VISUAL INSPECTION AS A SCREENING METHOD IN ASSEMBLY PROCESS FOR QUALITY IMPROVEMENT

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ABSTRACT: Kaizen is one of the famous approach in the Japanese manufacturing industries to increase the productivity. There are many techniques applied in Kaizen, but surprisingly the visual inspection 'point to point checking jig' is a potential technique to respond customer needs in term of quality issue. This study is performed to detect missing rivet pin during riveting process manually done by operators. The root cause of this the quality issue is due to lack of awareness among the operators. 'Point to point checking jig' is apply in order to eliminate waste at production line related to the manually process by operators. Plan, Do, Check and Action or known as PDCA is a method that has been applied in this study. The point to point jig was designed and fabricate with characteristics of mistake proofing. 50 samples were prepared as a pilot run to monitor and validate the progress action. This procedure is to ensure zero percentage (0 %) defect target was achieved in the following months after correction action had been taken. This paper shows the successful of 'point to point checking jig' in Kaizen, which gives impact to product quality performance.

KEYWORDS: *Kaizen; Visual Inspection; Point to Point Checking Jig; PDCA Method*

1.0 INTRODUCTION

To face a big challenge and to survive for excellence in market place, one of the improvement plan can be made is to merge the improvement activities with the quality. Productivity and quality improvement are combined purposely to gain a competitive advantage for most manufacturing industries management. Therefore,

a manufacturer should always creative and innovative to apply advanced manufacturing technique and skills, to adopt better quality control for a long run during mass production. And one of the main concerns is the identification of the strategies of change and how is it managed.

Kaizen is a Japanese compound word which means Kai (change) and Zen (for the better). The word has become common in many western companies [1]. Kaizen means continuous improvement (CI) is one of the core strategies for excellence in production. It has become one of the important tools for getting improvement in any field i.e. production, process, quality and maintenance in the manufacturing industry [2-3]. The word Kaizen was introduced by Imai Masaki in 1986 and used by Toyota to improve their performance for waste reduction. Kaizen has many techniques that can be applied to make an improvement in the production line [4-5].

According to several studies, Kaizen apply many types of techniques in forms of umbrella which include Kanban, approach, improvement, zero defects, effectiveness, networking, six sigma, just-in-time, poka-yoke, FMEA and productivity improvement [6-12]. These techniques have been used in many ways, but the aim is the same to improve the productivity, reduce the waste also the cost of the manufacturing process. Kanban is a system that produces only the quantity required by the customer demand. The quantity of the product that been produced is just enough with the customer demand from the customer and it is considerably stockless. Meanwhile, improvement is an updating the product according to a customer that always change from time to time [13]. On the other hand, zero defects refers to making mistakes when doing work. Normally, the good quality of the product can be achieved by practicing zero defects. Effectiveness is also part of the kaizen approach where this method providing the best services to capture customer heart. After the customer confidence has been secure, the connections with customers can be developed through networking. Harry and Schroeder [14] mentioned that six sigma is a process that help company to distribute close to perfect product and services. Poka-yoke is a mistake proofing designed to avoid mistakes and to make it easy to detect any mistake happened.

All those tools are used to eliminate MUDA that also that may occur in manufacturing area [15-16]. The word "Muda" in Japanese means waste [17]. Waste is an activity that does not add any value to a product. Beside, waste may lead to a higher manufacturing processing cost due to the unneeded processing process or extra tools required while the product will be sold at the same price. There are many types of waste that occur in the manufacturing process such as overproduction, processing, motion, transportation, rework, defect, and waiting. Overproduction usually refer to making something before it is truly needed. This may lead to a finish product waste and it may cause excess inventory. Meanwhile, the processing mean making the part/product more than it is needed compare to what customer requirement. Motion refer to an unnecessary movement of people that does not add any value. Contradict to motion which precisely refer to waste due to human generated, transport is an unnecessary movement of raw materials or work in progress or finished goods. Rework is making corrections or scrapping work that has already been done before it will be sent to customer. Defect can be classify as flawless or refer to mistakes in product manufacturing which happened when production or refer to mistakes in the process that requires rework. Waiting is an idle time happens when waiting for the next step in production. This activity also does not add any value to a product and will cause waste.

In production normally the rejected parts leakage to customers are caused by

i. Insufficient training for the operators
ii. Operators do not follow the checking method
iii. Bypass checking process during running the production.

Based on the above problems, the purpose of this research is mainly focus to apply point to point checking jig in Kaizen to improve product quality during mass production. It is to solve problems in quality and to support problem solving by the production workers team.

1.1 Company Background

The company that has been selected to make an implementation of continuous improvement is located at Cheng Malacca, Malaysia. It is a company which is a fully integrated electronics manufacturing services manufacturer of electronics and computer peripherals. They are able to provide total integration and turnkey services and technology such as plastic injection molding, enclosure and metal stamping, and engineering services. In this factory, it consists of 5 departments which are Press Shop, Secondary Assembly, Powder Coating, Final Assembly and Moulding department. The department that has been placed is Final Assembly Production that produced Chassis Base Assembly.

2.0 LITERATURE REVIEW

2.1 Visual Management

Visual management is known as management system that attempts to enhance excellence performance setting through the key performance index (KPI). It is one of management approach that combines all information together such as signalling, limiting or guaranteeing (mistake – proofing/poka yoke) visual devices, so that places become self-explanatory, self-ordering, self-regulating and self-improving [18]. It has been evolving and effectively employed in some manufacturing and service organizations for a long time.

Continuous improvement (or Kaizen in the lean terminology) is a highly dynamic capability and able to be defined as "an organization-wide process of focused and sustained incremental innovation [19]. Visual management serves as a base for continuous improvement and perhaps more important stimulate employee involvement to manage and improve quality [20]. Then, visual management makes the organization listening visual with high ability to respond to people's ideas. This research study to create a system based on visual management, keeps on organization focused on monitoring, filtering, maintaining of quality performance.

2.2 Kaizen

Kaizen or continuous improvement is one of the lean tools and a technique has become popular among researchers because it can increases productivity of the production high quality product with a minimum efforts. These activities are implemented through recognition and elimination of waste (MUDA) throughout the manufacturing process. It involves everyone in the workplace to cooperate together in order to make Kaizen successfully implemented. There are many manufacturing company successfully implemented Kaizen and brought changes to their company. [21] describes that the company that successful in their Kaizen activities such as Nichols Foods manufacturing food products that meet decreasing in their quality rejections, reduction in change over times and increase in manufacturing efficiencies. A small manufacturing designing system had successfully reduces 25% of the unit cost, reduces floor space requirement by 15% and develops better communication network throughout the organization. Other than that, a study on the 'inventory management Kaizen' that has been conducted at 'BAE SYSTEM' to remove waste shows an improvement was made for the process time when it was reduced from 610 hours to 290 hours. Usually to conduct this activity, a team must be form to improve a specific areas that already been identified for an improvement. This team will brainstorm together to find a solution using Kaizen techniques that can be apply as an improvement for the targeted area. The activity consists of Gemba Kaizen and Genchi Genbutsu where the meaning is a shop floor and going to a workplace to identify problem.

To implement Kaizen at production line, there are many approaches that can be use depending on the current situation of the production line. Beside that Kaizen has a form such an umbrella that covered many techniques that can be used in the numerous organizations such as Toyota. There are many tools and techniques available in lean manufacturing that are focuses on eliminating seven waste. But the easiest techniques to use and applied among the other techniques is a Kaizen. It is easy and even the small improvement could also been considered as Kaizen. It can be applied in many other areas and not only focusing on manufacturing industry. As mentioned earlier, Kaizen has many techniques that can be used as a countermeasure for

problems at the production line. Through this research, the literature review was done to study on the techniques of Kaizen that are available to solve problems occur when searching a countermeasure for the problem arise [22].

According to Basu [4], PDCA (Plan Do Check Action) cycle represents the repeated and continuous nature of continuous improvement. It is obtained by the actual result of an action that is being compared with a target or set point and the difference between those two is then monitored and corrective measures are adopted. PDCA Cycle means continuously looking for better method to make improvement. And each word from PDCA Cycle brought different meaning that represents the basic steps of PDCA Cycle.

Basic Steps

i. P (Plan) stage: It is where comprising the formulation of a plan of action is done based on the analysis of the collected data.
ii. D (Do) stage: Implementation of a new ways will be done in this stage. It may involve a mini-PDCA cycle stage until the issue of the implementation is resolved.
iii. C (Check) stage: The results of the new implementation that has been done will be checked in this stage and being compared with targets to see if expected performance improvement has been achieved.
iv. A (Action) stage: If the change made has been successful, then the outcome is consolidated.

3.0 METHODOLOGY

Plan, Do, Check and Action (PDCA) cycle is used in this study. The application of the PDCA cycle is more effective because of the close loop during the analysis process. By using the PDCA cycle continuously looking better improvement.

Plan (P):
Implementation of the PDCA method is most appropriate to execute this research where Plan (P) refer to establishing the aim for improvement. In this phase the quality objectives should be identified before start the project.

Do (D):
Do the action taken based on planning to solve the problem after the brainstorming among the technical group members had been done.

Check (C):
Check (C) defined as the determining whether the implementation has produced the planned improvement.

There are several procedures in Check (C) station where several principles in point to point checking jig need to be followed which are:

i. Place parts at the same orientation
ii. Using of eye as pointer to guide during the checking process.
iii. Apply the method, either zig-zag or up down method. Number was provided at the checking jig as a guideline.
iv. Once abnormality was found, rejected part will be separated into reject bin.

Action (A):
Action (A) characterizes standardizing as the preventing recurrence of the original problem or setting goals for the new improvement [12]. Point to point checking jig was implemented at station Check (C) as shown in Figure 1.

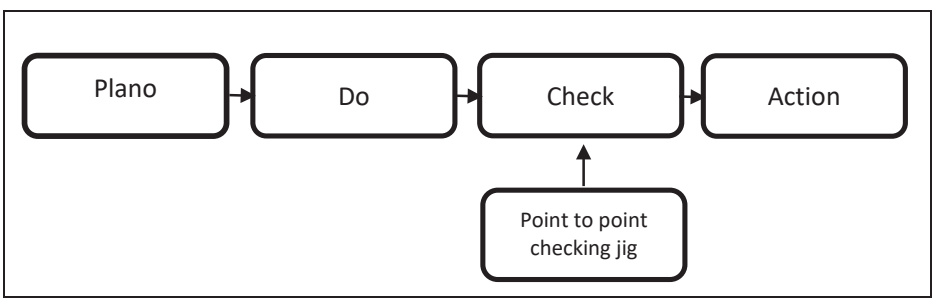

Figure 1: Point to pint checking jig

Table 1 shows the PDCA action and activities in resolve the problems. There are four steps which are Plan, Do, Check, and Action Phase. PDCA cycle represents the repeated and continuous nature of continuous improvement and idea implementation PDCA in Kaizen had been applied previously.

Table 1: Action and activities in PDCA

Step	Phase	Action/Activities
Step 1	Plan	- Aim quality objectives to be achieved.
Step 2	Do	- Countermeasure action on the problematic process.
Step 3	Check	- Check the effectiveness of the countermeasure by using point to point checking jig.
Step 4	Action	- Implement the countermeasure which after improvement had been done.

The PDCA cycle is used to detect lacking in the riveting process. And point to point checking jigs was designed according to problem. And the process must be full monitor to ensure the improvement of product quality is achieved.

4.0 RESULTS AND DISCUSSION

4.1 Plan (P)

The study was conducted at final assembly line in one of manufacturing company in Malaysia. The waste's data are collected and evaluated for improvement purpose. The company offers many services as sheet metal stamping, plastic injection molding, powder coating and assembly. This study only focuses on assembly process of product XYZ. To produce one complete product, the production line will receive the part from molding and press shop department.

Gemba walk had been done when entering the production line to familiarize with the process involved in the production line and to analyze the wastes. Gemba was done after the problematic model/product was identified. After analyzing the data for the month of August, September and October, 2017; it is found that the highest defect is missing rivets.

Figure 2 shows the overall defects that happened in three (3) month which are August, September, and October. Missing rivets was the highest defects for three accumulate months, followed by the broken rivet and dented.

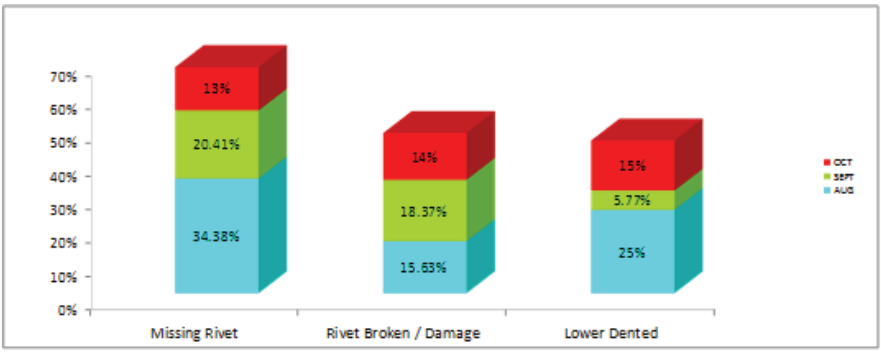

Figure 2: Total defects in 3 particular months

4.2 Do (D)

After the problem of defect had been identified, the countermeasure was made to overcome the defect that affect to the quality of the product. A riveting jig was made as a guidance for the operators to make their process easier, by using this jig the operator only followed the hole that needed to be riveted in that process. Moreover, this jig has Poke Yoke characteristics in which it tells the operators that the part is wrongly positioned on the jig. The riveting jig is shown in Figure 3. The location for both riveting jig is different, thus it guides the operators during when part positioning.

Figure 3: Point to point checking jig

4.3 Check (C)

After fabricating process was completed, the riveting jig is transferred to the production line for trial session. 50 samples were tested whether the jig is able to overcome missing rivet problem. The missing rivet defect was 100% eliminated during the implementation as shown in Figure 4.

Figure 4: Eye was used as a pointer during implementing visual inspection

4.4 Action (A)

The countermeasure can be reviewed over time because PDCA is cyclical and not linear. Although, the improvements have been put in place and effective improvements are found to be consistent, process management must not end at this stage. Figure 5 shows that an improvement is achieved through the adoption of point to point checking jig to reduce quality problem. There was 0 defect result after implementing this PDCA method in production line.

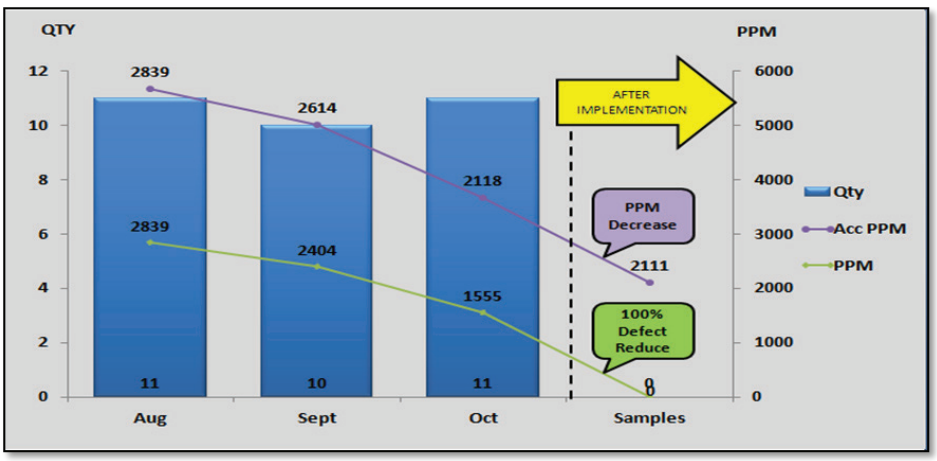

Figure 5: Results after improvement plan

5.0 CONCLUSION

This paper has discussed the processes and implementation of Kaizen conceptually and empirically. The focus of the paper has been, more specifically, on how organization embedding of quality and productivity in solving the problems at production line. The intangible benefits from the Kaizen activities increase the motivation of each operator in doing the verification during the process. Beside the job enrichment, the awareness of the product quality also improved. As a conclusion, the objectives of this study are achieved where the main objective of this research is to apply Kaizen techniques in the process area in the same time to improve product quality. Through the improvement, there was zero defect results after method implemented was achieved through the adoption of point to point checking jig after 3 months using the method. Continuous improvement can always be made to achieve good target in product quality performance. Thus, the study shown point to point checking as visual inspection method in assembly process is a relevant approach to simultaneously enhance product quality performance.

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