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An Application of Statistical Quality Control On Process Improvement: Case Study

[1]M.H. Norhidayah and [2]Wan Ahmad Najmuddin Wan Saidin

[1]*Kolej Islam Antarabangsa Sultan Ismail Petra (KIAS), Muamalat Department, P.O.Box 68, Nilam Puri, 15730 Kota Bharu, Kelantan., Malaysia*
[2]*International College of Automotive (ICAM), Mechanical Department, Faculty of Engineering, Lot 1449, PT 2204, Peramu Jaya Industrial Area, 26607 Pekan, Pahang, Malaysia.*

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ABSTRACT

Background: Normally, inspection of quality control can be performed at three main points during the production line which are raw material, production process and finished product before delivery to the customers**. Objective:** The aim of this paper is to identify the problems that face regarding quality control in the production. **Results:** From the analysis, it showed that the first three processes were in control. However, for threading section, there are two points beyond out of control limit. The causes of thread problem also have been determined by using cause-andeffect diagram. **Conclusion:** The company need to develop a quality section and provide training to workers.

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INTRODUCTION

From the history of human evolution, it is showed the quality has always been integrated into the history of human society. This observation has caused the ancient builders were more skilled and quality conscious than what we belong today (Jarrett, 2007). However, quality was restricted to manual skills, experiences and proficiency. The entire work of building houses, halls, or temples, producing agricultural, as well as arms and ammunition were taken as a matter of art.

Quality can also be defined as the ability of a product or service which can meet or exceed the customer's expectation or requirement. Quality is a system, when implemented, yields increases in the market share and reduces scrap and rework. Quality can be a process improvement techniques and theories that start with a company's vendors and extend beyond the sales of the company's product and services to the customer. Moreover, the quality system is continuously improved by people who are expert in quality such as W. Edwards Deming, and Genichi Taguchi (Stevenson, 2007). The selection of quality control technique is influenced by three factors: ease of use of the technique; ability to measure product specification fulfillment; and ability to improve critical quality and productivity problem (Nizam et.al.,2009)

The area of research is focused on the quality control of one product produces by a small medium enterprise (SME). Normally, inspection of quality control can be performed at three main points during the production line which are; raw material or input entering to production line, production process, and finished product before delivery to the customers. Among these three inspection points during production line, the study focuses only on the production line. The other two inspection points just as the additional information to enrich the information embodied in the project. The techniques discussed in the study, were focused on the process control chart, process capability, and cause and effect diagram.

1. Methodology:

The raw material for product was mill steel rod with diameter 16 mm and its length was 12000 mm. The first step mill steel rod has to cut at 1.8 m long. This step took 6.28 second to finish. Once it was cut, the rod was sent to forging machine. The bundle mils steel rods were cut and were sent in 100 pieces. In forging machine, cycle time of forging process about 58.23 second each. Then, it was transferred to deburring section. In deburring, the materials were cut to refine the product.

Once it finished, it was transferred to pressing machine for thread process. The final process was threading where the material made a thread for a nut. Finally, a bundle of material was galvanized. The total cycle time

Corresponding Author: M.H. Norhidayah, Muamalat Department, Kolej Islam Antarabangsa Sultan Ismail Petra (KIAS) P.O.Box 68, Nilam Puri, 15730 Kota Bharu Kelantan., Malaysia.
E-mail: norhidayah169@gmail.com

was 220.42 second, which were excluded galvanizing process. All the data collected had been constructed in table to make it more systematically. For this research, there have 54 subgroups, which contain 100 pieces of Stayrod for one subgroup and each subgroup have 5 measurements. The main data analysis is statistical process control and process capability analysis. Both the two types of analysis were solved by using MINITAB which a powerful QC tool aided in data analysis. From the Xbar-R chart, the information that has been provided could be used for quality improvement.

RESULTS AND DISCUSSIONS

The data have been collected within 10 days. In manufacture of Stayrod, there have two processes that can be categorized as variable data and analyzed by using Xbar-R chart. While, deburring, pressing and threading data were analyzed by using C chart**.** The Figure 1. shows the Xbar-R chart of length in cutting section. Among the data for Xbar chart, all subgroups are in limit. The mean is 1807, upper control limit (UCL) is 1813.75 and lower control limit (LCL) is 0. No point beyond the control limit, so that the process is in a state of control. For the forging section, the thickness square head of stayrod was considered. The Figure 2. shows the Xbar-R chart of thickness square head in forging section. Among the data for the Xbar chart, subgroup 1 has the highest value which is 25.0mm while subgroup 13 has the lowest value which is 14.97mm. For the forging section, the meanis 16, UCL is 18.15 and LCL is 13.85. There have 47 subgroups remain within the control limit while 7 subgroups are falling outside the control limits. For the R chart in Figure 2, the mean is 3.722, UCL is 7.869 and the LCL is 0. The forging process was considered as out of control because having subgroup fall outside the control limits. Besides that, the control chart for thickness also shows that is has the unnatural, unstable nature of the variation which makes it hard to predict the future variation and continuous improvement.

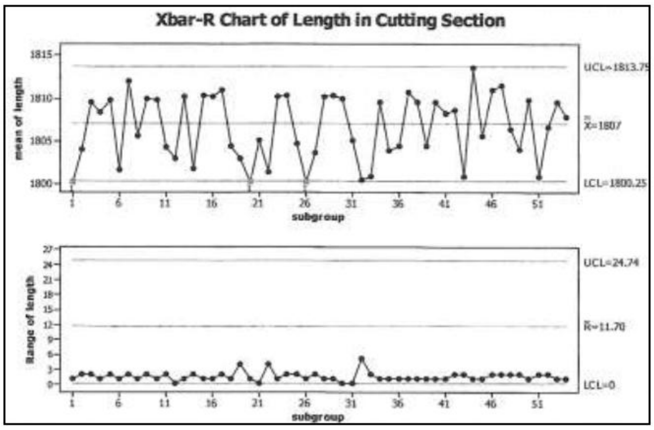

Fig. 1: Xbar-R chart of length in cutting section.

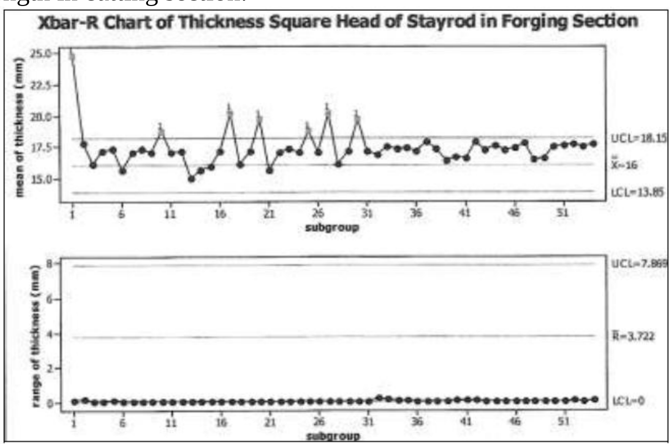

Fig. 2: Xbar-R chart of thickness square head of stayrod in forging section.

For deburring, pressing and threading process, the inspections are based on fail or not fail inspection. So, the suitable category for the inspection is attribute data. In deburring process section, all subgroups have 0 pieces of defective Stayrod. It means the process is definitely in control. While, for pressing and threading processes sections, c chart of defects were used to analyze the processes. From the Figure 3 (a) and (b), there are

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shown the pressing process is in control. Although the pressing process is in control, there also have a point far from the central line when compare to other subgroups. After done improvement, the new UCL is 1.574 and new LCL is 0.

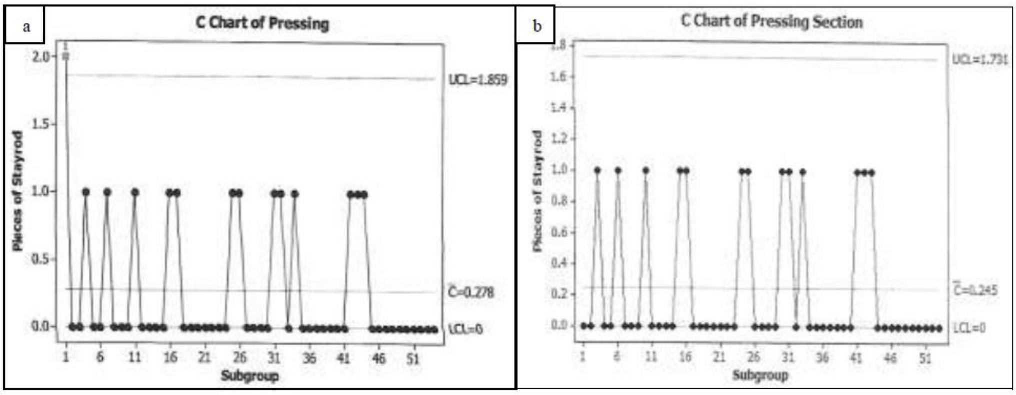

Fig. 3: C chart of pressing before improvement (a) and after improvement (b).

Figure 4(a) and (b) shows the c chart of defects in threading section. Regarding to the c chart, the mean is 0.574, UCl is 2.847 and LCL is 0. There are totally 52 subgroup remain within the control limits and 2 points beyond the out of control limits. After doing improvement, the new UCL is 2.532 and LCL is 0.

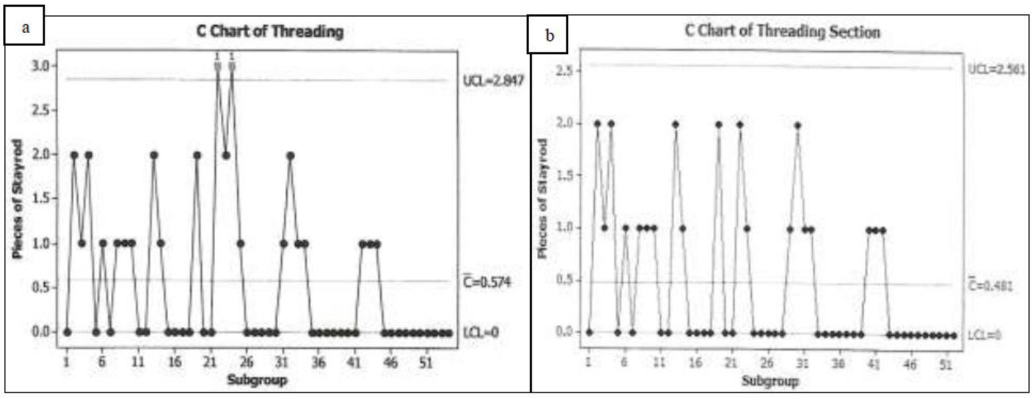

Fig. 4: C chart of threading before improvement (a) and after improvement (b).

From the analysis c chart and Xbar chart, the critical problem is the thread of Stayrod and cannot meet the company specification. Four major causes which are people, machine, environment and maintenance were identified. People including lack of cooperation, training and communication were identified. The employer should provide the specify training to the operator and maintenance skills. Rotation work or change the production schedule is also methods that can reduce the quality problems. The mould of the threading process have been used for a long time period, it should always check and maintain to ensure the shape and appearance that produce by the mould meet the company specification.

3. Conclusion:

Based control chart and process capability assessment, it showed that cutting, forging and deburring are in controls as the specification. However, for threading section, there are two points beyond the out of control limit. It has the enough evidence to prove that tread in threading section is the critical problem in the factory. The causes of thread problem also have been determined by using cause-and-effect diagram. The major causes are people, machine, environment and maintenance. People include the officer rom administrative department and operators from threading section which are lack of cooperation and communication on the quality checking. Operators also have lack of specific training regarding operation procedure and machine techniques. Hot and high humidity environment reduce the stamina and morale of operators which decrease their working performance. Additionally, machine must have a daily check sheet and machine operator must check the machine condition for every shift to confirm that the machines are in good condition. The machine’s pressure,

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temperature and holding time must be accurate to avoid flow lines/marks defects. Mould must always be in good condition and free from any dirt or dust that may cause stain marks and scratches (Jafri and Chan, 2001).

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