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Teaching Management With Poka-Yoke Model

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Abstract: Poka-Yoke, pronounced as "POH-kah YOH-keh", it was introduced by Shigeo Shingo (1909-1990), a Japanese industrial engineer who was born in Saga City, Japan and was one of the world's leading experts on manufacturing practices and also documented "The Toyota Production System". Poka-Yoke means "fail-safing" or "mistake-proofing". The term comes from Japan and it is "yokeru" which means "to avoid" and "poka" which means "inadvertent errors". First, Poka-Yoke was Baka-yoke but as this means "fool-proofing" or better "idiot-proofing" the name became Poka-Yoke.

Key words: management, poka-yake, teaching, economics

1. Introduction

Poka-Yoke can be explained as a special inspection mechanism which is used primarily to detect and prevent causes of defects in a system. Poka-Yoke created while Shingo was developing a quality management system called ZQC (Zero Quality Control). He believed that the majority of defects are committed by the workers or errors in the production system and the concept was that anyone can practice Poka-Yoke in his workplace. This method can be used whether is a possibility that something can go wrong, as it is a technique or a tool that can be applied to any type of process or the service industry. It is implemented by using simple objects which are called poka yoke devices and they are used in order to stop machine and alert operator when something is about to go wrong. These are highly reliable devices or innovations which can detect not normal situations before or immediately after they occur allowing production to be stop, thus preventing the production of defective products. (Bitner et al., 1990).

Good poka-yoke devices have many common characteristics (Chase and Stewart). They are simple and cheap. If they are too complicated or expensive, their use will not be cost-effective. They are part of the process, implementing what Shingo calls "100%" inspection. They are placed close to where the mistakes occur, providing quick feedback to the workers so that the mistakes can be corrected.

Shigeo Shingo was a leading proponent of statistical process control in Japanese manufacturing in the 1950s, but when he realized that the statistical approach it would never reduce product defects to zero, he began to research a better approach. The statistical sampling means that some rate of defects can reach to the customers. In 1961 Shingeo Shingo visited the Yamada Electric plant and he realized that there is a problem with one of products. Part of the product was a small switch with two push-buttons supported by two springs. Occasionally, the worker assembling the switch would forget to insert a spring under each push-button. Sometimes the error

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would not be discovered until the unit reached a customer, and the factory would have to dispatch an engineer to the customer site to disassemble the switch, insert the missing spring, and re-assemble the switch. This problem of the missing spring was both costly and embarrassing. Management at the factory would warn the employees to pay more attention to their work, but despite everyone's best intentions, the missing spring problem would eventually re-appear.

Shingo suggested a solution that became the first poka-yoke device (Shigeo Shingo). In the old method, a worker began by taking two springs out of a large parts box and then assembled a switch. In the new approach, a small dish is placed in front of the parts box and the worker's first task is to take two springs out of the box and place them on the dish. Then the worker assembles the switch. If any spring remains on the dish, then the worker knows that he or she has forgotten to insert it. The new procedure completely eliminated the problem of the missing springs. So Shingo tried to develop this mistake-proofing concept for the next three decades. One of the important and crucial distinctions he made was between a mistake and a defect.

He said that mistakes are inevitable and they are made by people who are human and cannot be expected to concentrate all the time on the work in front of them or to understand completely the instructions they are given. People are not infallible. On the other hand, defects result from allowing a mistake to reach the customer, and defects are entirely avoidable.

The goal of poka-yoke is to engineer the process so that mistakes can be prevented or immediately detected and corrected. Poka-yoke devices adopted gradually by Japanese plants over the next three decades, causing one observer to note. (Poka-yoke: Improving Product Quality by Preventing Defects). It is not one device, but the application of many very simple “fail-safing” mechanisms. Each one is relatively simple - something which anybody easily could do on his own (Michel, 2001).

2. Implementation

Poka-yoke can be implemented at any step of a manufacturing process where something can go wrong or an error can be made. According to Shigeo Shingo, there are three types of poka-yoke for detecting and preventing errors in production: The *contact* method which identifies product defects by testing the product’s shape, size, color, or other physical attributes. Contact methods are based on some type of sensors which detects abnormalities in the product's shape or dimension and responds accordingly. Interference pins, notches with matching locator pins, limit switches and proximity switches are sometimes used to ensure that a part is positioned correctly before work occurs. Asymmetric parts with matching work fixtures can also alleviate incorrect positioning. If orientation is not critical, symmetrical designs can then be used to prevent defects. In situations which are prone to mistakes contact methods are very useful. Such situations involve rapid repetition, infrequent production, or environmental problems such as poor lighting, high or low heat, excess humidity, dust, noise, or anything which distracts a worker (Chase & Stewart, 1994).

The *fixed-value* (or *constant number*) method alerts the operator if a certain number of movements are not made. When we have processes where the same activity or move is repeatable, fixed-value methods are suitable. This method usually uses very simple techniques, such as methods that allow operators to easily track how often this activity has been performed. The *motion-step* (or *sequence*) method determines whether the prescribed steps of the process have been followed.

The motion-step method is useful for processes requiring several different activities performed in sequence

by a single operator. This is similar to the fixed-value situation in that the operator is responsible for multiple activities but instead of performing the same activity multiple times the operator performs different activities. First, each step in the process is identified by the specific motions needed to complete it. Then devices are created to detect whether each motion is performed and then alert the operator when a step is skipped. An assembly process could utilize a device that senses when all required components are present at the start of the process for each unit. The devices could then detect when each component is removed from its dispenser, if a component is not removed, the sensing device alerts the assembler before he/she can move on to another unit[1].

Shingo's said that awarning poka-yokes is when the operator is alerted when a mistake is about to be made and control poka-yoke when the poka-yoke device actually prevents the mistake from being made.

Shingo argued that errors are inevitable in any production. Nevertheless 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 (Foster, 2001).

3. Implementation in Service Industries

Service industries can also implement Poka-yoke. Service failure is inevitable and occurs in both the process and the outcome of service delivery. Customer's expectations cannot be managed when the service fails. According to Bitner et al. (1990), when failures occur, employee behaviors related to the core service requests for customized service and unexpected employee actions.

Because of service failures dissatisfaction, decline in customer confidence, customer defection and decrease in employee morale and performance can be created.

Customers react in different ways when they encounter a service failure. These include loyalty, voice (e.g., complaining to the service provider, or another party) and exit. Poka yoke is a design of a production process so that a specific error cannot occur. Although Shingo did not focused on the manufacturing industry, the Poka yoke concept can have even more merit in the service sector. In both areas the customer is the key. However, in the service sector it becomes a challenge to place a statistical measurement on the intangible aspects of customer service. So, Poka yoke could have a great impact in the service industry because it places fail-safe measures on processes that can make a difference in maintaining a relationship with the customer. It only requires a good or bad value placement on the process.

According to Chase and Stewart (1994), service poka-yokes can be divided to server errors and customer errors. Server errors result from the task, treatment, or tangibles of the service. Customer errors occur during preparation, the service encounter, or during resolution. Task errors include doing work incorrectly, work not requested, work in the wrong order, or working too slowly.

Two classes of service poka-yoke

Service Poka yokes: Task: incorrect work, work not requested, work completed in the wrong order, work completed too slowly, **Treatment:** failure to acknowledge the customer, failure to listen to the customer, failure to react appropriately to the customer. **Customer Poka yoke: Preparation:** failure to have materials available, failure to understand their role in the transaction, failure to engage in the correct service, encounter, failure to remember steps in service process, failure to follow system flow, failure to specify desires, failure to follow instructions. **Resolution:** failure to signal service failures, failure to learn from experience, failure to adjust

[1] http://www.enotes.com/poka-yoke-reference/poka-yoke.

expectations, failure to execute post encounter actions.

The simple steps for implementing Poka-Yoke: Identify the areas where a high rate of errors occurred or even a single error is very costly. Identify the root of the problem through 5 Whys or cause and effect analysis. Decide whether to use a shut-out or attention type method to confront the problem. Decide whether a contact, constant number or sequence method is best (it will depend on the nature and purpose of the activities). Design an appropriate poka yoke. Test it to see if it works. Once you have a working method then ensure you have the right tools/checklists/software, etc. for it to work consistently and correctly. Train everyone to use it. After it has been in operation for a while (the time period will depend on the frequency of the activity) review performance to ensure errors have been eliminated. Take whatever steps are needed to improve on what you have done.

4. The Significance of Method

According to Shingo, the importance of Poka-Yoke is based on the followings: It helps people and processes work right the first time. It uses techniques that stop defects of products and process be occurred and by this way it is impossible to make mistakes. So quality and reliability are improved. The use of simple poka-yoke ideas and methods in product and process design can eliminate both human and mechanical errors. Poka-yoke does not need to be costly. Moreover, it is essential to sum up the benefits of the implementation of this method. Using Poka-Yoke, productivity is enhanced, the quality can reach the highest level, the quality cost and the rework will be lowered and the most significant is that customer satisfaction will be enhanced.

Table 1 Key Elements of Poka-Yoke

Key Elements of Poka Yoke	
Point of Origin Inspection (Proactive)	**Corrective Action (Reactive)**
It identifies the defect immediately. It requires Poka-yoke usage at or before the inspection points during the process. It is 100% effective in catching defects.	Also known as Informative Reaction. **Advantages:** Check occurs immediately after the process. Can be an operator check at the process or successive check at the next process. Very effective in preventing defects from being passed to next process. **Disadvantages:** Not 100% effective, as it cannot eliminate all defects. Not effective as the Source inspection approach. This is however more effective than statistical sampling and does provide feedback in reducing defects.

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