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Quality Improvement Technique: Through Poka –Yoke Concepts

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Abstract: *Toyota production system (TPS) has extensive use of Poka-Yoke (mistake-proofing) devices. Poka-Yoke is also an essential process component of Motorola's Six Sigma strategy. However, Poka-Yoke has been largely ignored in academia. Traditional engineering design Poka-Yoke has proven to be very effective to build quality into production processes. However, its application in non-production processes is very limited due to its reliance on physical features for error detection. Based on case study results, this paper presents a theoretical framework to unify developments in the design for Poka-Yoke. Practical guidance is also provided for Poka-Yoke implementation.*

Keywords: *lean; TPS; Toyota production system; Six Sigma; quality management; Poka-Yoke; mistake-proof*

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I. Introduction

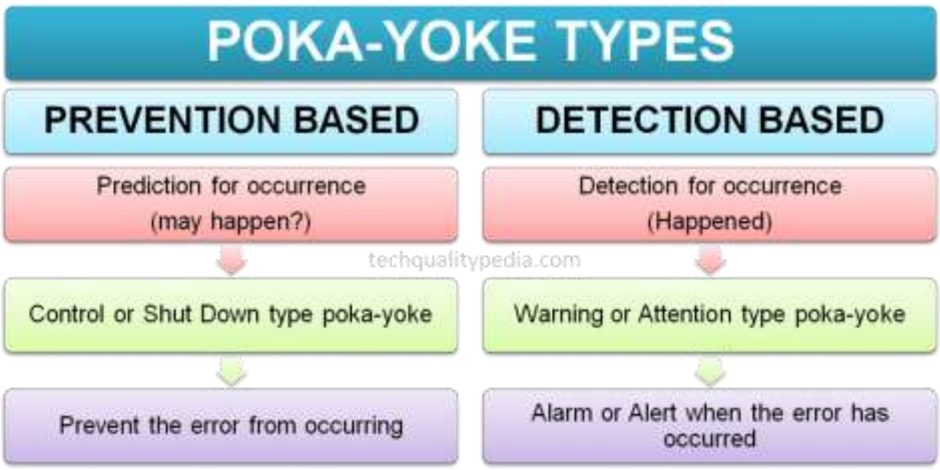
Shigeo Shingo of Japan invented the concept called **Poka Yoke** in the 1960s for preventing human errors. **Poka poke** is a Japanese term that means **Mistake Proofing** or **Error Proofing**. Shigeo differentiated the concepts of human mistakes and defects in the manufacturing process. According to him, "defects occur only when mistakes are permitted to reach the customer". The essential idea of **Poka Yoke** is to design your process so that chances of mistakes are eliminated at source or at least easily detected and corrected. Mistake Proofing is one of the important tools of **Lean Manufacturing** and Six Sigma methodology.

Poka-yoke means-making the system/process mistake proof or error-proof so that defects generation can be eliminated at source or at first place, and can be easily detected and corrected. It is an improvement tool for the detection and prevention of mistakes/defects/errors at the manufacturing process stage with the objective of achieving zero defects.

1.1 Poka- Yoke types

Poka yoke categorized into main two types:

1. Prevention type
2. Detection type

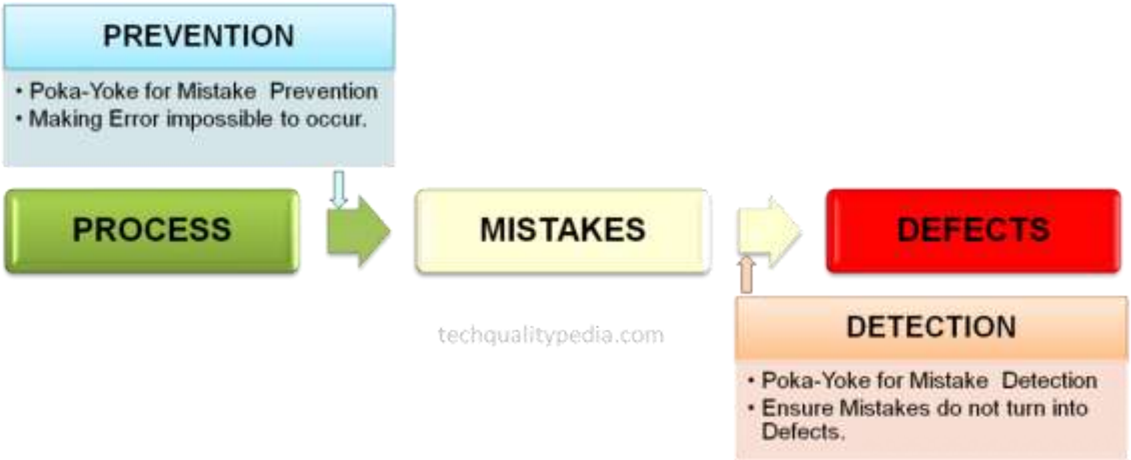


1. Prevention type: In this type of Poka-yoke system, a process is designed so that the defect or mistakes is impossible to occur. In simple words, prevention Poka-yoke not allowing the possibility for the mistake to occur in the first place.
We can prevent the occurrence of human error by:
1. Elimination
2. Prevention
3. Replacement
4. Facilitation

2. Detection type: In this type of Poka-yoke system, mistakes or errors are easily detected and corrected at the source or next work station. We make sure that mistakes do not turn into defects and reach to customer end. In simple words, detection Poka-yoke allowing the mistake to occur but provide some means of detecting, alerting, and correcting it.

We can minimize the effects after occurrence of human by:
1. Detection
2. Correcting or Mitigating.

In manufacturing industries, prevention Poka-yoke generally considered better than the detection Poka-yoke.



1.2 Poka Yoke Approaches | Regulatory Functions
There are two types of regulatory function to prevent and detect errors, or we can say there are two types of approaches for mistake-proofing devices:
1. **Control Approach**
2. **Warning Approach**

1. Control Approach: Control approach senses the error/problem and stops or shut down the machine/process so that corrective measures can be taken quickly, and thus preventing defects occurrence.

2. Warning Approach: The warning approach signals the occurrence of defects or mistakes through buzzers, lights, or other warning devices. However, the warning method does not shut down the machine or process

1.3 Sources of errors
Sources of errors in manufacturing or service industries classified in terms of 6Ms factors:
1. Man or Human error
2. Machine
3. Method
4. Material
5. Measurement
6. Mother Nature or Environment.

Any one of above or combination of two or more factors may cause error in process that can lead to defects.

1.4 Poka Yoke Benefits

Benefits of **Poka-Yoke** implementation are:

1. Elimination of mistakes/errors/defects before they occur.
2. Detecting and correcting defects as they occur.
3. Improvement in product and process quality
4. Reduction in cost due to poor quality
5. Reduction in customer complaints and rejection.
6. Prevention of defect outflow to customer.
7. Elimination of unwanted operations related to quality control.
8. Higher productivity.
9. Less bourdon on workers.
10. Enhance customer satisfaction.

2.1 Poka Yoke System

Poka Yoke devices consist of three methods for prevention and detection of errors/mistakes in manufacturing process.

1. **Contact method**
2. **Fixed-Value method**
3. **Motion-step method**

Each method enlisted above can apply in Control approach or Warning approach.

1. Contact method: Contact methods involve testing/inspecting for product parameters and other physical attributes such as size, shape, color, etc. to identify if any error exists.

Examples of contact devices are**-** Limit switches, toggle switches, and physical contact sensors.

2. Motion or sequence method: The motion method determines that whether the defined sequence of operation has been followed.

3. Counting or Fixed-value method: The counting method alerts the machine operator if the number of items, movements, or events is not followed or made.For example, five screws required to assemble a case. A counter device on the tool/machine keeps track of the no. of screws used.

2.1 Poka-Yoke examples and benefits

Shingo (1986) provided about 110 Poka-Yoke examples in his book as he formalised the Poka-Yoke theory. To spread the Poka-Yoke concept in western companies, Productivity Press (1997) released a new book, Mistake-proofing for Operators: The ZQC System, an edited version of Shingo's original publication. Many Poka-Yoke examples were retained in the book. Another highly featured publication on Poka-Yoke examples, Poka-Yoke: Improving Product Quality by Preventing Defects, was edited by NKS/Factory Magazine (1988). The book contains 240 examples of Poka-Yokes from more than 100 Japanese plants. It includes a list of 10 errors and a list of 10 sources of defects. The examples of PokaYokes are organized mainly in accordance with error types. The book also gives an overview of the Poka-Yoke concept and methods, and explores the relationship between human error and product defects. Industrial practitioners and consultants reported impressive benefits from Poka-Yokes. Shingo recorded an example of zero defect production over six months in a drainpipe assembly line operation involving 23 workers who handled 30,000 units every month. This nearly impossible achievement was accomplished through the installation of Poka-Yoke devices which worked in conjunction with source inspections, self-checks and successive checks (Shingo, 1986). AT&T Power Systems, the first Deming prize winner among US companies, reported a net saving of $2545 per Poka-Yoke device for a total of 3300 Poka-Yoke devices implemented (Grout, 1997). Ford Motor Company installed a Poka-Yoke to effectively prevent the use of wrong sensors in the engine assembly line (Manivannan, 2007). Tsou and Chen (2005) built a dynamic model to evaluate the effect of Poka-Yoke in a defective production system. Their modelling results suggest that Poka-Yoke is generally cost effective in helping manufacturers deliver satisfactory returns.

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