Muda, Mura And Muri

Idea In Short

One of the most important goals of Lean manufacturing is the elimination of waste. Taiichi Ohno, father of the Toyota Production System [TPS], defined three categories of waste: Mura, Muri and Muda. While Muda is the most widely known, Muri and Mura are equally important to understand.

Some Japanese words have made their way into the western business language since Lean spread worldwide and inspired all businesses. Three of them are quite well known: Muda, Muri, Mura. The Toyota Production System, and later on the concept of Lean, was developed around eliminating the three types of deviations that shows inefficient allocation of resources. The three types are Muda [waste], Mura [unevenness], and Muri [overburden].

The Toyota Way

Respect for People is one of the two guiding principles of the Toyota Way, a management philosophy originally developed for the manufacturing of automobiles. This management philosophy has two important components:

1. Continual Improvement (also known as Kaizen), and
2. Respect for People (also known as Respect for Stakeholders)

Continual Improvement

The Continual Improvement part of the Toyota Way, which emphasizes eliminating waste, is better known in the Western world by the adjective lean. The guiding principle behind Respect for People is to:

> Foster a corporate culture that enhances individual creativity and teamwork value,

> while honoring mutual trust and respect between labor and management.

Lean production and management emphasize continuous, incremental improvement and doing more with less. Because the key performance indicators (KPIs) for Continual Improvement could be measured, this part of the Toyota Way sometimes received more attention in the Western world.

Respect for People

According to Toyota, the Respect for People principle breaks down into two essential components, respect and teamwork:

> RESPECT: We respect others, make every effort to understand each other, take responsibility and do our best to build mutual trust. TEAMWORK: We stimulate personal and professional growth, share the opportunities of development and maximize individual and team performance.

The Respect for People component of the management philosophy, however, often received less attention because the key performance indicators for respect were difficult to measure. However, today, companies are finding it easier to correlate data from disparate sources, including social media, and assign monetary value to KPIs for more subjective management concerns like customer satisfaction and employee churn. Respect for People is also sometimes considered to conflict with a traditional business culture, which often puts a great deal of emphasis on short-term profit and a clear, quick and measurable path to ROI (return on investment). This too is changing, however, as corporate cultures that promote employee engagement and work-life balance increasingly demonstrate greater productivity, innovation and sustainability.

Muda

Muda means wastefulness, uselessness and futility, which is contradicting value-addition. Muda refers to processes or activities that don't add value. These types of waste do not help your business or workers in any way. They increase costs and make tasks take much longer than they should. Value-added work is a process that adds value to the product or

service that the customer is willing to pay for. There are two types of Muda:

1. Type 1, and
2. Type 2

Muda Type 1

This includes non-value-added activities in the processes that are necessary for the end customer. For example, inspection and safety testing does not directly add value to the final product; however, they are necessary activities to ensure a safe product for customers.

Muda Type 2

This includes non-value-added activities in the processes, but these activities are unnecessary for the customer. As a result, Muda Type 2 should be eliminated. There are seven categories of waste under Muda Type 2 that follow the abbreviation TIMWOOD. The seven wastes are:

1. Transport i.e., excess movement of product
2. Inventory i.e., stocks of goods and raw materials
3. Motion i.e., excess movement of machine or people
4. Waiting
5. Overproduction
6. Over-processing, and
7. Defects

These seven types of wastes were commonly observed in industrial workshops and proved pretty generic to many other activities, even in administration and services (with a little adaptation). A later eighth type was identified and now commonly admitted in the list: the waste of human talent[s]. Muda are not the sole type of waste, but they are the easiest to understand and relatively easy to identify by observation. Muda hunting has become a regular activity, sometimes even popular activity in some companies.

Mura

Mura means unevenness, non-uniformity, irregularity, and variability. This is the reason for the existence of any of the seven wastes. In other words, Mura drives and leads to Muda.

Variability can take multiple aspects; different bottle filling levels in a filling line, varying cutting length, or inconsistent color tones in successive batches, etc. The physical characteristics of a raw material may vary over time or according to different batches supplied; quantity, weight, length, texture, hardness, elasticity, etc. The settings of a machine may vary over time, human practices and actions may vary from one person to another and over one day. The sources of variability are innumerable and variability generate waste as some of the output must be reworked or even discarded. For example, in a manufacturing line, products need to pass through several workstations during the assembly process. When the capacity of one station is greater than the other stations, you will see an accumulation of waste in the form of overproduction, waiting, etc. The goal of a Lean production system is to level out the workload so that there is no unevenness or waste accumulation. The Japanese approach seeks to eliminate the causes of irregularities and not hide them with buffers. By gradually decreasing the size of buffer stocks, causes of irregularities are revealed and it is possible to eliminate / reduce them. The basic idea is that every workflow must flow smoothly like a river. If obstacles are disturbing its course, remove the obstacles, do not add water. Mura can be avoided through the Just-In-Time Kanban systems and other pull-based strategies that limits overproduction and excess inventory. The key concept of a Just-In-Time system is delivering and producing the right part, at the right amount, and at the right time.

Muri

Muri means overburden, beyond one's power, excessiveness, impossible or unreasonableness. In other words, Muri means unreasonableness, like the use of oversized or excessive means relative to the need or the desired result. Muri is also about the physical overload, the hardship, exposure to mental stress, which lead to wasting energy, health and ultimately human capital. This waste can be obvious, like hauling a small light box with a big truck or conversely overloading a smaller truck with large/heavy load. Muri can result from Mura and in some cases be caused by excessive removal of Muda [waste] from the process. Other muri may be more subtle like immobilizing large capacity pallet boxes for storing some small lightweight components when the need for storage could be solved with cheaper and easier to handle smaller boxes. Special attention should be paid when working postures include arm extension or leaning forward with the bust, back bent, leaning the head, torso rotations, squat, etc. Repeatedly pushing or pulling strongly, lifting heavy weights, using the fist as a hammer, and so on. Muri also exists when machines or operators are utilized for more than 100% capability to complete a task or in an unsustainable way.

Muri over a period of time can result in employee absenteeism, illness, and breakdowns of machines. Standardize work can help avoid Muri by designing the work processes to evenly distribute the workload and not overburden any particular employee or equipment.

Case - Raw Material Shipment

The wastes - Muda, Mura, and Muri - are interrelated. Eliminating one of them will affect the other two. For example, a firm that needs to transport 6 tons of materials to a customer has several options1.

Option 1

The first option is to load one truck with all 6 tons and make a single trip. However, in this example, it would be considered Muri due to the overburden of the truck. This excess load can lead to a breakdown.

Option 2

The second option is to divide the transportation into two trips. One with two tons and the other with four tons. This would be considered Mura since the unevenness of the arrival of materials to the customer can lead to problems at the receiving dock. In the first trip, the delivery may be too little for the production necessary on-site. In the second trip, the amount of delivered material may be too much for on-site storage and material handling. This leads to Muri since one of the trucks is overburden and the receiver is also overburden for that delivery. Additionally, Muda can be seen from the uneven workload. This can cause employees who receive the materials to wait around.

Option 3

The third option is to load two tons on each truck and make three trips. Even though this option has no Mura and Muri, it has Muda since the truck would not be fully loaded on each trip. Each truck can carry up to 3 tons of material and this option makes one unnecessary trip.

Option 4

The fourth option is to deliver the materials with two trucks each with 3 tons. In this

example, this would be the optimal level that minimizes Muda, Mura, and Muri. Muda does not exist because the trucks are carrying the loads at their maximum capacity. There is no excess capacity nor unnecessary trips with this strategy. Mura does not exist because the workload between the two deliveries is uniform. As a result, there is no unevenness. And finally, Muri is absent from this option because both the truck and the operators are not working beyond their capacity.

5S System

The purpose of Lean manufacturing is to find and eliminate muda, mura, and muri, in order to improve quality, safety, and efficiency. One Lean tool that can help you eliminate these forms of waste is the 5S system. 5S helps to declutter, clean, and organize the workplace using the 5S principles:

1. Sort
2. Set in order
3. Shine
4. Standardize, and
5. Sustain

Sort

Sort is the first step in 5S. During this phase, you remove tools, supplies, and equipment that are not part of the work process. This declutters the workplace, freeing up space that was previously ill-used.

Set in order

Set in order is the next step, requiring you to organize the workplace and everything in it to improve the flow of work, based on how work is actually done.

Shine

Shine, the third step, requires you to clean the workplace and restore everything to its original condition. This makes it easier to spot equipment and product defects that may have otherwise been hidden.

Standardize

Standardize, the fourth step, requires you to develop rules that will ensure work is completed consistently and that 5S is applied uniformly and regularly.

Sustain

Sustain is the final step of 5S. It requires that you work to ensure that 5S becomes a daily habit.

Summary

In real world applications of Lean, it is not always easy or possible to find an optimal solution. Reducing Muda can lead to Muri. The existence of Mura can be seen as a waste in Muda. And finally, Muri can lead to a breakdown in the system that will result in a large amount of Muda and Mura. Since real world problems are dynamic and the needs of customers are always changing, our work processes must also change as well. As we design our processes and standardize our work, we must look at the resulting system from the lens of these three concepts. Only by considering the impacts of Muda, Mura, and Muri and optimizing our production strategy can we develop an efficient Lean system.