	312 – 45 = 267 hours
Availability Rate (Net loss / total working hours) x 100	(182/312) x 100 = 58.33%	(267/312) x 100 = 70.83%
Percentage of Quality [(Total steam produced – defected steam) / total steam produced] x 100	[(3120-780) / 3120] x 100 = 75%	[(3120-450) / 3120] x 100 = 87.5%
Performance Rate [Net loss- (management loss + start up loss) / Net loss] x 100	[182 – (26+13)] / 182 x 100 = 78.57%	[267 – (26+13)] / 267 x 100 = 82.35%
OEE	58.33% x 75.00% x 78.57% = 34.3 %	85.58% x 85.58% x 82.35% = 60 %

Table 2. Total time save per month for targeted amount.

Time save for produce one piece calendar in seconds (s)	75 – 67.41 = 7.59 s
Researcher's target amount produced per hour	50
Time save per hour	(50 x 7.59s) / 60s = 6.325 minutes
Working days per month (30 days as standard)	22 days
Time save per month	(22x 6.325 minutes) / 24 hours = 5.80 hours

7 Conclusion

Due to the machine breakdown time has been reduce hugely, the availability rate for the machine after the implementation of TPM reached 70.83%. Moreover, the percentage of quality has been increase from 75% to 87.5% with the implement of TPM. At last, the performance rate was also shows the significant increase from 78.57% to 82.35% after implement TPM into the company. As conclusion, overall equipment effectiveness of ABC Sdn Bhd was improved from 34.3% to 60% through implementation of TPM with the help of

reducing in the number of machine breakdowns. The entire working environment was change dramatically and mistakes reduced with 5S implementation. Lastly, a suggestion about changing current production layout was proposed. One-piece flow implementation was suggested to replace batching production line. According to simulation on Flexsim, one-piece flow implementation can reduce production time for one piece of calendar from 75 seconds to 67 seconds. The company can save total around 6 hours in one month.

After in-depth investigation in ABC SdnBhd, a serious problem in quality management was found by researcher. Due to the absent of quality control in

production line, company get complaints from customers about receiving defect products. Thus, the researcher suggested that ABC SdnBhd have to set up a work station for quality control purpose in the company immediately before the company getting complaints or negative feedbacks from the customers.

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