THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Applying of Lean Management to Increase Organization Efficiency: "ABC" Plant Case Study

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Abstract:
The lean management tools problem-solving methodology is one of several techniques used to eliminate organization waste. This paper demonstrates the empirical application of lean tools methodology to reduce production waste though investigation of root causes of non-added values activities and provide a solution to reduce/eliminate these activities. Also, it will give a basic idea about the historical developments that led to Lean Methodology including evolution of Lean, a basic idea about Lean and its concept, what it is about and its methodology. It will also brief about Lean Manufacturing's integration and how it has helped in process improvement, how Lean enhanced and the initiators of Lean (successful case studies). The researcher explains the effective use of resources, usually expressed as the ratio of output to input, focusing on frequency of dismissal of spare parts. In addition, the organization structure, Engineering team, Detailed processes of dismissal of spare parts that are used during downtime hours, MTTR, MTBF, spare parts location management, True efficiency, Net efficiency the organization development was, also explained. Zero downtime and zero losses from decreasing downtime duration in operation by eliminating non added values in the processes using lean management to increase organization production efficiency using specific lean tools. In the world of competition, Lean Manufacturing is considered as a fast-growing and efficient approach. Lean Manufacturing is applied to remove manufacturing wastes continuously to increase the productivity and efficiency. The aim of the lean manufacturing is not only high quality but also low cost for the satisfaction of customers' demands. The benefit of this technique is not only the removal of wastes but also identification of the reasons causing them through specific guidelines and principles. Customers' requirements: Internal customer needs delivery of spare parts on time and seeks for implementation of maintenance management system documents and facilitates spare parts dismissal documents. In this research, I have decided to choose the multi-method to combine quantitative and qualitative data collection and analysis in one study. Individually, these approaches can answer different questions, so combining them can provide you with more in-depth findings and qualitative data can show how and why you got these results. Exploratory research design is chosen to gain background information and to define the terms of the research problem. This is used to clarify research problems, hypotheses and to establish research priorities.

Keywords: *Lean management, lean tools, eliminate non-added values activities, reduce duration of dismissal spare parts*

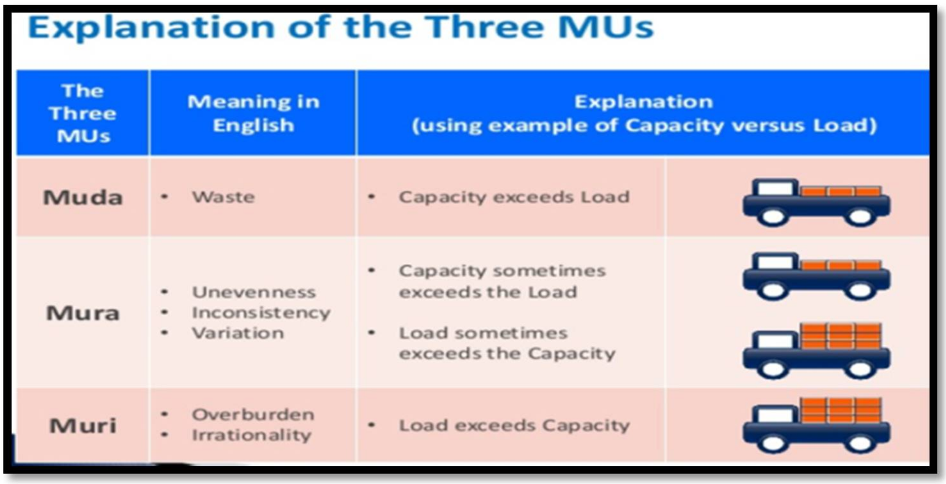
1. Introduction

ABC Corporation will produce superior financial returns for its shareowners by providing high value-added logistics, transportation, and related information services through focused operating companies. Customer requirements will be met in the highest quality manner appropriate to each market segment served. ABC Corporation will strive to develop mutually rewarding relationships with its employees, partners, and suppliers. Safety will be the first consideration in all operations. Corporate activities will be conducted to the highest ethical and professional standards. That is why, the economic units, especially the productive ones, responded by adopting Lean manufacturing by changing their business strategies for the better, which is a multi-dimensional approach that includes a wide variety of principles, management practices and contemporary manufacturing methods. This chapter gives an overview about the research framework including the study problem. The paper evocates the principles and tools of one of the most effective lean management tools and improvement methodologies, the trial of making value flow at the pull of customer implement lean manufacturing which leads to prevention and elimination of wastes in the manufacturing processes. Waste can be classified as one of the seven wastes which are inventory, waiting, motion, transport, defects, over production, and over processing. However, these wastes do not benefit operations leading to adding no value to the provided service or product, they affect the cost. According to a lot of studies, 95% of operations are waste and the added value is only 5%. Lean manufacturing helps in removing the waste to save the unrequired effort and time. Lean benefits are more profits, more output per man hour keeping higher efficiency, improvement of supplier relations, improvement of employee involvement and morale, improvement of delivery performance, improvement of customer satisfaction, greater levels of stock turnover, rapid development, lower levels of inventory, less process and machine breakdowns, decreased the space required, quality performance, less rework, and defects. Individuals of any organization can make gains by applying the principles of lean which are usually very easy just to hit short term goals. This usually sabotages lean initiatives resulting in losing its value as an effective tool. This happens because they do not work on a lean culture for the business. People usually resist any changes if there are no policies that force them to redeploy them because of their fear to lose their jobs because of improvement of efficiency.

2. Literature Review

Toyota, which is an automotive manufacturer, developed Toyota Production System (TPS). It is an integrated socio-technical system, and its function is organization of logistics and manufacturing, which includes the interaction with customers and suppliers to lower waste and cost. The word “Lean” is usually used to refer to TPS [15]. According to Ohno and Bodek (2019), the purpose is to work smart and get rid of waste so that only minimal inventory is required. This results in decreasing physical space needs, increasing cash flow, and facilitating the delivery of the needed results easily via internal processes single piece flow to the end customer. Lean Manufacturing is also called “JIT Manufacturing” or “just-in-time production”. This system is the main reason for being made Toyota’s name is known worldwide today. Toyota has been considered as a pioneer in the production and automotive manufacturing industry. The system was growing in the beginning of 1948, with critical effects from Eiji Toyoda, Taiichi Ohno, and Shigeo Shingo. Eiji Toyoda, who was a member and an engineer of Toyota founding family, visited in 1950 the River Rouge Ford Plant and flashed the invention of the Toyota Production System. He once said to his colleagues, “there are some possibilities to improve the production system.” The aim is to recognize and minimize three main obstructions or nonconformities from optimal distribution of resources within the system [15]:

- Waste (Muda)
- Inconsistency (Mura)
- Overburden (Muri)


Explanation of the Three MUs

The Three MUs	Meaning in English	Explanation (using example of Capacity versus Load)
Muda	• Waste	• Capacity exceeds Load
Mura	• Unevenness • Inconsistency • Variation	• Capacity sometimes exceeds the Load • Load sometimes exceeds the Capacity
Muri	• Overburden • Irrationality	• Load exceeds Capacity

Figure 1: The Toyota 3M Model: Muda, Mura, Muri [15]
TPS Is Based on Four Main Representational Pillars

2.1. Cellular Manufacturing

Conventional manufacturing system designed the shop floor layout depending on the activities. It depends on the items of the product in distinct fixed areas in lean manufacturing. Then, the layout produces a single peace floor and minimizes the order floor time, work in advance, material handling costs and so on [4].

2.2. Supply Chain Integration

The “lean” system can be efficacious when it is implemented across the producing chain, i.e., from the suppliers to the end user. This chain is affected by every link along, and any member who does not deliver. This process is long and includes many interfaces. Thus, manufacturers must organize the supplier base [13].

2.3. Just-in-time

“Making only what is demanded, only when it is demanded, and only in the amount that is demanded” [13].

Requiring the raw material for the end customer at the precise time and not earlier can lead to an enormous reduction in the inventory cost. The main target of JIT is attained by applying the techniques like:

- Total Productive Maintenance (TPM).
- Standardization.
- Kanban.
- Kaizen:

It indicates for a continuous improvement. As we use the terminology, it is a technique that attempts toward perfection by reducing waste. This comes by empowering people with tools and a procedure for exposing to improve opportunities and inventing change. Kaizen means waste to be any activity that is non-value-adding that the customer is willing to pay for it. We seek for value-adding, that means any work done correct the first time that essentially changes a product or service from the prospective that customer is reasonable willing to pay. People creating wasteful processes are themselves wasted. They are deprived of the satisfaction of involving in significant tasks that produce outputs customers' value. Furthermore, they are huminite as humans because involving in activities that are not added values gives their energies and serious efforts as merchandises of little value [13].

2.4. Lean Management, Definition & Benefits

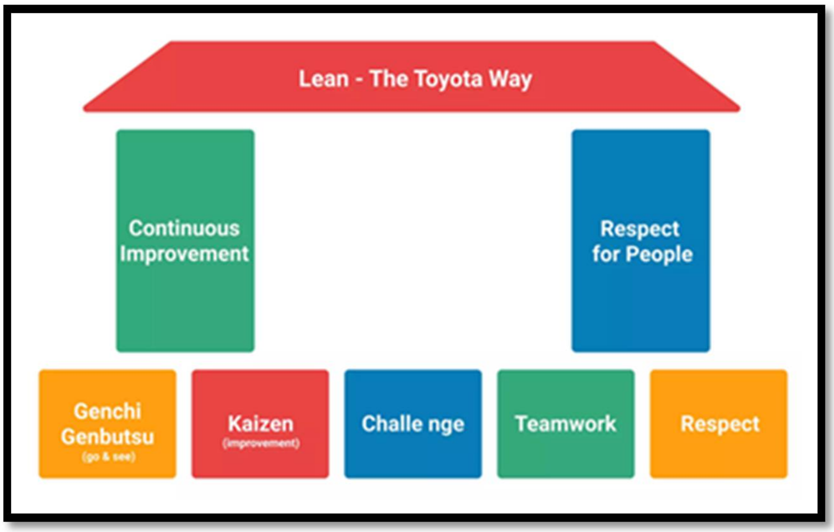


Figure 2: Lean Concepts [4]

Continuous improvement, respect: We respect others, responsibility was taken effort was made to understand each other, and trust each other, Genchi Genbutsu: (Gemba) means to go to the source for finding the facts to take correct decisions, kaizen: We always seek for innovation at our business operations, challenge: A long-term vision was created, facing challenges with bravery and creativity to get our goals and teamwork: We arouse personal and professional growth; opportunities were shared for developing and enhance individual and team performance. Lean manufacturing, which is a rapid growing process, aims to increase the industry productivity. The lean manufacturing tools are used in a lot of sectors not only in industry as represented in Figure (03). It can also be employed from a family to Space Company [4].

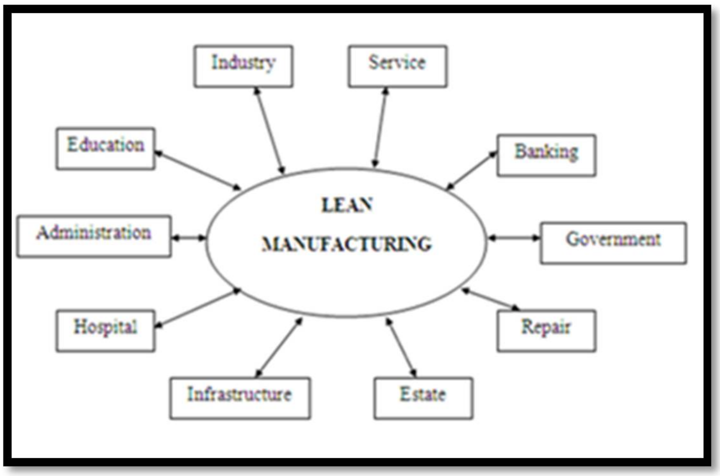


Figure 3: The Main Areas to Implement Lean Manufacturing

The commercial aim of Lean Manufacturing is to decrease waste in the produced goods. The basic plan depends on the fabrication and product development to decrease the cost significantly through a succession of business reviews. The essential insight is that after the designing of a product, most expenses are assigned. An engineer will usually come up with safe, familiar processes and sound materials not competent and cheap ones. This may lead to decreasing the project threat, decreasing income, and increasing economic risks. Good organizations keep expanding and evaluating the checklists to examine the designs of the produced goods. Customer, marketing and advertising representatives examine requirement in order to get rid of expensive supplies at the organization engineering rank. Common automatic components, versatile power supplies, or fasteners which are joint modules may be developed [4]. Lean thinking values are coming out to improve the enterprises' productivity, flexibility, and dependability worldwide. Lean thinking is also applied to reduce inventories, group sizes, and set up times. Lean mainly focuses on avoiding misuse in any project. This includes waste and cost. As project has reduced costs and improved class, the primary competitive gauge is the capability to react to the customer. This presents the concepts of lean manufacturing and introduces tools and methods which make these principles act in a developed environment [4].

3. Dismissal of Spare Parts

Spare parts management is to take the proper decision if these items are to be stocked as spare parts or not, when to replenish the order and how many items to replenish. This question is important to answer; we must analyze the status before taking this decision. We face two constrains- one is availability of spare parts and the other is minimizing the storing cost. Cost here comes from carrying cost, machines downtime due to parts out of stock and ordering cost, while for expensive parts, the ordering costs may be neglected [8]. Classification of spare parts allows for inventory control and determines the most of important spare parts. Then stakeholders implement different inventory strategies for this classification of spare parts and set priority for the essential items to keep in stock. Multiple criteria ABC classification: Traditionally, firms have classified spare parts into A, B, and C groups, called ABC classification, based on one single criterion, based on annual cost usage of the spare part, Spare parts cost measured multiplied by demand volume. However, spare parts management cannot depend on single criterion. There are many other criteria not considered in ABC classification. Multiple criteria were proposed by Flores & Whybark (1986, 1987) [8]. The most important spares are described by high demand and low inventories. Changes are not required regarding management policy and business strategy. Obsolescence/deterioration issues take place when spares with low operation and low inventories are identified. Business should be carefully handling this type of item. Highest inventories level and highest demand should be considered as top priority. Proper safety stock should keep with accurate reorder point and enough quantity. If it does not require safety stock so, we can apply just in time methodology in this case [3].

3.1. Main Objectives

Inventory levels: Optimize inventory levels at all stages of production, particularly works-In Progress between production steps. Lower working capital requirements come from lower inventories also mean. Labor productivity: By reducing the idle time of workers, it will improve labor productivity and ensure during work, they are using their energy as productive as possible (including not doing unnecessary tasks or unnecessary motions). Utilization of spare parts and space: Spare parts and warehouse space should be used efficiently by reducing bottlenecks and increasing the rate of production though existing spare parts for reducing machine downtime.

3.1.1. Efficiency=Output Rate ÷ Standard Output Rate×100

Production efficiency calculated by dividing output rate to the maximum designed rate is a rate of maximum performance or the maximum volume of work produced per unit of time. This is a key performance index to show us the utilization of a production line daily.

3.1.2. Productivity vs. Efficiency

Productivity functions to be calculated as input per output, per amount of time. Efficiency in production most often indicates to the performance and utilization production line rather than just the number of units produced. Entities aim to optimize production levels to achieve efficient production which helps to lower per-unit costs and increase per-unit returns.

3.1.3. Production Efficiency

Production efficiency could be applied to manufacturing and be applied within the service industry. Human capital and time can be used to present a service. Here, efficiency can be calculated by the ability to complete a task in the shortest amount of time with an optimized level of quality output.

- Net efficiency%: (actual production bottles)/ (Theoretical net production bottles -planned hours) *100
- It has been calculated and downtime time has been measured to identify the internal customer CTQs.
- True efficiency%:(actual production bottles)/ (Theoretical net production bottles -Dark hours) *100

3.1.4. MTBF and MTTR

MTBF, or Mean Time between Failures, is a metric that shows the average time taken between a failure and the next time it occurs. These gaps of time can be calculated by using a formula. On the other hand, the MTTR, or Mean Time to Repair, is the time taken to repair the failure after occurrence. It is the time spent for the technician in each process.

3.2. Dismissal of Spare Parts Process Flow Chart

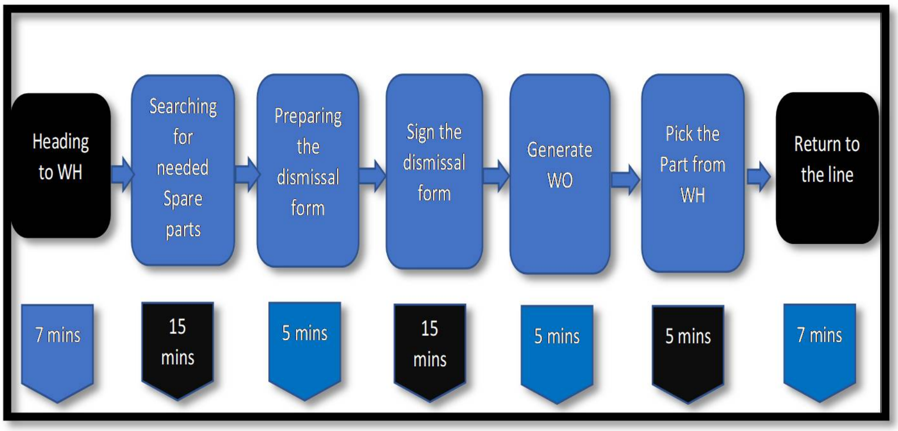


Figure 4: Process Flow Chart

- Total Process time=59 mins.
- Value added=24 mins.
- Non-value added=35 mins.

Total Containers lost calculated as follow:

- Filler rated speed*(Non-value added*frequency of dismissing spare parts)/Containers.

3.3. Time and Motion Analysis for Dismissal Process of Spare Parts

Activities	VA mins	NVA in mins
1-Motion from Line 7 to WH	7	0
2-Searching for identical part in the WH without any data Part no or SAP code or location	0	15
3-Preparing the dismissal form	5	0
4-Motion to Engineers office to sign the form	0	15
5-Motion to data entry office to create WO	5	0
6-Motion to WH to pick up the spare	0	5
7-Motion from WH to Line 7	7	0
Total of breakdown maintenance activities Hours	Total VA Hours	Total NVA Hours
202	161.17	40.83
Total Cases Lost	245,000 Cases	

Figure 5: Time and Motion Analysis

4. Lean Implementation

4.1. Introduction

The researcher will assess the company's goals and waste that contribute to achieving the company's goals. The maintenance team tried to reduce the delivery time of the spare parts to be within the allowed time. Then improving the company's income, the maintenance team implemented the four stages of lean steps: lean culture, planning, concept, and tools. The researcher also explains the application of Lean methodology in dismissal of spare parts. Lean approach is used primarily to reduce waste; it often reduces over-processing as well. In fact, one of the eight types of waste in Lean is over processing and waiting.

4.2. Customers Critical to Quality

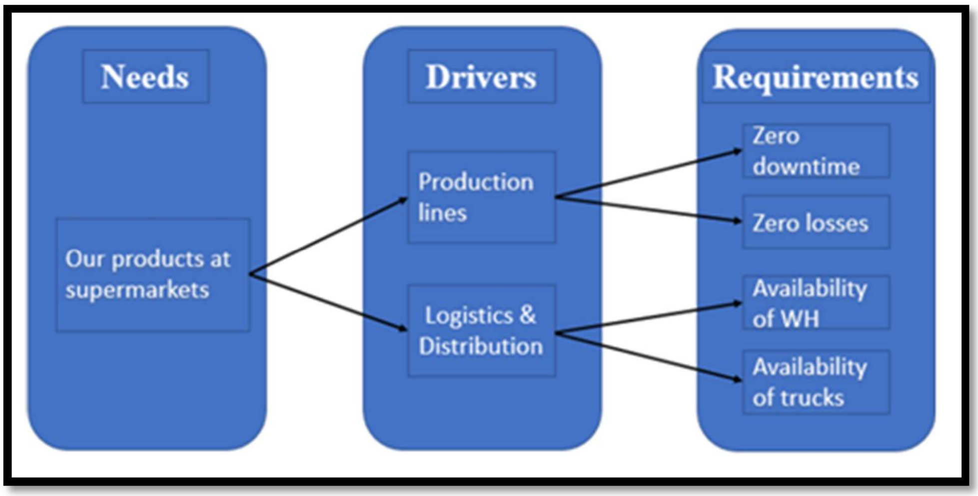


Figure 6: Process CTQ Flow Chart

What is critical to quality from the customer's point of view is what business process is important for enhancing. Going forward to Project ideas must also be directed to what is important to the customer satisfaction.

4.3. Project Prioritization

Critical point from the prospective of management team considers the project important for the business success as follows:

- Process correctly.
- Process cost.
- Process time

4.4. Statement of the Problem

1. What is the problem?
   - Delaying the delivery of the spare parts to be installed in the production line which leads to increase the downtime hours.
1. Where does the problem occur?
   - In Line 7 as shown below in figure 07.
2. When did the problem arise?
   - When the line is down waiting spare parts to be installed.
3. How long do the spare parts take to be installed?
   - The duration of the work is 59 mins.
4. How wide is the problem?
   - This delay results in increasing the waste cases to 245,000 Cases.

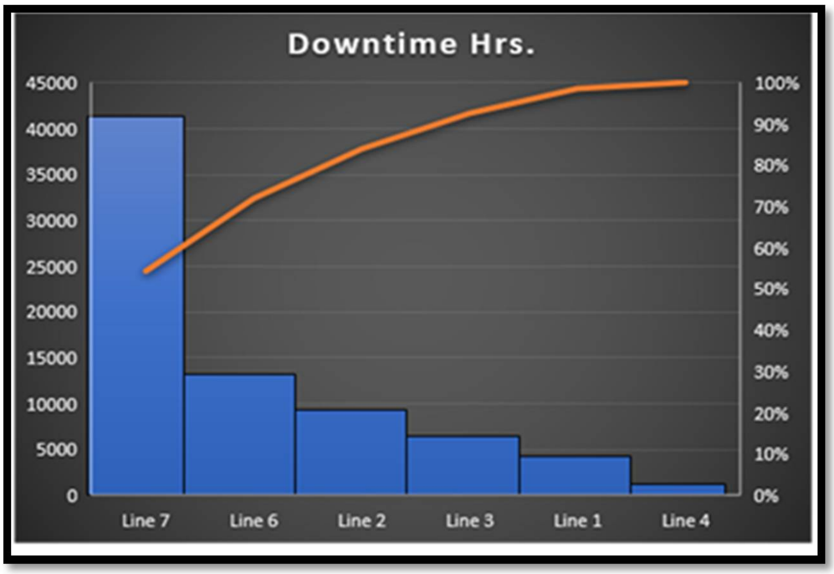


Figure 7: Pareto Chart for Production Lines

Sum of TE %	Sum of Th TE (hrs.)	Sum of NP (hrs.)
77%	18498.61667	14129.16117
Sum of DT	Sum of Overhaul2	Sum of PM
1,205.13	122.1666667	726.5
Sum of Line_Setup	Sum of Line_shutdown	Sum of Shifting
541.5833333	21.33333333	293.1666667
Sum of Cleaning	Sum of Rinse	Sum of CIP_5s_CAT3_
652.5833333	56.58333333	360.9166667
Sum of CIP_5s_Weekly_	Sum of CIP_3s_Weekly_	Sum of CIP_3s_CAT3_
21.75	8	86.25
Sum of Pack_CO	Sum of Quality_test	Sum of Intervention
65.25	2	35.75
Sum of Syrup_Preparatio	Sum of No_Crew	Sum of Poor Planning Index
108.25	7.333333333	55%

Figure 8: Activities on Production Line 7

The statistics show in Figure 09 a high level of delay in installing spare parts, which leads to:

- High downtime for machines.
- High loss of Production volumes.
- Complexity of warehouse management.
- Unutilized manpower during machines' failure.
- Poor management for maintenance activities during crises.

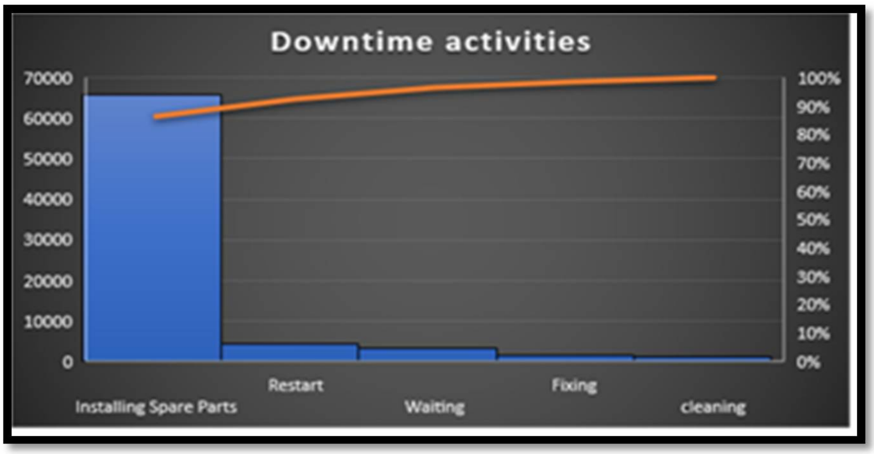


Figure 9: Pareto Chart for Production Lines

4.5. Waste in Warehouse

Warehouses also can apply lean management approach. Waste should be eliminated by applying lean such as unnecessary transportation, excessive inventories, employee motion, material waste, etc. In the warehouse, the aim for applying lean concepts to operate in efficient way to help in reduction of inventory and return on cash flow also operate in smooth way.

There are some instructions that should be followed to eliminate waste in warehouse:

- Eliminate unnecessary inventory movement.
- Reduce excess inventory.
- Eliminate manual processes.
- Reduce paper waste.

<u>4.5.1. The Most Common Types of Warehouse Waste</u>

4.5.1.1. Over-processing Waste

Over-processing is doing more than required work, such as approvals from management team that the customer will never see. Unlike inventory waste or over-production, over-processing waste is a waste harder to assess. It's sometimes difficult to gauge when a necessary task, such as over-stringent company policies, such as quality checks, painting of products, double handling in receiving and picking up items from warehouse becomes over-processing; it results in high labor costs and wear of equipment. Poor inventory management comes from over-processing waste. It also reduces organization ability to add value in areas customers care about.

4.5.1.2. Transport Waste

Moving unnecessary products leads to contribution in transportation waste. It may expose you to unutilized warehouse or space and excess inventory. It reflects on energy key performance resulting from using forklifts and other vehicles to transport products. Considering the many ways transport waste impacts your operating costs, for that it is considered in Lean principals.

4.5.2. The Reasons of Transport Waste

The most reasons of transport waste are:

- Poor warehouse layout: Spare parts warehouse is far away from the production line, resulting in unnecessarily long trips to and from.
- Double handling: new arriving stock in storage area with pallet racking (one trip) before moving that material to the pick face (a second trip). This results in double handling. Spare parts with high demand, and therefore with higher pick face replenishment rates, exacerbate the problem.
- Spare parts for accessibility: Workers move spare parts from their location to access other stock due to poorly organized sections.
- Large spare parts in sizes: Properly storing a large spare part will need multiple trips, which is clearly a wasteful movement if the large spare parts in size contribute to other types of warehouse waste such as inventory, over-production, and motion waste.
- Multiplication in storage areas leads to poor communication management and more time to arrive for the required part.

There are some modules to assess transport waste. Management and staff should rethink in warehouses location design so that a machine needed for Step 2 is located near the machine for Step 1. In addition, pallet flow racks, so it will reflect on saving efforts and cost.

Limiting the amount sitting in buffer storage by pallet flow racks which accept more stock to sit in the pick-face, results in reduce in double handling. Finally, a reorganization of storage can address the presence of multiple storage locations and inventory scuffling.

4.5.2.1. Motion Waste

Workers do their best to maintain a warehouse operational. Sometimes, they work harder than they should have, and this is called motion waste when someone moves, runs or works more than necessary. Technically, motion waste is different from transport waste. Transport waste means the waste of products movement, while motion waste means the waste of people movement.

The Common Causes of Motion Waste:

Undoubtedly, limited space, poor organization of tools and products, and poor layout lead to motion waste. Also, Poor work methods and processes could be the reason of motion waste if a certain work needs extensive manipulation of a tool or product.

4.5.2.2. Waiting Waste

Time is considered as a valuable resource and a lot of warehouses easily do not make good use of it. Examples of waiting waste are:

- Waiting of People during processing of machines to produce certain products.
- Waiting of Products to move to the following step in the assembly line.
- Waiting of Products for shipping to stores, and then to customers.
- Unutilized Equipment sitting due to bottlenecks.

All the previous examples can affect the capability of making use of technology, processes, and people efficiently. On the bright side, the most common causes of this kind of waste have been investigated by experts who have lately found out solutions to solve this issue.

The Common Causes of Waiting Waste:

- Poor internal communications
- Poorly developed processes
- Production bottlenecks
- Labor shortages
- Long set up times
- Unscheduled employee absences
- Unscheduled downtime

It is not necessary for a warehouse to suffer from all of these problems, but it must suffer from one or two of them. Solving and elimination of the problem starts after identification of the cause.

4.5.2.3. Inventory Waste

Accumulation of raw materials, work in progress material, or final products leads to inventory waste. Excessive inventory causes loss of money leading to tie up cash, and negatively affects the cash flow of a warehouse. In case of business suffering from poor cash and utilizing financing options to handle carrying costs, the accompanying interest payments result in further strain. Examples of carrying costs are:

- Interest payments
- Insurance premiums
- Rent/storage costs
- Spoilage

Application of just in time (JIT) manufacturing promoted by lean principles is to minimize excessive inventory. It means that companies produce the needed products when they are needed to limit the time at which materials go through production or final products sit on shelves.

4.5.3. The Common Causes of Inventory Management Waste

The main cause of inventory waste is over-production. Over-production occurs when business owners stubbornly hold to forecasting methods without a logical rationale, lose faith in the suppliers, and fail to introduce efficiencies to stop or minimize bulk production. Finally, this leads to inventory waste as well as transport and motion waste.

4.5.3.1. Defects Waste

Producing faulty products or making any mistake while processing leading to shipping back or remaking products is considered to be defects waste. Sometimes, the warehouse may be incapable of managing the flow of the returned inventory in case of a full recall. Even if the warehouse can manage it, it's a strain on resources.

In other words, defects waste includes any mistakes during warehouse processes. Examples of defects waste are:

- Missing or incorrect deliveries
- Incorrect data entry for orders
- Returned inventory with inappropriate paperwork

The Common Causes of Defects Waste: Bad suppliers, poor training, operating errors, unclear warehouse processes and procedures result in Defect's waste.

5. Lean Tools for Improvement and Conclusion

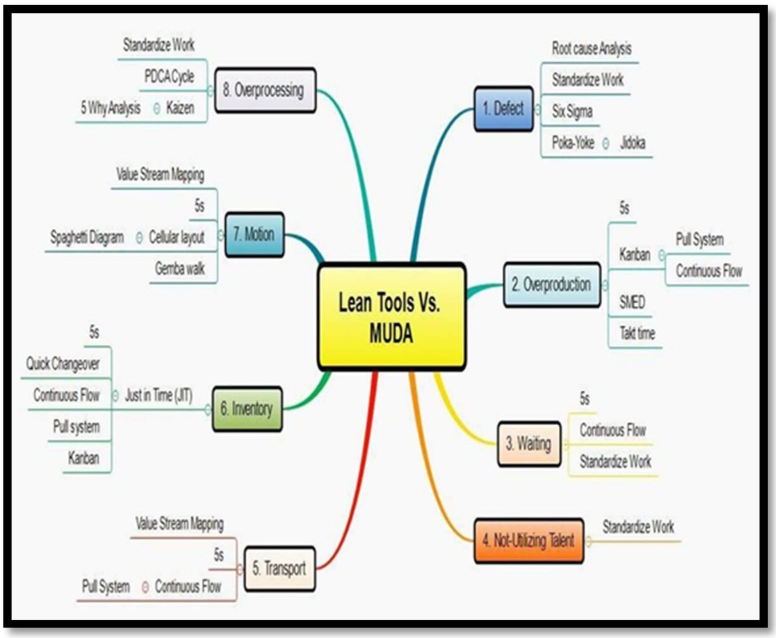


Figure 10: Lean Tools vs Muda

5.1. Existing Approaches to Lean Implementation

To achieve process excellence, the organization should choose the most suitable tool from the lean arsenal. Most of organizations focus on the benefit of lean tools and forget to focus on the sustainability of the used tools. Organizations should take into consideration not only the benefits of the introduced technique but also its detriments. Questions to be asked:

- How could the implemented lean technique benefit the organization and how could it be achieved?
- How the change intervention sustainability could be affected by the application of lean technique?

5.2. The Benefits of 5Ss in Organization

5Ss are to eliminate Muda such as:

- Transportation
- Waiting
- Inventory

And improve quality control by reducing defects and variation in any process.

5.2.1. How 5Ss Spell Success in the Warehouse

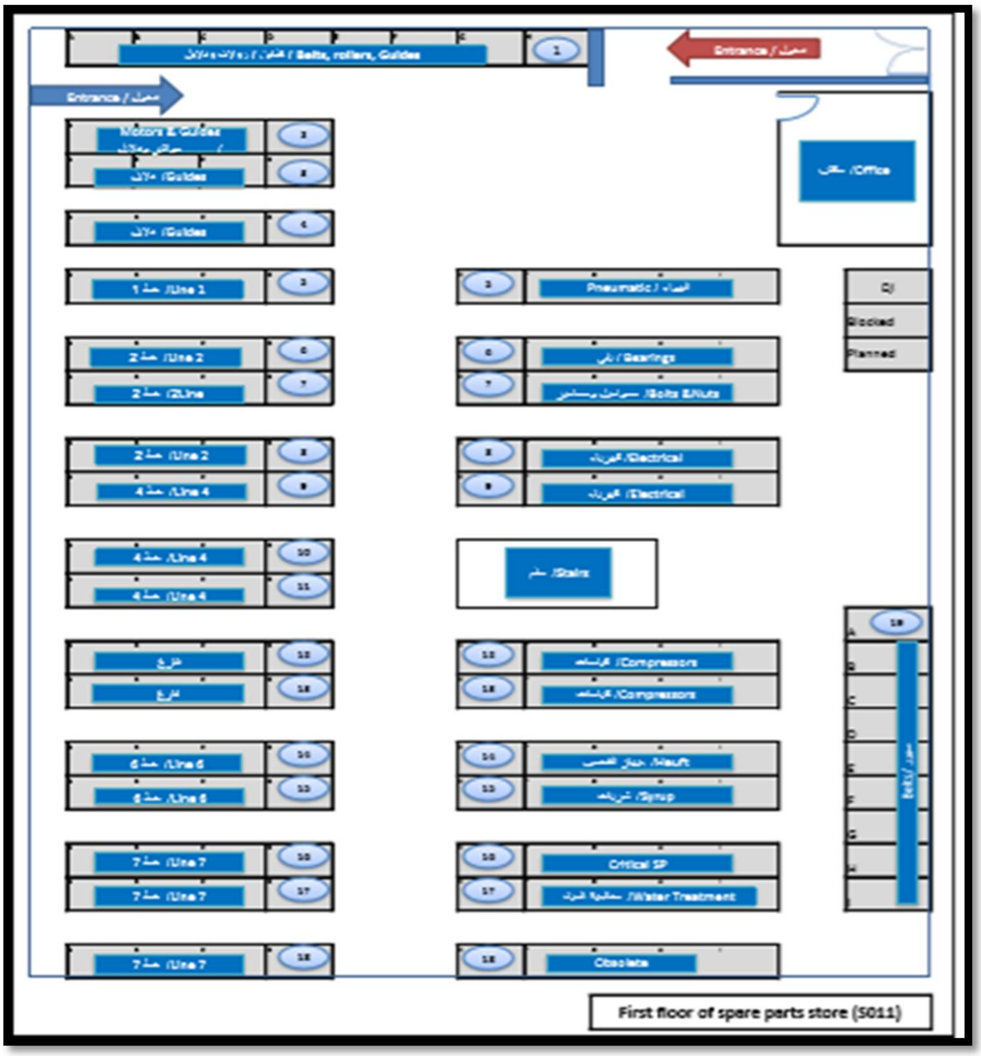


Figure 11: Spare Parts Warehouse Map

5.3. Improvement Which a Value Stream Map Typically Provides

Value Stream Mapping is a tool to visualize organization processes that help in determining the lead time in each process which highlights the bottlenecks that you face during your operation. It is considered to be an effective tool to eliminate Motion and Transport waste by:

- Highlighting the interaction between each item within the process.
- Ordering item from the forefront such as material management, scheduling, and department workflow.
- Displaying material workflow in each process and visualizing it.

5.3.1. Dismissal of Spare Parts Process Flow Chart after Removing Non-Added Value

Figure 12: Process Flow Chart after Improvement

5.4. Visual Management Implementation

Visual Controls determine problem and have the potential to help facilitate the communication of these problems, eliminate waste, shorten waiting times, optimize over-processing and transportation costs, reduce inventory, create a safe working environment, and even increase your profits.

The easiest way of visual controls is to use coloring codes to communicate with its special message or show something with it. After implementation coloring codes, employees will easily understand what should do next step. Color coding styles help you to talk with one language across the operation or business.

Color coding tools can be applied in form of saving and distinguishing these tools or boards to all departments, color coding floor markings, even office documents. Coloring of boards helps employees with an updated instruction on everyone tasks every day in his workplace. Visual board will help in efficient tasks tracking from employees' side.

Figure 13: Spare Parts Warehouse Signage

Figure 14: Spare Parts Identification Colored Labels

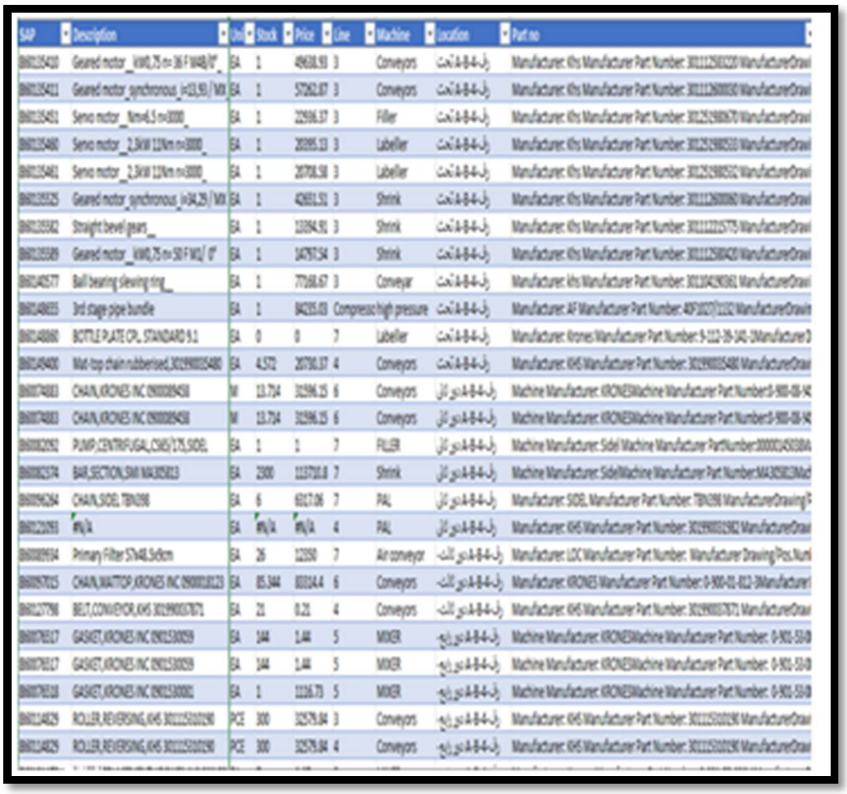
5.5. Standardize Work

Standardized work in lean tools is not used properly well, as it is one of the most powerful tools. Improving standard work never ends. The new standard should become further improvement and baseline; it is a never-ending process. It reduces over-processing, waiting and defects by documentation of best practice create the standardization workplace that should be committed by everyone to be baseline of continuous improvement or kaizen.

<u>5.5.1. Standardization Document</u>

- Reductions in variability
- Reductions in injuries and strain
- Easier training for new operators
- A baseline for improvement activities.

5.6. Standardization Document



SAP	Description	Uni	Stock	Price	Line	Machine	Location	Part no
[illegible]	Geared motor_ [illegible]	EA	1	4968.93	3	Conveyors	[illegible]	Manufacturer: Khs Manufacturer Part Number: [illegible]
[illegible]	Geared motor_synchronous_ [illegible]	EA	1	5762.87	3	Conveyors	[illegible]	Manufacturer: Khs Manufacturer Part Number: [illegible]
[illegible]	Servo motor_ [illegible]	EA	1	2256.37	3	Filler	[illegible]	Manufacturer: Khs Manufacturer Part Number: [illegible]
[illegible]	Servo motor_2,3kW 11Nm n=3000_	EA	1	2095.13	3	Labeller	[illegible]	Manufacturer: Khs Manufacturer Part Number: [illegible]
[illegible]	Servo motor_2,3kW 11Nm n=3000_	EA	1	2078.58	3	Labeller	[illegible]	Manufacturer: Khs Manufacturer Part Number: [illegible]
[illegible]	Geared motor_synchronous_ [illegible]	EA	1	4283.51	3	Shrink	[illegible]	Manufacturer: Khs Manufacturer Part Number: [illegible]
[illegible]	Straight bevel gears_	EA	1	[illegible]	3	Shrink	[illegible]	Manufacturer: Khs Manufacturer Part Number: [illegible]
[illegible]	Geared motor_ [illegible]	EA	1	14797.54	3	Shrink	[illegible]	Manufacturer: Khs Manufacturer Part Number: [illegible]
[illegible]	Ball bearing slewing ring_	EA	1	7768.67	3	Conveyor	[illegible]	Manufacturer: Khs Manufacturer Part Number: [illegible]
[illegible]	3rd stage pipe bundle	EA	1	84235.03		Compressor high pressure	[illegible]	Manufacturer: AF Manufacturer Part Number: [illegible]
[illegible]	BOTTLE PLATE CPL STANDARD 9.1	EA	0	0	7	Labeller	[illegible]	Manufacturer: Krones Manufacturer Part Number: [illegible]
[illegible]	Mat-top chain rubberised, [illegible]	EA	4.572	20730.37	4	Conveyors	[illegible]	Manufacturer: KHS Manufacturer Part Number: [illegible]
[illegible]	CHAIN,KRONES INC [illegible]	M	13.714	31596.15	6	Conveyors	[illegible]	Machine Manufacturer: KRONES Machine Manufacturer Part Number [illegible]
[illegible]	CHAIN,KRONES INC [illegible]	M	13.714	31596.15	6	Conveyors	[illegible]	Machine Manufacturer: KRONES Machine Manufacturer Part Number [illegible]
[illegible]	PUMP,CENTRIFUGAL, [illegible] ,SIDEL	EA	1	1	7	FILLER	[illegible]	Machine Manufacturer: Sidel Machine Manufacturer PartNumber [illegible]
[illegible]	BAR,SECTION,SMI [illegible]	EA	2300	113718.8	7	Shrink	[illegible]	Machine Manufacturer: Sidel Machine Manufacturer Part Number [illegible]
[illegible]	CHAIN,SIDEL [illegible]	EA	6	6017.06	7	PAL	[illegible]	Manufacturer: SIDEL Manufacturer Part Number: [illegible]
[illegible]	#N/A	EA	#N/A	#N/A	4	PAL	[illegible]	Manufacturer: KHS Manufacturer Part Number: [illegible]
[illegible]	Primary Filter [illegible]	EA	26	12350	7	Air conveyor	[illegible]	Manufacturer: LDC Manufacturer Part Number: Manufacturer Drawing Pos.Num
[illegible]	CHAIN,MATTOP,KRONES INC [illegible]	EA	15.344	[illegible]	6	Conveyors	[illegible]	Manufacturer: KRONES Manufacturer Part Number: [illegible]
[illegible]	BELT,CONVEYOR,KHS [illegible]	EA	21	0.21	4	Conveyors	[illegible]	Manufacturer: KHS Manufacturer Part Number: [illegible]
[illegible]	GASKET,KRONES INC [illegible]	EA	144	1.44	5	MIXER	[illegible]	Machine Manufacturer: KRONES Machine Manufacturer Part Number: [illegible]
[illegible]	GASKET,KRONES INC [illegible]	EA	144	1.44	5	MIXER	[illegible]	Machine Manufacturer: KRONES Machine Manufacturer Part Number: [illegible]
[illegible]	GASKET,KRONES INC [illegible]	EA	1	1126.73	5	MIXER	[illegible]	Machine Manufacturer: KRONES Machine Manufacturer Part Number: [illegible]
[illegible]	ROLLER,REVERSING,KHS [illegible]	PCE	300	32575.84	3	Conveyors	[illegible]	Manufacturer: KHS Manufacturer Part Number: [illegible]
[illegible]	ROLLER,REVERSING,KHS [illegible]	PCE	300	32575.84	4	Conveyors	[illegible]	Manufacturer: KHS Manufacturer Part Number: [illegible]

Figure 15: Spare Parts Location and Stocks

6. Results, Discussion and Conclusions

This paper presented a successful case study of reduction in a non-added value in dismissal of spare parts process by applying lean management tools methodology. Therefore, the paper can be used as a reference for Manufacturing Industrialists to guide specific process improvement projects. After the analysis is carried out by applying lean tools, the improvement project presented in this paper found that Critical point from the prospective of management team was implemented at:

- Line Line 7
- Category PET
- Pack Size 970 ml
- Speed (bph) 3600
- DT hrs. 202

Frequency of installing spare parts 70

Saving result from applying lean methodology:

Total NVA hrs	Lost Cases	Saving in EGP	
Before	41	245,000	637,000
After	14	84,000	218,400

An organization implements lean management to support the organization and supports the sustained improvement in manufacture. This results in improving quality and efficiency. It leads to about 70% incremental changes in manufacturing. Lean management process gets rid of any waste and improves processes by looking over any step that may not add value saving effort, time, and money.

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