Influence and application of Poka-Yoke technique in automobile manufacturing system

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Abstract. Manufacturing defect are most important parameter to improve the quality of product for the all-manufacturing industries. In the manufacturing sector day by day new tool and new techniques are applied for improving the quality at low cost. In this practical study discussed about the most important tool of lean manufacturing is poka-yoke (mistake proofing) technique. In all the manufacturing sector, a lot of small-small problem is affected the product quality and cost. In this paper the 70×90×10 oil seal mixing poka-yoke is solved for the improvement of quality of the product and save the manufacturing cost.

Keywords: Poka-Yoke, Lean Manufacturing, Oil seal, Automobile.

1. Introduction
In the current years intensifying competition in the international economy caused a major change in approach to quality management. The quality action should therefore include its reach the whole product life cycle, starting from customer identification requirements and expectations, by the customer’s service. An important factor in the functioning of company shall take appropriate selection constant improvement strategies of processes [1], where special emphasis is put on preventing strategy. The prevention strategy replaced detection strategy; new strategy indicates shifting the focus on the functions and activities relating to improving each element and operation broader process. In the present time we have techniques, tools and methods which support such approach to the quality. Thanks to the implementation in the organization following minimizing [2-4] Costs, eliminate defects and thus more monitoring and improving the quality and reduce cost operations in processes. Based on defect prevention in analysis and monitoring of each activity in the process and implementation at each stage of the process and each step operations tests and safeguards protecting against appearance of a problem [5-8]. Collection of information on emerging deficiencies and prevent them is a much more efficient way of improving quality than the

In this paper case study discussed on the oil seal mixing. The problem identified and solve by the poka-yoke technique for improve quality, cost saving and safety of the product some more objective given below.

➢ To improve the quality of product
➢ To increase the productivity of product
➢ To save the time of production of product
➢ To increased production flexibility
To saving the area of work station
➢ To increase the safety at work station
➢ To save cost in productivity

2. Problem Formulations
The main purpose of this chapter is to establish the methodology for quantitatively assessing the value of maintenance activities. In this chapter, we will introduce the principle of the methodology, and describe the framework and process of quantitatively assessing the value of maintenance activities.

2.1 Methodology of Research

![Figure 1. Steps to implement poka yoke](image)

**Step-1,** In this stage, the protests coming from the clients (Both inner and outer client) are gathered. The rule of the standard is dictated by considering different measures resembles a number of protests from the client, the number of deformities recognized by quality control, materiality abandons (their effect on the client, costs, executed interaction), and afterward, information is gathered extensively according to examination consequences of the gathered information organization plans for creating poka-yoke framework for the chose to issue. In this manner in the first stage, the issue is chosen

**Step-2,** In this step, to analysis of observation of problem found workestation, considered all the parameters of problems identifications.

**Step-3,** In this step, take best decision of problem solving and brainstorming all the solution provided by the expert and take best decision to solving this problem and take every possible solution of the problem.

**Step-4,** Subsequent to getting different elective arrangements the time has come to choose the best one out of completely gathered arrangements. Rules for choice might have cost, the time required, changes in the existing framework, freedom to grow new arrangements, straightforwardness inactivity, and so forth by alluding all choice models' board of trustees closes with one best arrangement.

**Step-5,** This progression is worried about execution arranging. It manages material prerequisite, preparing the material lastly fabricated system is carried out at the real working site.
**Step-6.** The made items are checked for absconds under examination additionally the exhibition of poka burden framework is likewise observed and the project is closed brought down.

![PDCA cycle to implement poka yoke](image)

**Figure 2.** PDCA cycle to implement poka yoke

### 3. Research Objectives

Case study-70×90×10 oil seal model mixes poka yoke

70×90×10 oil seal means 70 inner diameters, 90 outer diameters, 10 thicknesses of oil seal. Oil seal to prevent the leakage of oil from oil seal housing 2 oil seal use in one tractor in axel tube. 70×90×10 are two different type for different model depends upon the housing

- Single leap 70×90×10
- Double leap 70×90×10

Need of 70×90×10 oil seal poka yoke due to oil seal 70×90×10 missing poka-yoke for oil seal miss elimination, oil seal 70*90*10 leap damage elimination, oil seal 70*90*10 wrong oil seal fitment elimination and felt ring cut elimination. The existing methods. Manual pressing operation by pneumatic lever – chances of oil seal miss.

Total 5 tools used in Press machine to cover all oil seal pressing operation. - chances of wrong tool used as manual process causing seal damage. Two different types of oil seal used single lip and double lip – chances of fit wrong fitment. Felt ring centralization is part of assy process – Manual activity cause to improper fitment.

According to market research our company needed to improve its quality of tractors a lot, and there were many problems of parts getting damaged during pressing due to excessive pressure. At one press
the problem was very huge such that operator was instructed to press and just when it touches the oil-seal take the ram up, and the pressing operation depended hugely on operator skills and the amount of pressing varied operator to operator. To achieve our goal of quality improvement the project was indispensable.

![Figure 3. Concept for 70*90*10 oil seal](image)

- Oil seal press machine converted in to – PLC system
- Oil seal detection is interlocking with press machine operation.
- Tool selection is on the basis of component selection.
- Felt Ring centralization is the mandatory part of process can be done by sensor interlocking for next ration

**Brainstorming**

- Can we use Double lip oil seal 70X90X10 similar to 242 NF??
- Double lip is always better to protect dust getting inside housing
Conceptual design

Figure 4. All north model

Empty Axle Tube, oil not present
Figure 5. 242 new features housing axel tube

Brainstorming

- 242 NF having same characteristics compared with North models Please ref above
- 242 NF and All North variants are similar features in axle tube- only seal is different

Work out Feasibility of the fixture: -
Keeping in mind of the worst operator we could get, and the working conditions, following points were considered as important: -

- Easy to use.
- Durable
- Balls should not be directly in the approach of the operator.
- Dispenser should be installed at the height of around 4 feet just behind the line.
- Arrangements to avoid the falling of balls on ground should be given.
Arrangement to avoid locking of balls is very important.

Table 1. 70 X 90 X 10 Oil seal Mandrel

| Sr. No. | Tool No.   | Model Identification             | Type of Lip | Oil seal |
|---------|------------|----------------------------------|-------------|----------|
| 1       | T/21201414 | North (Oil seal Hsg.)            | Single Lip  | 70*90*10 |
| 2       | T/2120185  | 242 NF (Oil seal Hsg.)           | Double Lip  | 70*90*10 |

Table 2. Oil Seal Different for Different Model

| Sr. No. | Tool No.   | Model Identification             | Type of Lip |
|---------|------------|----------------------------------|-------------|
| 1       | T/21201414 | Normal (Oil seal Housing)        | Single Lip  |
| 2       | T/21201424 | Reduction cover                  | Double Lip  |
| 3       | T/2120152  | South                            | Double Lip  |
| 4       | T/2120176  | 364                              | Double Lip  |
| 5       | T/2120185  | 242 NF                           | Double Lip  |

4. Results and Discussion
The methodology that has been discussed in the previous chapter has been applied to the different poka yoke problem solve successfully. The results are very convincing in the term that they help in overcoming many of the sub-causes and root causes. This chapter discusses the results that have been obtained from the poka yoke technique. The root causes that have been found using the mistake have been addressed in this chapter and their remedies have been suggested.

Value Engineering --- Cost Analysis

North Variants (Oil seal 70*90*10-Single Lip)

Table 3. Model Production

| Month            | Model | Production |
|------------------|-------|------------|
| June to oct 2014 | 333   | 3173       |
| June to oct 2014 | 380   | 958        |
| June to oct 2014 | 368   |            |

Total No of tractor Produced 4 month=5899

Average no of tractor produced /Month=5899/4=1180
- Double Lip Oil Seal 96150354 – 43.72 Rs.
- Single Lip Oil Seal 93627986 -- 39.73 Rs.
- Cost Difference between single leap and double leap : 43.72-39.73 = 3.99 Rs
- 2 oil seal required for one tractor
- Cost for 1 tractor 2*4=8 Rs
- 8 Rs Per tractor
- Saving cost in per month 8*1180= 9440 Rs.
- Saving cost in per year 9440*12=113280 Rs.

In one improvement by the pokayoke technique in one work station .Saving amount(113280 Rs.)

**Table 4. Transmission area improvement by poka-yoke technique from june to October 2014**

| S.no | G2 line | G1 line | FD line |
|------|---------|---------|---------|
| 1.   | PPM Wrong part fitment, dent and damages, hammering (All Inclusive Line + Testing + Road Test + PDI + Field) | 600 | 532 | 1000 | 924 | 1400 | 1223 |
| 2.   | Defect elimination in 4 month | 36 | 27 | 480 | 312 | 84 | 61 |
| 3.   | No of Hammering Blows / assembly | 42 | 34 | 62 | 35 | 62 | 42 |
| 4.   | Pokayoke for Defect arrestment in nos/assembly | 2 | 5 | 0 | 6 | 0 | 3 |

**Figure 6. Wrong Part Fitment/dent**
Wrong part fitment, dent and damages

From Table 4, shows the wrong part fitment, dent and damages in PPM different parameter analysis in different work station in assembly unit of EICHER tractor. Improvement in four-month data in PPM by poka-yoke technique to eliminate wrong fitment, dent, damages and number of hammering blow. From Fig 6. shown percentage improvement in following line

- In G2 line before implement defective product (PPM) is 600 and after implementation is 532(PPM) and total in percentage improvement 11.33%
- In G1 line before implement defective product (PPM) is 1000 and after implementation is 824(PPM) and total in percentage improvement 17.60%
- In FD line before implement defective product (PPM) is 1400 and after implementation is 1123(PPM) and total in percentage improvement 19.70%
Defect elimination

From Table 4, in 2nd row shown the defect elimination before the improvement and after improvement following work station line by the Fig 7. shown following line graph

- In G2 line defective elimination before improvement (PPM) is 36 and after implementation is 24(PPM) and total in percentage improvement 33.33%
- In G1 line before implement defective product (PPM) is 480 and after implementation is 312(PPM) and total in percentage improvement 35%
- In FD line before implement defective product (PPM) is 84 and after implementation is 61(PPM) and total in percentage improvement 27.38%

Poka-Yoke Implementation

From Table 4, in 3rd row shown the defect elimination before the improvement and after improvement following work station line by the Fig 8. shown following line graph

- In G2 line defective elimination before improvement (PPM) is 2 and after implementation is 5(PPM) and total in percentage improvement 60.00%
- In G1 line before implement defective product (PPM) is 6 and after implementation is 2(PPM) and total in percentage improvement 66.66%
- In FD line before implement defective product (PPM) is 1 and after implementation is 3(PPM) and total in percentage improvement 66.66%

No of Hammering Blows / assembly

From Table 4, in 4th row shown the defect elimination before the improvement and after improvement following work station line by the Fig 9. shown following line graph

- In G2 line defective elimination before improvement (PPM) is 42 and after implementation is 34 (PPM) and total in percentage improvement 19.04%
- In G1 line before implement defective product (PPM) is 43 and after implementation is 35(PPM) and total in percentage improvement 43.54%
- In FD line before implement defective product (PPM) is 62 and after implementation is 42(PPM) and total in percentage improvement 32.25%

5. Conclusion

- By using pokayoke technique defective product reduction in G2, G1 and FD line are 11.33%, 17.6% and 19.7% respectively.
- Cost save in 70*90*10 oil seal poka-yoke is Rs.113280 per year

Wrong part fitment, dent and damages

- In G2 line before implement defective product (PPM) is 600 and after implementation is 532(PPM) and total in percentage improvement 11.33%
- In G1 line before implement defective product (PPM) is 1000 and after implementation is 824(PPM) and total in percentage improvement 17.60%
- In FD line before implement defective product (PPM) is 1400 and after implementation is 1123(PPM) and total in percentage improvement 19.70%
**Figure 10.** Shown wrong part fitment in % age

Wrong part fitment, dent and damages

|        | G2     | G1     | FD     |
|--------|--------|--------|--------|
| 11.33% |        | 17.60% | 19.70% |

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