Using Poka-yoke Method for detection defect product In assembly component automotive

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ABSTRACT
AXY is one of the component automotive companies that produce electric components for motorcycles. With respect to the increasing sale of motorcycles from a year to a year in Indonesia, this competition will be followed by competition in the automotive component industry. On time delivery and good quality as main requirement in competition among the industry's components of the motorcycle. Basically, in the quality control process, AXY inspects every part since the receipt of material and production processes to anticipation defects product, but in reality there are always defect products that pass to the customer. Therefore the purpose of this research is to improve or apply poka-yoke in the work area to improve the quality of the production process. The application of poka-yoke with sensor installation applying in initial process rotor assembly line(applyresin). Errors that occur can be identified, with a buzzer sound if there is a defect product not same with specifications. With the poka-yoke method, 100% of defect products can be caught before they are sent to the next process, so that no defect products will pass to the customer

Keywords– *Component, Automotive,Production, Poka-yoke, Quality.*

I. INTRODUCTION
In today's competitive world, every organization must produce high-quality, defect-free products at optimum costs. The new culture of total quality management, total productive management in manufacturing and the service sector creates new ways to improve product quality. By using various TQM tools such as 6 Sigma, JIT(JustinTime), Poka-yoke, VSM, etc.

This method is intended to develop a quality culture. This paper is intended to focus on the basic concept of poka-yoke in its implementation in quality control in the production line.

This case study is carried out at AXY which is one of the automotive industry which is engaged in electric motorcycle components. The products produced by AXY include rotor assembly which functions as a motor drive on motorcycles. Because of the importance of the rotor product's function in motorcycles, the quality problem must be maintained from the component of the supplier,assembly process until delivery to customer.Based on customer claim, found 3AX Rotor Assembly less quantity emboss (Standard quantity emboss 11pcs actual 10 pcs) effect on Engine Assembly Motorcycle cannot start at customer. The type of defect product can be seen in the figure 1.

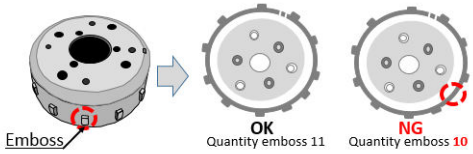

Figure 1. Less Quantity Emboss

From the traceability of the problem, defect product comes from the supplier'scomponent (Rotorcomponent)and passes to the customer. In the final process in the rotor assembly line there is a 100% visual checking by operator but the result is not maximal due to the personal moral of the operator itself (human error).The team conducts analysis and corrective actions both in process supplier and internal process AXY. Kaizen's approach is done to get the right countermeasure for this problem. System poka-yoke becomes the main choice in the Kaizen to solve the problem of less emboss on the rotor assembly line.

II. LITERATURE REVIEW
Poka-yoke is a Japanese remedial strategy to prevent the occurrence of defects, arising during the production process. Poka-yoke is a precautionary measure that focuses on identification and eliminates the specific cause of the variation in the production process. This concept was called Mistake Proofing was created by Shigeo Shingo, when this was one of engineers Toyota

Motor Corporation. This method in other word is to prevent defect & error originating in the mistake (Patil 2013; Davei 2015).The word poka-yoke means “error” and yoke means "avoid". The main approach of poka-yoke is to achieve zero defect products (Davei 2015). To produce defect-free products, poka-yoke is the best approach on assembly lines. This willimprove product quality which will directly improve industrialstatus (Yubao 2015). The Poka-yoke mechanism consists of a control method and a warning method. This is used for errors in proving the whole system (Pratik 2015). Poka-yoke allows the process to run smoothly because it is a fail-safe solution (Ketola 2010). The main purpose of the poka-yoke technique is that of obtaining zero error products, using a simple device to fixing, assembling, warning and other related devices, which prevents people from making mistakes. This device, known as a poka-yoke, is usually used to stop the engine and alert the operator if something is wrong (Paun 2011).

The plant level operational performance with achievement of quality can be obtained through implementation TQM philosophy. This implementation requires top management commitment through four stages the process of adoption, adaptation, acceptance and use (Sanjay 2001). Aquilani suggest that TQM must begin from above; where serious obsession and commitment to quality and leadership must be demonstrated "even if it is true that" middle management also has a key role to play in communicating message (Aquilani 2017). Patil review many TQM philosophical concepts and summarize "poka-yoke" as the most revolutionary concept of all. A poka-yoke is the generation of ideas or the development of that mechanism helps operators to avoid mistakes (Patil 2013) . Rightly mentioned that the desire to achieve it business excellence in the Automotive Industry by promoting "Zero Defects" and the first time right production philosophy requires the integration of poka-yoke in all its activities (design and production)(Adrian 2006).

Based on its basic function, poka-yoke is divided into 3 that are: a). *Shutdown poka-yoke*: Preventive methods, by applying the shutdown method, can ensure around 100% free of defective products and the possibility to produce defective products is 0%. b*) Control poka-yoke:* This control method is to prevent the occurrence of defective products around 100%. Toensure that if there is a defect, it does not come from outside the production line and does not reach the customer. c) *Warning poka-yoke*: This method will make the operator aware of problems in the production process. When the operator receives the warning, he must immediately correct the process that caused the defect. This method notifies the existence of a problem or defect but does not guarantee that it will produce a 100% defect-free product. General warning methods can be exemplified using alarm (Patil 2013; Ronan 2017).

III. METHODOLOGY

The defect should be identified in the first stage of theproduction process, then analyzed the cause of the defect, probably due to the quality of the supplier's part which does not fit the standard or lack of personal knowledge on the production line. The following is thepoka-yokeimplementnt methodology in this study (Patil 2013; Varun Kumar 2016; Paquin 2006).

After deciding the idea of improvement by applying poka-yoke, the following steps are implemented:
Step 1 Identify the problem at this stage, complaints from customers are collected (both in defective products and other information) according to the results of the data analysis collected to expand the problem solving.In the automotive component industry most problems are found in various categories such as defect components, material problems, leaks, and unskilled personnel
Step 2 Observation at the workstation, the possibilityproblem willanalysis by fish bone diagram.
Step 3 Brainstorming for Ideas, This is a technique for capturing the creativity and worker skills in solving problems in brainstorming sessions, issues being examined are submitted to the committee. Then all the experts study the problem and provide various solutions to avoid the defect. Since everyone has one unique, this step ends with various alternative solutions.
The cause may be related to unsuitable humans, machinery, materials or methods.Most problems are found in various categories such as defect components, tool or machine failure, unskilled labor. This step ends with various alternative solutions for the same problem as Kaizen, Six Sigma, JIT, Poka-yoke, FMS, and TQM etc.
Step 4 Choose the best ideas, after getting various alternative solutions now is the time to choose the best of all the solutions collected. The selection criteria can be in the form of costs, time required, changes in existing systems, opportunities to develop new solutions, simplicity in operations, etc.By referring to all the criteria selection committee, it ends with the best solution is poka-yoke.
Step 5 Implementation and implementation plan, this step is related to the implementation of planning. This relates to material requirements, material processing and the mechanisms ultimately produced are implemented in

the actual Workplace.In the rotor process, most problems are found in various categories such as and the selection criteria end with the best one, the solution is poka-yoke which provides implementation in all processes with less cost and with a shorter time. In this step the real thing in the study is the problem behind it, the problem is sorted using a Quality control tool. The causes may be related to humans, machines, materials or methods.

Step 6 Monitoring and signing, Product produced and observed over several periods, the result is decided whether the fix is final or needs further analysis

IV. RESULT AND DISCUSSION

From the identification of the return of defective product from the customer is done by observing both the supplier process and also the process within the company in this case rotor assembly line. The cause of defect rotor component from supplier is not in accordance with the specification and by the team with the supplier has done a corrective action. For the cause of making at Press Shop on supplier and Caused of Flow out Rotor Assembly product as follows.

Press Shop at Supplier

Rotor components are produced in supplier with progressive stamping machines with a capacity of 200 tons. Figure 3 is the press process consisting of 8 processes. The embossing process is carried out in embossing process 1 (making 5 emboss) and embossing 2 (making 6 emboss).

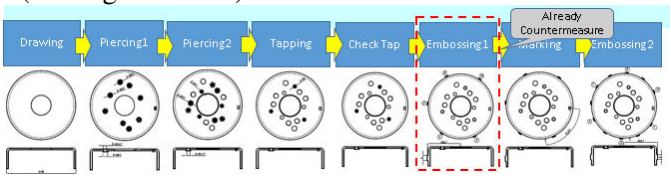

Figure 2. Caused of Making Press Shop

Jumping process , no process in embossing 1, nothing punch emboss no. 10 when process , caused problem bolt tightening punch lose .This problem already talked countermeasure by team and supplier. Based on the supplier's countermeasure, AXY Quality Incoming monitoring the defective component for 3 month and the results were not found less emboss component rotor

Process Rotor Assembly at AXY

In Rotor Assembly production there are 4 lines that work on different models according to the production plan. After the component checking process by Quality Inspection, the component be sent by the warehouse to the production line. There are 5 manpower in production line and 1 manpower as Quality Inspector

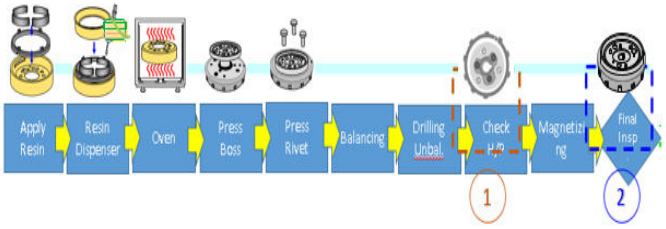

Figure 3. Caused of Flow out Rotor Assembly

The rotor process can be seen in Figure 3 where the main components of the rotor from the supplier and other components are assembled in the production line; at the end of the process it checks the Half Pierce and visual inspection. Even though it has been checked, there are still defect products that pass to the customer. Caused of flow out due to rotor Assembly line have checker machine but can't detection NG efect(① Check H/P machine) and Human error problem when visual &mark defectcheck defect part by operator (② Final Inspection).

① *Check Half Pierce Machine*

Figure is a Half Pierce machine which functions to check angle and radius rotor assembly. Machine only checkangle and radius emboss no. ⑤ so if part have problem defect less quantity,emboss, machine can't detected

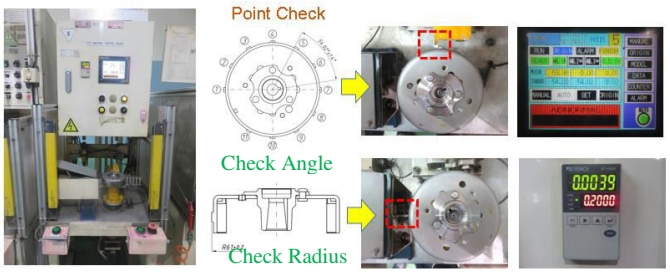

Figure 4. Half Pierce Machine

Check angle: Measured from the center point of the boss component to emboss no. 5, on the monitor the actual angle are 58.98 but the standard 54.02 + 1.4°, so that the monitor shows an abnormal signal (Product defect). *Check radius:* Only measure emboss no. ⑤ of the total 11 emboss, on monitor the actual radius deviation of 0.0039 where the standard deviation is max. 0.2000, this product is judged OK.The Weaknesses on this machine only detect 1 point (emboss no. 5), actual quantity of emboss varies (2, 4, 9 and 11) according to the model. Functionof angle and radius check to determine the emboss radius angle of rotor assembly product that is used to set the stator pulsher to the rotor at an

assembling engine motor. The problem effect if no emboss or less emboss on ignition is less perfect because the pulser cannot detect the signal on the emboss motorbikes and large problems cause the motor to not turn on.

② *Final Inspection*

The final process on the rotor assembly line is checking in the final inspection by QC Inspector.Figure 5 is the final inspection on the rotor line there are 6 checking processes, the check quantity emboss in Check Ignition Timing

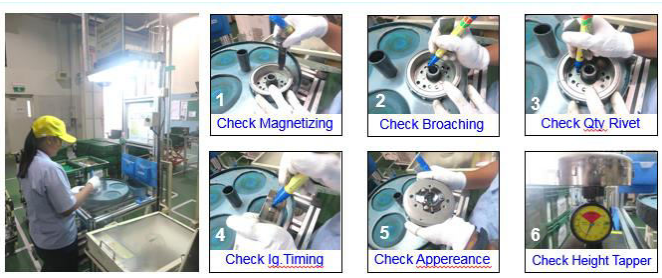

Figure 5. Final Inspection at Rotor Assembly line

Function for inspection quality final check 100% , used method visual and marking by operator.Disadvantages : if have problem human error,defect part can flow out delivery to customer. Errors arise because of the inconsistency of employees following work standards and lack of knowledge about what effects are caused if the defect part passes to the customer.From this problem the team brainstormed and chose the best idea so that the same problem did not appear again, it was decided to apply poka-yoke in the initial process to the rotor assembly line to capture the damaged product before being sent to the next process.

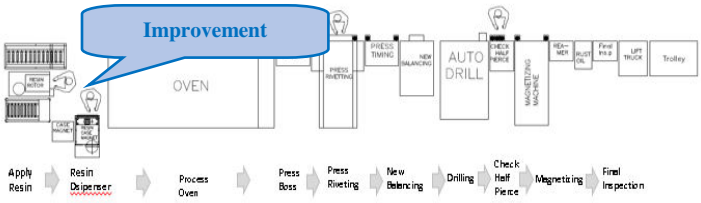

Figure 6. Rotor Assembly Line

The rotor assy's process in Figure 6 consists of 6 processes, half pierce checking of machines only checks emboss number ⑤ (from total 11 emboss) and visual inspection at the end of the process, but less emboss problems in both of these processes have not been able to detect100%. The initial process(applyresin) which is the object of improvement by applying Poka-Yoke.Figure 7 are the mechanism ofpoka-yoke in Rotor Assembly line (apply resin process) using work machine principle to rotation for check emboss with addition sensor proximity at Jig, modification PLC program and modification display.

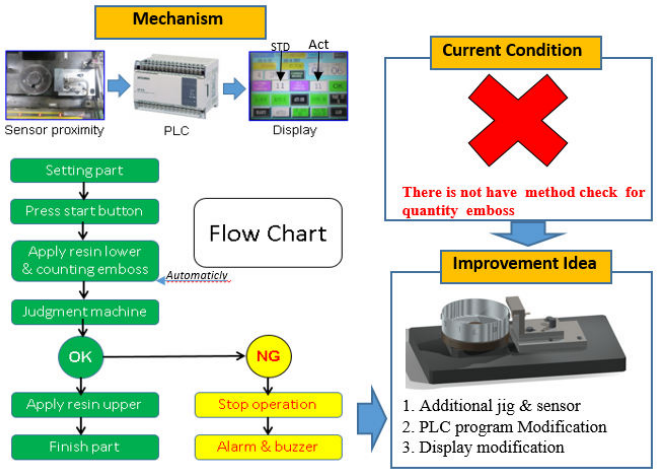

Figure 7. Mechanism Poka yoke

When the process applies resin, the sensor automatically reads the amount of emboss on the rotor part assembly and will appear in the actual display quantity of the reading, if the quantity emboss less from standard, automatically the machine will stop and the alarm &buzzer will stop. Operator will check actual product and inform to superior the abnormal condition.

The poka-yoke system applied in Rotor Assembly Line is a simple design, easy dandory and setting not change Cycle Time also prevent lost cost and defect part assembly. Comparing before and after kaizen (poka-yokeapplication) be shown in figure 8. Alert, with this method makes the operator aware of the condition of something abnormal. Poka-yoke shows the worker that a defect has been generated in this process. When the operator receives a warning, he must immediately report to the leader above it to do further snacks.

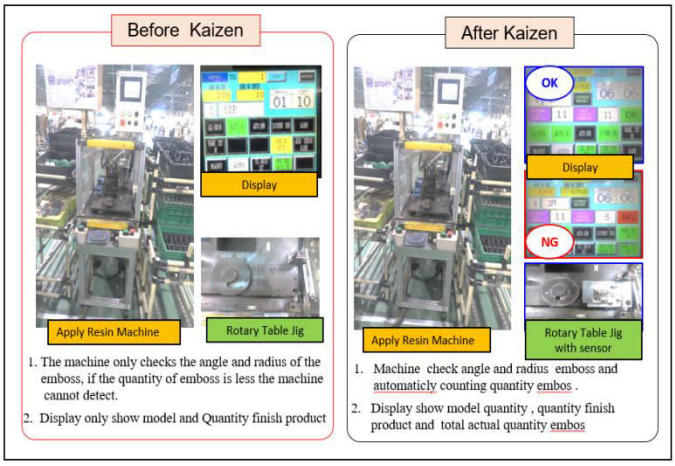

Figure 8. Before and after Kaizen (Poka-yokeApplication)

Monitoring is carried out for 3 months both at the supplier and at AXY (Rotor Assembly Line), from the results obtained there are no more defect components and products due to less quantity emboss. .From the results of kaizen (poka-yoke) it is very helpful for companies to anticipate defective products so that they do not pass to the next process

V. CONCLUSION

Visual inspection by human tends to be unstable because is influenced by the human factor itself .To error is human nature so we can't blame human being for each and every mistake. Poka-yoke is a system to organize work and eliminates the possibility of user error or prevent error occurred, but poka-yoke is just a tool, and it depends on its own users against the signals provided by this system, such as what to do if a product fails. The purpose of applying poka-yoke is "Zero Defect, Zero Waste and Zero Delays". In one sentence poka-yoke is a systematic preventive action on the ladder of success in QualityManagementSystem (QMS)with a higher level of performance and productivity and with high quality products at minimum costs.

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