Technical Guide
“Introduction To Manufacturing Waste (Muda)”

Small and Medium Enterprises Development Authority
Ministry of Industries & Production
Government of Pakistan
www.smeda.org.pk

HEAD OFFICE
4th Floor, Building No. 3, Aiwan-e-Iqbal Complex, Egerton Road,Lahore
Tel:(92 42)111 111 456, Fax:(92 42) 36304926-7
helpdesk@smeda.org.pk

REGIONAL OFFICE PUNJAB	REGIONAL OFFICE SINDH	REGIONAL OFFICE KHYBER PAKHTUNKHWA	REGIONAL OFFICE BALOCHISTAN
3rdFloor, Building No. 3, Aiwan-e-Iqbal Complex, Egerton Road Lahore, Tel: (042) 111-111-456 Fax: (042) 36304926-7 helpdesk.punjab@smeda.org.pk	5TH Floor, Bahria Complex II, M.T. Khan Road, Karachi. Tel: (021) 111-111-456 Fax: (021) 5610572 helpdesk-khi@smeda.org.pk	Ground Floor State Life Building The Mall, Peshawar. Tel: (091) 9213046-47 Fax: (091) 286908 helpdesk-pew@smeda.org.pk	Bungalow No. 15-A Chaman Housing Scheme Airport Road, Quetta. Tel: (081) 831623, 831702 Fax: (081) 831922 helpdesk-qta@smeda.org.pk

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2. Introduction to SMEDA

The Small and Medium Enterprises Development Authority (SMEDA) was established in October 1998 with an objective to provide fresh impetus to the economy through development of Small and Medium Enterprises (SMEs).

With a mission "to assist in Employment Generation and Value Addition to the national income, through development of SME sectors, by helping increase the number, scale and competitiveness of SMEs", SMEDA has carried out 'sectoral research' to identify Policy, Access to Finance, Business Development Services, strategic initiatives and institutional collaboration & networking initiatives.

Preparation and dissemination of prefeasibility studies in key areas of investment has been a successful hallmark of SME facilitation by SMEDA.

Concurrent to the prefeasibility studies, a broad spectrum of Business Development Services is also offered to the SMEs by SMEDA. These services include identification of experts and consultants and delivery of need-based capacity building programs of different types in addition to business guidance through help desk services.

2.1 Industry Support Program

In order to enhance competitiveness of SMEs and achieve operational excellence, SMEDA established an Industry Support Cell (ISC) for provision of foreign technical support and knowledge transfer in collaboration with International Development Organizations. SMEDA's Industry Support Program (ISP) initially launched with Japan International Cooperation Agency (JICA) and actively engaged in reducing energy inefficiencies and improving production and quality of products with the support of Japanese Experts. Later on, similar activities with other international partner organizations like German Corporation for International Cooperation (GIZ), Training and Development Centers of the Bavarian Employers' Association (bfz), Germany, and United Nations Industrial Development Organization (UNIDO) were also successfully implemented.

3. What is Manufacturing Waste and Its Type

A waste in activity that does not add any value to the product or service. This is one of the ways in which organisations lose money, as the customer does not need it and will not pay for it.

Eliminating the activities which are redundant and wasteful is one of the most significant first step for building a successful company. This concept is an integral part of Lean thinking and it helps you increase profitability and productivity.

The idea of eliminating waste originates from the Toyota Production System. Taiichi Ohno, who is considered as one of the founding fathers of lean manufacturing, dedicated his career to establish a solid and efficient work processes.

During his journey, Ohno described three major hurdles that can influence an enterprise processes negatively: Muda (wasteful activities), Muri (overburden) and Mura (unevenness).

Based on his observations and deep analysis, he categorized the 7 types of following waste (7 Mudas), which later became a popular practice for cost reduction and optimizing resources:

a. Transport
b. Inventory
c. Motion
d. Waiting
e. Over-Processing
f. Overproduction
g. Defects

a- Transport

Transport is the movement of material or semi finished product from one location to another, this is a waste as it adds no value to the end product.

Since the movement of material adds no value therefore it adds only cost and in some cases very high due to involvement of workforce or operators or usage of fork trucks.

Excessive / unnecessary transportation may be because of:

- Unplanned layout
- Complex material handling system
- Multiple storage areas

- Large batch size

b- Inventory

Inventory waste is inventory that is left untouched waiting to be used. This wastes space as well as the capital used to purchase the inventory without immediate financial returns.

Inventory can be all raw materials on hand, materials in the production process, completed products or products in transport to end customers. Excessive inventory can also mask other types of waste by having 'just in case' inventory on hand to make up for defective products being produced. It can also exacerbate waste such as the overproduction of defective parts, increasing the impact of defects waste or costs of rework.

Anytime materials, parts, assemblies or products are sitting not having value added overhead is being increased.

Inventory waste is often caused by:

- Un-reliable supply chains
- Long setup times
- Production speeds that are not aligned between production areas
- Overcapacity

c- Motion

In lean manufacturing, motion waste means the increased motion of machinery or a person due to an inefficient manufacturing process. Wasted motion increases the amount of wear and tear on both workers and machinery, therefore decreasing its lifespan or ability to work on at a manufacturing site. Not only does wasted motion cost money, it can also lead to unnecessary accidents, injuries and low productivity.

Motion waste can be produced by:

- In-efficient floor layout
- Improper equipment
- Poor allocation of tasks between machinery, people or steps in a process

Observe the following activities to identify the motion waste:

- Walking
- Reaching

- Lifting
- Stretching
- Bending
- Lowering

d- Waiting

In lean manufacturing, waiting waste is inventory that is sitting idle, whether it's between manufacturing stations or end product waiting on shelves or in warehouses waiting to be demanded.

Waiting waste may include:

- parts or assemblies waiting in queues for the next step in the operation
- people waiting for material, equipment or tools to perform their operation
- finished products waiting to be shipped or sitting in stores
- idle equipment

Following are the main causes of this type of waste:

- Unbalanced production process
- Unplanned downtime
- Setup times that are too long
- People left organization unexpectedly

e- Over-Processing

In manufacturing, it is the prime focus to produced the products as per customer's requirements using various equipment and methods. Identification of over-processing waste can be sometimes difficult, but elimination of rework or adhere the customer specifications can reduce this waste.

Causes of of over processing may include:

- Rework to meet the specification
- Communication gap with the customer that creates doubts on the part of manufacturer regarding the requirements
- Poor quality control during processing that leads to rejection and hence more work is to be done to meet the customer's specifications

f- Over-Production

This waste can happen when parts, assemblies or products are manufactured which are not needed but also when items are produced before they need or also when products are produced more than the required quantity.

Recommended steps that are suggested commonly are:

- Use TAKT time to balance the manufacturing process across the production stations
- Implement a pull system or Kanban system

Overproduction may be because of:

- Misunderstand the customer needs
- Weak production planning
- Product design change while existing design are in production

g- Defects

This kind of waste is occurred when a product is found to have flaws after the production occurs. The affected parts may be reproduced or rework is done to make it acceptable which results in additional costs and delays.

Defects are one of the costly form of waste because it can lead to overproduction, additional transportation or over-processing.

While, analysing the process to eliminate the defects you'll find following causes:

- Weak quality control
- Lack of documentation
- Weak inventory control
- Lack of proper production planning
- Lack of proper machine maintenance

4. Tools and Techniques to Overcome Waste

There are various tools and techniques to overcome the waste, few of them which are most commonly implemented in industry are as follows:

a- 5S

5S Management technique is the most powerful and effective tool for continuous productivity and quality improvement. The logic behind the 5S technique is that cleanliness, orderliness and discipline at the workplace are the basic requirements for producing high quality products and services with little or no waste and with high productivity.

5S was introduced by Japan as a basic Quality and Productivity tool. It stands for five systematic steps of the process. In Japanese all these 5 steps begin with the letter "S" and therefore the steps termed as "5S":

5S is the Japanese method of creating a high Quality, a highly productive and a safe Working environment. 5S is a systematic 5 steps method of organizing a work place/home or school.

i. **SEIRI** - Classify all items around you, separate what is wanted from what is not wanted. Reduce clutter.
ii. **SEITON**- Organize everything in proper place for easy location. Allot a permanent place for everything and keep everything in its place.
iii. **SEISO** - Maintain high standards of cleanliness, dust and dirt free.
iv. **SEIKETSU** - Standardize all procedures.
v. **SHITSUKE** - Train and maintain discipline.

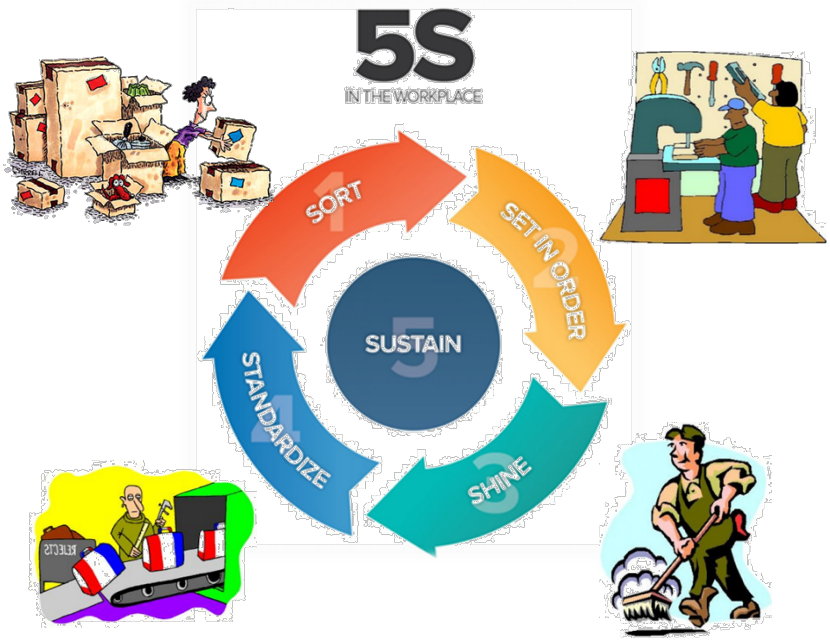

Figure 1: 5S

b- Just in Time

The Just in Time (JIT) style of inventory management – also sometimes referred to as the Toyota Production System (TPS) – is a strategy of managing inventory and/or production that links the ordering of raw materials to production scheduling.

The JIT method ultimately helps companies cut down on waste from making too many products (or supplying too many goods). Therefore, they don't use up raw materials that may or may not *actually* be necessary to fulfil the orders they have. In turn, it cuts down on the costs they have for inventory, freeing up cash flow.

In manufacturing industry, the just-in-time inventory system works well and this produces large volumes of undifferentiated products, by increasing production of the right part in the right place at the right time. To be successful in just-in-time inventory system there are few prerequisites. Some of the prerequisite are mentioned below:

- Stable Production Schedule
- Quick Setup Time
- Trained Workers
- Shorter Lead Times

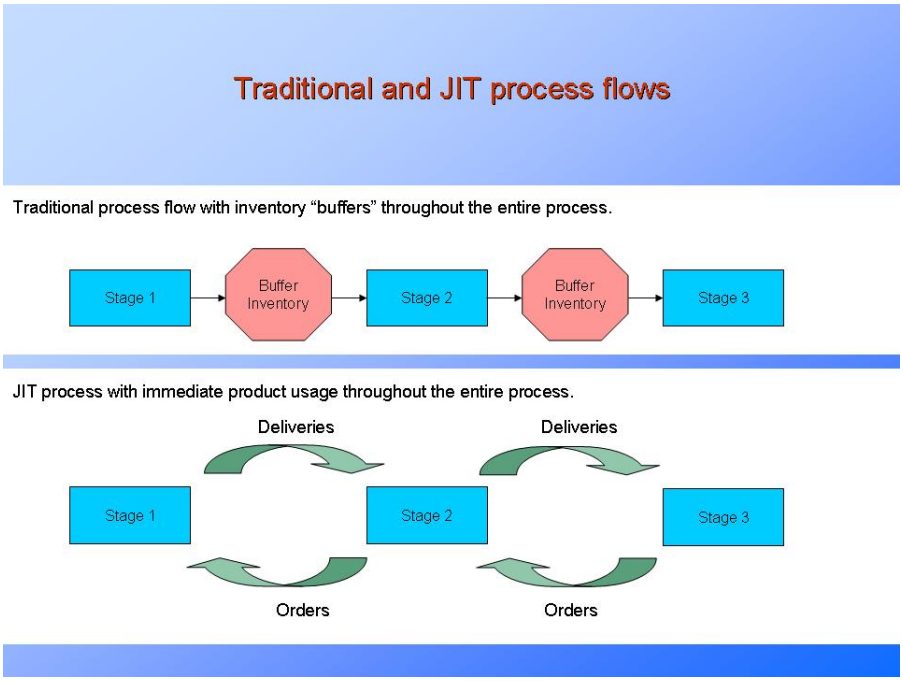

Figure 2: Just in Time

c- Single Minute Exchange of Dies (SMED)

SMED means Single-Minute Exchange of Dies, it is a system for intensely decreasing the time it takes to complete equipment changeovers. The essence of the SMED scheme is to convert as many changeover steps as possible to "external" (performed while the equipment is running), and to shorten and streamline the remaining steps. The name Single-Minute Exchange of Dies comes from the goal of reducing changeover times to the "single" digits (i.e. less than **10 minutes**).

For further details on SMED, please follow the following link:
https://smeda.org/index.php?option=com_phocadownload&view=category&download=1652:technical-guide-on-single-minute-exchange-of-dies&id=198:productivity-improvement&Itemid=977

d- Line Balancing

Line balancing is a production strategy that involves balancing operator and machine time to match the production rate to the Takt time.

For a given production line, if production time is exactly equal to Takt time, then the line is perfectly balanced. Otherwise, resources should be reallocated or rearranged to remove bottlenecks or excess capacity. In other words, the quantities of workers and machines assigned to each task in the line should be rebalanced to meet the optimal production rate.

Takt time is the rate at which parts or products must be produced in order to meet customer demand.

$$Takt\ time = \frac{Production\ Time\ Available}{Required\ Units\ of\ Production}$$

For example, if a manufacturer has a takt time of five minutes, then it needs to complete a product every five minutes in order to meet customer demand.

Let's go deeper with another example. Manufacturer G operates 1,000 minutes per day. Its customer demand is 500 widgets per day. To calculate takt time, we divide production time by customer demand:

1,000/500 = 2 minutes

In order for Manufacturer G to meet demand, it needs to produce a widget every two minutes.

Following are the benefits of line balancing:

- Reduce waiting waste
- Reduce inventory waste
- Absorb internal and external irregularities
- Reduce production costs and increase profits

e- Layout

Factory layout is the arrangement of the machines and equipment within a factory including the departmental layout, layout of machines within a department and layout of individual's work place.

Generally, two types of factory layouts are used in industry depending upon the requirements of the firm:

a- Process Focused Layout
b- Product Focused Layout

a- Process Focused Layout

In this type of layout arrangement, all production operations of similar nature are grouped together in the same department or part of the factory.

This layout is suitable where small quantities of a large range of products are to be manufactured.

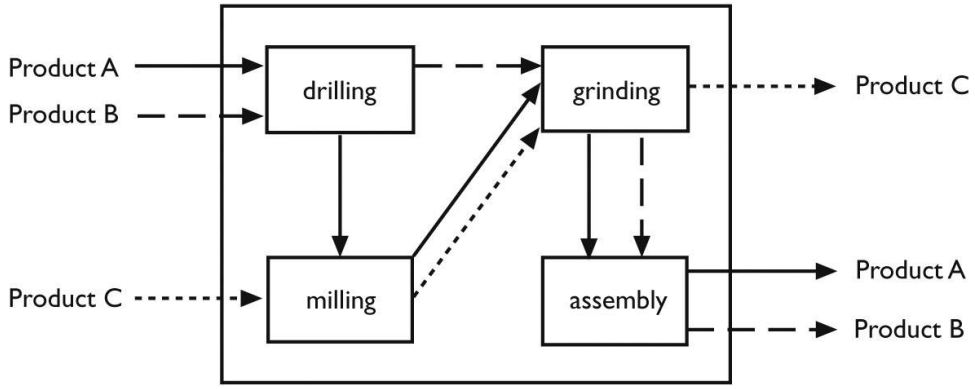

Figure 3: Example-Process Focused Layout

b- Product Focused Layout

In this type of layout, equipment is arranged according to the needs of the product and in the same sequence as the operations.

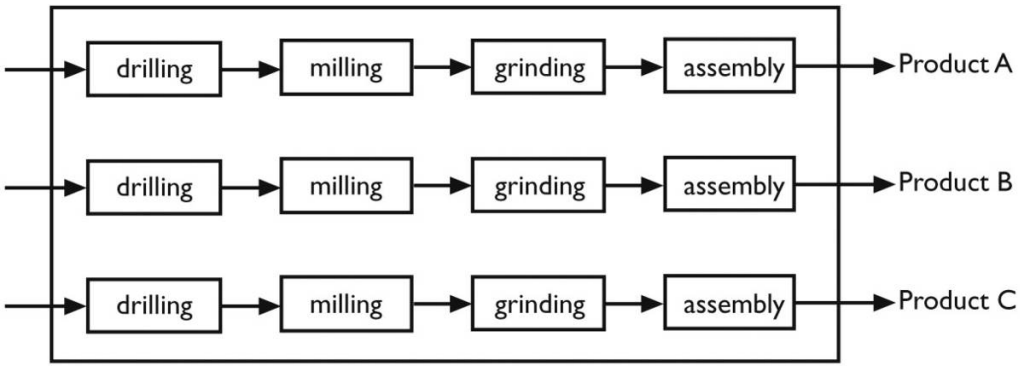

Figure 4: Example-Product Focused Layout

This layout is suitable for small range of products in very high large quantities.