

A Review on use of Mistake Proofing (Poka Yoke) Tool in Blow Molding Process

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Abstract: *Manufacturing defects or errors are always the key concerns of any manufacturing industry. The success of any organization depends on the quality of product especially right product produced. This dissertation work is to be done in small blow moulding company, which manufactures the Air duct for automobile air conditioners. The initial research shows the past trends of rejection is between 8-9% which includes human error in material removal, wrong fitting of clamp, molding defects, etc. the need is to reduce that to compete in highest competitive market and to continuous satisfaction of customer. One of the successful devices in lean production to eliminate waste caused by errors is 'mistake-proofing' or 'Poka-yoke'. Mistake-proofing is one of the effective approaches that prevents inadvertent errors and helps workers to be mistake-proof and does not allow defective products to flow to next processes. The Poka-Yoke approach was developed in the manufacturing industry as a way of improving productivity by reducing errors using often very simple adaptations. This dissertation work corroborates that, as Poka-Yokes to be implemented in manufacturing process of Air duct – Blow molding process. Methodology/approach: This dissertation work demonstrate the use of the Poka-Yoke approach in a manufacturing process of blow molding process, highlighting how they served to improve product quality by reducing rejection/waste. Status: the relevant literature review has been done along with study of Poka Yoke technique. Next step of study of manufacturing process of Air duct by blow molding is done and process mapping is done through process flow diagram. Next Phase of Work: Identification of the processes which contributes to the rejection and rework after process study. Application of Poka Yoke in the manufacturing process mainly to eliminate manual error by designing suitable means which reduces the rejection.*

Keywords: poka-yoke, blow moulding process, air duct, mistake proofing.

1. Introduction

In the recent 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, 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 their implementation in the organization following minimizing costs, eliminate defects and thus more monitoring and improving the quality operations in processes.

Based on defect prevention is 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. Collection of information on emerging deficiencies and prevent them is a much more efficient way of improving quality than the

standard quality control. Observations of the current problems arising in processes can be their causes demonstrate.

It is therefore an effective approach to apply mechanisms to prevent errors formation precisely at the moment they occur. Idea of "grounds command defects" known as the method or technique Poka-Yoke is just such mechanism. Poka-Yoke method was introduced by Shigeo Shingo in 1961, when this was one of engineers Toyota Motor Corporation. This method, in other words, is to prevent defects and errors originating in the mistake. Poka-Yoke technique can be applied both to prevent causes, which will result in subsequent occurrences of errors and to carry out inexpensive control determining whether to adopt or reject the product. It is not always 100% probability elimination of all errors, in such cases it is the task of Poka-Yoke methods is detection as soon as possible

The main objective of the project is to produce the defect free product, i.e. improving product and process quality of blow moulded product by implementing preventive tool – Poka Yoke.

2. Problem

Manufacturing of Air duct is done through blow moulding technology. After blow moulding process, it requires to remove excess material. Currently, Material removal process is done manually. Workers remove the excess material with sharp knife.

Removal process is totally depends on workers skill, there are high chances of improper removal of material which rejects material. Past rejection data is also very high due to manual removal (Human Error). Below figure shows the specific area and problem.



Figure 1: Defects in Air duct

The problem requires to be attended with high priority and it is very important to reduce rejection because it affects company's reputation and cost as well. The human error elimination is required in such a way that it eliminates the error. For that purpose, Poka Yoke techniques is identified and it will be implemented in manufacturing process, i.e. improvement in manufacturing process so the said problem can be eliminated.

3. Relevant Research Review

M. Dudek-Burlikowska and D. Szewieczek has investigated the Poka-Yoke method as an improving quality tool of operations in the process. The Purpose of research is to a new approach for the implementation of quality philosophy Zero Quality Defects with usage of the Poka-Yoke method in the polish organization has been presented. The possibility of usage of mistake proofing device is connected with monitoring and improvement of operations in the process. The finding of the research is, at the present time the organizations should implement quality tools, techniques, methods which support the prevention strategy and should pay attention to improving each element and operations in the process. The Poka-Yoke method of preventing errors by putting limits on how operation can be performed in order to force the correct completion of the operation has been presented. The possibility of implementing of the Poka-Yoke method as a factor of improving operation in the process in the motorizations companies has been shown.

Tarcisio Abreu Saurin, José Luis Duarte Ribeiro and Gabriel Vidor have conducted research on A framework for assessing poka-yoke devices. This study introduces a framework for assessing poka-yoke devices (PD), encompassing both those designed for quality control (referred to as quality PD) and those designed to control hazards to health and safety at work (referred to as safety PD). The framework assesses the processes of the design,

operation and maintenance of PD, rather than the outcomes of these processes. The development of the framework involved three stages: (a) defining 15 attributes of PD, identifying those that provide fail-safe characteristics and those that inform best practices in design, implementation and maintenance; (b) defining what the set of evidence and what the sources of evidence should be for assessing the existence of each attribute; the sources include documents, interviews, observations and a meeting to discuss the results of the assessment with company representatives; and (c) defining a scoring system to express the results of the assessment. The application of the framework is illustrated by means of assessing four PD; two of them being concerned with quality and two with safety.

Cristóbal Miralles, Raymond Holt, Juan A. Marin-Garcia and Lourdes Canos-Daros have conducted case study to design of workplaces through the use of PokaYoke. Purpose: Employment plays an important part in many people's lives beyond merely providing income, since continued participation in work can have many therapeutic benefits for workers defined as disabled. However, disabled workers face a range of barriers to employment, despite legislation intended to improve workplace accessibility emphasizing adaptations to the workplace, which many employers often find difficult and expensive.

The Poka-Yoke approach was developed in the manufacturing industry as a way of improving productivity by reducing errors using often very simple adaptations. This paper argues that, as Poka-Yokes are designed to make life easier and improve the performance of workers without impairments, they are closer to the philosophy of Universal Design than to Accessible Design, and offer an easy and inclusive way of making work more accessible for all kind of workers.

Design/methodology/approach: This paper provides a case study demonstrating the use of the Poka-Yoke approach in a sheltered work centre for disabled; highlighting how they served to improve accessibility to work by fulfilling Universal Design principles.

Findings: Our research allows us to demonstrate the great potential of Poka-yokes for gaining accessibility to the workplace. The real application of this approach, both in sheltered work centers and ordinary companies, can contribute to improve the high unemployment rates of disabled people.

Research limitations/implications: The proposal is innovative and was applied in one specific company. Thus, a range of customized Poka-yokes would be desirable for different industrial sectors.

Practical implications: Managers of sheltered work centers, and also of ordinary companies, can realize about the great potential of Poka-Yokes as an easy means of gaining flexibility and accessibility.

Arash Shahin and Maryam Ghasemaghaee have investigated

use and implication of Poka Yoke technique in Service sector. Comparing with other sectors, although the service sector has been growing fast and shares most of the revenue and employment worldwide; apparently its productivity and quality have not been growing. What is vital in today's growing of the service sector is to have a better understanding of tools, techniques, and policies to help keep management's focus on productivity and quality improvement. The rigorous application to the service sector of those engineering and management techniques that have been so effective in the manufacturing sector is a starting point for service managers to help them bring their companies back to life. In this paper, Poka yoke as one of the effective quality design techniques experienced in manufacturing has been suggested and developed for service fail-safing. For this purpose, the subjects of service failure and service recovery have been introduced. Then, service Poka yoke has been demonstrated and its solutions have been classified. Some case examples have been presented in three categories as layout, technology and self-service for a better understanding of the subject. This paper also has proposed a framework, by which the common and uncommon elements of service Poka yoke and Service recovery solutions have been classified and addressed schematically. The framework seems very helpful for the managers to focus on the more effective approaches, if they are about to fix problems at the design stage of the processes. Finally, some barriers and critical success factors of adopting Poka yoke in services applications has been discussed.

Ramin Sadri, Pouya Taheri, Pejman Azarsa and Hedayat Ghavam have carried out research to improve the productivity through Mistake-proofing of Construction Processes. Construction defects are always the key concern of the construction industry. Different constructed facilities generate different types of defects and demand different levels and types of quality, depending on the functions, system types, and materials used.

To achieve mistake-proofing concept in a construction site, zones where are prone to error should be identified. These mistakes could be quality problems, delay in delivering a mid-process product, safety issues and so on. By tracking where the problems locate, the project manager could place his/her attention on investigating and resolving the problem, and implement the mistake-proofing device to prevent recurrence of problems in the future. There are six of main mistake-proofing principles listed in order of preference in fundamentally addressing mistakes: (1) Elimination seeks to eliminate the possibility of error by redesigning the product or process so that the task or part is no longer necessary; (2) Replacement substitutes a more reliable process to improve consistency; (3) Prevention engineers the product or processes so it is impossible to make a mistake at all; (4) Facilitation employs techniques and combining steps to make work easier to perform; (5) Detection involves identifying an error before further processing occurs so that the user can quickly correct the problem; (6) Mitigation seeks to minimize the effect of errors. The results show that

the construction operations have high potential of mistake-proofing, and therefore the application of Poka-yoke devices can finally lead to drastic promotion in construction industry. At last section, a case study related to the simple operation of a trolley hoist also conducted to evaluate productivity improvement due to the process mistake proofing in practice

4. Poka Yoke

Poka-yoke is a Japanese term that means "fail-safing" or "mistake-proofing". A poka-yoke is any mechanism in a lean manufacturing process that helps an equipment operator avoid (yokeru) mistakes (poka). Its purpose is to eliminate product defects by preventing, correcting, or drawing attention to human errors as they occur. The concept was formalised, and the term adopted, by Shigeo Shingo as part of the Toyota Production System. It was originally described as baka-yoke, but as this means "fool-proofing" (or "idiot-proofing") the name was changed to the milder poka-yoke.

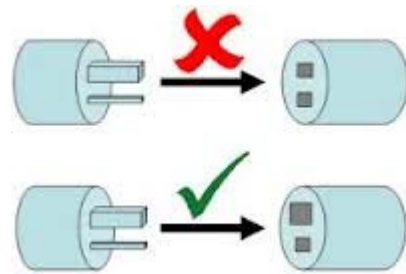


Figure 2: Simple Example of Poka Yoke

Shigeo Shingo recognized three types of poka-yoke for detecting and preventing errors in a mass production system. The contact method identifies product defects by testing the product's shape, size, color, or other physical attributes. The fixed-value (or constant number) method alerts the operator if a certain number of movements are not made. The motion-step (or sequence) method determines whether the prescribed steps of the process have been followed.

Either the operator is alerted when a mistake is about to be made, or the poka-yoke device actually prevents the mistake from being made. In Shingo's lexicon, the former implementation would be called a warning poka-yoke, while the latter would be referred to as a control poka-yoke. Shingo argued that errors are inevitable in any manufacturing process, but that if appropriate poka-yokes are implemented, then mistakes can be caught quickly and prevented from resulting in defects. By eliminating defects at the source, the cost of mistakes within a company is reduced.

Technical aspect of Poka-Yoke method

Poka-Yoke technique can be applied both to prevent causes, which will result in subsequent occurrences of errors and to carry out inexpensive control determining whether to adopt or reject the product. It is not always 100% probability elimination of all errors, in such cases it is the task of Poka-Yoke methods is detection as soon as possible. Analyze the process of product defects formation noted that between a mistakes resulting from the defect is yet one, the potential

possibility: The observation mistake and its correct. It is therefore the proposal -method for reducing defective is planning conditions in which error may not happen, or will be immediately visible and captured. Take into account the above Shigeo Shingo developed a achieving "zero defects" in industrial conditions, i.e. in such a way as simple and cheap. Was itself at the matter, that it is not possible to reduce the defects using random checks. It is necessary to the total control - 100% control. Shigeo Shingo adopted following assumptions:

- In the case of confusion applying the statistical process control is ineffective,
- Monitoring and control the poka-yoke should be:
- Autonomous, i.e. operations carried out by the contractor without intervention from the outside,
- 100% - the total
- Cheap.

Shigeo Shingo has analyzed in detail the process formation of defects and errors from the source to effect. He said that mistake from the producer becomes defect for the user in this moment when the customer unnoticed this defect. It should be therefore a maximum reduced and speed up action coupling back, and so on:

- As soon as possible and simplest should be detect errors (inspection of information, "after the fact", typical for statistical control),
- At the earliest as soon as possible signal error before it become the defect (in the inspection of information is amended to self-control 'upwards' means checking prior operations and material obtained),
- Eliminate possibility of the occurrence error (inspection at source, verify the conditions under which runs the operation in order to eliminate the possibility formation error).

The Poka-Yoke is a technique for avoiding human error at work. A defect exists in either of two states; the defect either has already occurred, calling for defect detection, or is about to occur, calling for defect prediction. Poka-yoke has three basic functions to prevent or reduce defects: shutdown, control, and warning. The technique starts by analyzing the process for potential problems, identifying parts by the characteristics of dimension, shape, and weight, detecting process deviation from nominal procedures and norms.

5. When to use it?

Poka-yoke can be used wherever something can go wrong or an error can be made. It is a technique, a tool that can be applied to any type of process be it in manufacturing or the service industry. Errors are of many types;

- 1 Processing error: Process operation missed or not performed per the standard operating procedure.
- 2 Setup error: Using the wrong tooling or setting machine adjustments incorrectly.
- 3 Missing part: Not all parts included in the assembly, welding, or other processes.

- 4 Improper part/item: Wrong part used in the process.
- 5 Operations error: Carrying out an operation incorrectly; having the incorrect version of the specification.
- 6 Measurement error: Errors in machine adjustment, test measurement or dimensions of a part coming in from a supplier.

6. How to use it?

Step by step process in applying poka-yoke:

- Identify the operation or process - based on a pareto.
- Analyze the 5-whys and understand the ways a process can fail.
- Decide the right poka-yoke approach, such as using a shut out type (preventing an error being made), or an attention type (highlighting that an error has been made) poka-yoke take a more comprehensive approach instead of merely thinking of Poka-yokes as limit switches, or automatic shutoffs a poka-yoke can be electrical, mechanical, procedural, visual, human or any other form that prevents incorrect execution of a process step
- Determine whether a contact - use of shape, size or other physical attributes for detection, constant number - error triggered if a certain number of actions are not made sequence method - use of a checklist to ensure completing all process steps is appropriate
- Trial the method and see if it works
- Train the operator, review performance and measure success.

7. Poka Yoke Visual Examples

1. Diskette



Figure 3: Diskette

3.5 inch diskette cannot be inserted unless diskette is oriented correctly. This is as far as a disk can be inserted upside-down. The beveled corner of the diskette pushes a stop in the disk drive out of the way allowing the diskette to be inserted. This feature, along with the fact that the diskette is not square, avoids incorrect orientation.

2. Pen

This pen prevents ruining shirts by retracting the tip automatically when the pen is clipped into your shirt pocket. The catch that keeps the tip out is actually in the pocket clip. When you pullout on the clip to put it on your shirt, the pin that engages the catch is released causing the tip to retract



Figure 4: Pen

3. Fueling Cap of Automobile

Fueling area of car has three mistake-proofing devices:

- Filling pipe insert keeps larger, leaded-fuel nozzle from being inserted
- Gas cap tether does not allow the motorist to drive off without the cap
- Gas cap is fitted with ratchet to signal proper tightness and prevent over-tightening.

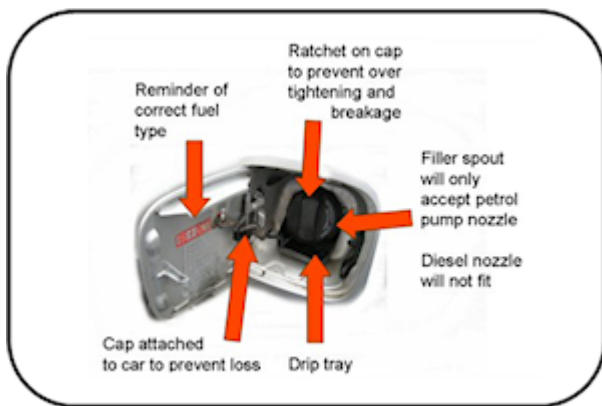


Figure 4: Fueling area of Car

8. Methodology

The goal of manufacturing is to produce value-added products in a timely manner, which is free of defects. Poke Yoke is applied in fundamental areas. The main objective of Poka Yoke is to achieve zero defects. It is used to create a system that prevents defects from occurring, and it used as a system to catch defects, which have just occurred and prevent them from continuing through the system.

Step by step process in applying poka-yoke:

1. Study and Analyze the operation or process Manufacturing process
2. Analyze and understand the ways a process can fail.

3. Decide the right poka-yoke approach, such as using a shut out type (preventing an error being made), or an attention type (highlighting that an error has been made) poka-yoke
4. Implement the poka yoke – modify process
5. Trial the method and see if it works
6. Result and conclusion

9. Acknowledgement

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Author Profile



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