International Journal of Multidisciplinary Informative Research and Review
2020; 1(1): 49-60
Published online September 30, 2020 (https://agribusinessedu.com/ijmirr-journal/)
DOI: 10.5281/zenodo.4309663
ISSN: 2709-6289 (Online)

Study on 7 Wastes of Lean in Garments Manufacturing

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To cite this article:
Md. Noor Nabi Raaz, Amanullah Aman. Study on 7 Wastes of Lean in Garments Manufacturing. *International Journal of Multidisciplinary Informative Research and Review*. Vol. 1, No. 1, 2020, pp. 49-60.

Abstract: *Garment Business today has become very competitive. Low price, less lead time, high costing, many competitors have made the market saturated. Depending on the level of journey, this business has come to a professional and scientific stage, where accurate planning, proper time management in production and operation, high skilled technical support, optimum cost-profit estimation are very important issues to survive.*

Now a day's it's impossible to run a garment manufacturing operation without scientific and professional approach. Industrial Engineering concepts are developed on this demand. Industrial Engineering concepts are required in every stage in Costing, Product R&D, Planning, Supply Chain, Production management, Maintenance management, Layout plan, Productivity Improvement, Cutting Improvement, and Manpower Skill Development and so on. Industrial Engineering also more concepts are required in Initiative on lean manufacturing, learning of lean tools and looking for scope of implementation. Every Garment Owner now understands that only scientific and professional approach can make the profit. So demand for Industrial Engineering is very high, and still the availability of Industrial Engineers is very less than the demand.

Keywords: *Garments, Lean tools, Industrial Engineering (IE), Garments Waste, Production.*

1. Introduction

Lean is a term to describe a system that produces what the customer wants, when they want it, with minimum waste - it is based on the Toyota production system. Lean thinking focuses on value-added lean and consists of best practices, tools and techniques from throughout industry with the aims of reducing waste and maximizing the flow and efficiency of the overall system to achieve the ultimate customer satisfaction. Lean manufacturing is manufacturing philosophy that shortens the time between the customer order and the product build/shipment by eliminating sources of waste. Another way of looking at lean is that it aims to achieve the same output with less input- less time, less space, less human effort, less machinery, less material, less costs. Japanese manufacturers'-building after the Second World War was facing declining human, material and financial resources. The problems they faced in manufacturing were vastly different from their Western counterparts. These circumstances led to the development of new and lower cost manufacturing practices. Japanese leaders such as the

Toyota Motor Company's Eiji Toyoda, TaiichiOhno and Shigeo Shingo developed a disciplined, process-focused production system now known as the

"Toyota Production System" or "Lean Production". The objective of this system was to minimize the consumption of resources that added no value to a product. When a U.S. equipment manufacturing company, Lantech, completed the implementation of lean in 1995, they reported the following improvements compared to their batch-based system in 1991: manufacturing space per machine was reduced by 45%, defects were reduced by 90%, production cycle time was reduced from16 weeks to 14 hours-5days; and product delivery lead time was reduced from 4-20 weeks to 1-4 weeks. Waste is anything that does not contribute to transforming a part to the customers' needs. The aim of lean manufacturing is the elimination of waste in every area of production including customer relations, product design, supplier networks, and

factory management. Its goal is to incorporate less human effort, less inventory, less time to develop products, and less space to become highly responsive to customer demand while producing top quality products in the most efficient and economical manner possible. Essentially, a “waste” is anything that the customer is not willing to pay for. Originally seven main kinds of wastes such as transporting, overproducing, waiting, defects, unnecessary motion, inappropriate processing and unnecessary inventory (TaiichiOhno’s seven categories of waste) were identified as part of the Toyota Production System. On the other hand, applications of lean manufacturing in the continuous process sector have been far fewer. It has sometimes been argued that in part, this is because such industries are inherently more efficient and have a relatively less urgent need for major improvement activities. Managers have also been hesitant to adopt lean manufacturing tools and techniques to the continuous sector because of other characteristics that are typical in this sector. These include large, inflexible machines, long setup times, and the general difficulty in producing in small batches. While some lean manufacturing tools might indeed be difficult to adapt to the continuous sector this does not mean that the approach is completely inapplicable; for example, Ahmad et al., Melton, Radnor, Cook and Rogowski, and Billesbach. Abdullah *et al.* and Abdelmalek *et al.* examined aspects of continuous production that are amenable to lean techniques and presented a classification scheme to guide lean implementation in this sector.

2.Literature Review

Lean Manufacturing

Lean manufacturing or lean production, often simply "lean", is a systematic method for the elimination of waste ("Muda") within a manufacturing system. Lean also takes into account waste created through overburden ("Muri") and waste created through unevenness in workloads ("Mura"). Working from the perspective of the client who consumes a product or service, "value" is any action or process that a customer would be willing to pay for.

Lean manufacturing is a management philosophy derived mostly from the Toyota Production System (TPS) (hence the term Toyotism is also prevalent) and identified as "lean" only in the 1990s.TPS is renowned for its focus on reduction of the original Toyota *seven wastes* to improve overall customer value, but there are varying perspectives on how this is best achieved.

History of Lean:

Although there are instances of rigorous process thinking in manufacturing all the way back to the Arsenal in Venice in the 1450s, the first person to truly integrate an entire production process was Henry Ford. At Highland Park, MI, in 1913 he married consistently interchangeable parts with standard work and moving conveyance to create what he called flow production. The public grasped this in the dramatic form of the moving assembly line, but from the standpoint of the manufacturing engineer the breakthroughs actually went much further.

Henry Ford

Ford lined up fabrication steps in process sequence wherever possible using special-purpose machines and go/no-go gauges to fabricate and assemble the components going into the vehicle within a few minutes, and deliver perfectly fitting components directly to line-side. This was a truly revolutionary break from the shop practices of the American System that consisted of general-purpose machines grouped by process, which made parts that eventually found their way into finished products after a good bit of tinkering (fitting) in subassembly and final assembly.

The problem with Ford’s system was not the flow: He was able to turn the inventories of the entire company every few days. Rather it was his inability to provide variety. The Model T was not just limited to one color. It was also limited to one specification so that all Model T chassis were essentially identical up through the end of production in 1926. (The customer did have a choice of four or five body styles, a drop-on feature from outside suppliers added at the very end of the

production line.) Indeed, it appears that practically every machine in the Ford Motor Company worked on a single part number, and there were essentially no changeovers.

When the world wanted variety, including model cycles shorter than the 19 years for the Model T, Ford seemed to lose his way. Other automakers responded to the need for many models, each with many options, but with production systems whose design and fabrication steps regressed toward process areas with much longer throughput times. Over time they populated their fabrication shops with larger and larger machines that ran faster and faster, apparently lowering costs per process step, but continually increasing throughput times and inventories except in the rare case—like engine machining lines—where all of the process steps could be linked and automated. Even worse, the time lags between process steps and the complex part routings required ever more sophisticated information management systems culminating in computerized Materials Requirements Planning (MRP) systems.

As Kiichiro Toyoda, TaiichiOhno, and others at Toyota looked at this situation in the 1930s, and more intensely just after World War II, it occurred to them that a series of simple innovations might make it more possible to provide both continuity in process flow and a wide variety in product offerings. They therefore revisited Ford's original thinking, and invented the Toyota Production System.

Kiichiro Toyoda

This system in essence shifted the focus of the manufacturing engineer from individual machines and their utilization, to the flow of the product through the total process. Toyota concluded that by right-sizing machines for the actual volume needed, introducing self-monitoring machines to ensure quality, lining the machines up in process sequence, pioneering quick setups so each machine could make small volumes of many part numbers, and having each process step notify the previous step of its current needs for materials, it would be possible to obtain low cost, high variety, high quality, and very rapid throughput times to respond to changing customer desires. Also, information management could be made much simpler and more accurate.

In a subsequent volume, Lean Thinking (1996), James P. Womack and Daniel T. Jones distilled these lean principles even further to five:

- Specify the value desired by the customer
- Identify the value stream for each product providing that value and challenge all of the wasted steps (generally nine out of ten) currently necessary to provide it
- Make the product flow continuously through the remaining value-added steps
- Introduce pull between all steps where continuous flow is possible
- Manage toward perfection so that the number of steps and the amount of time and information needed to serve the customer continually falls.

3. Objectives

The objectives of lean manufacturing are as follows-

- To know about lean manufacturing
- To know about lean tools
- To know about 7 types of waste which responsible for highly production cost
- To know about 7 wastes causes

4. Proposed System

Lean Today

As these words are written, Toyota, the leading lean exemplar in the world, stands poised to become the largest automaker in the world in terms of overall sales. Its dominant success in everything from rising sales and market shares in every global market, not to mention a clear lead in hybrid technology, stands as the strongest proof of the power of lean enterprise.

This continued success has over the past two decades created an enormous demand for greater knowledge about lean thinking. There are literally hundreds of books and papers, not to mention thousands of media articles exploring the subject, and numerous other resources available to this growing audience.

As lean thinking continues to spread to every country in the world, leaders are also adapting the tools and principles beyond manufacturing, to logistics and distribution, services, retail, healthcare, construction, maintenance, and even government. Indeed, lean consciousness and methods are only beginning to take root among senior managers and leaders in all sectors today.

Lean Tools

Lean tools include

- 5s/Good housekeeping.
- Value stream mapping.
- Visual workplace
- Total productive maintenance (TPM).
- Pull/Kanban system
- Kaizen
- Cellular/Flow manufacturing.
- Tact time/ Balancing
- Quick changeover/Setup reduction.
- Single minute exchange of dies.

Short description of lean tools is given below:

Lean Tools - 5s

- Seiri - sorting.
- Seiton – straighten/set in order
- Seiso – sweeping/shining/cleanliness
- Seiketsu – standardizing
- Shitsuke – sustaining the discipline

Lean tools – 5s short descriptions are given below:

I. **Sort**: Remove unwanted item from workplace and dispose them properly
II. **Set in order:** Arrange every item as per its usage frequency making it easily available for use - "A place for everything and everything in its place"
III. **Shine**: Clean the workplace and look for the source, which is adding dirty substance and work towards eliminating that source
IV. **Standardize:** Everything in right order as per set standards, with high standard of housekeeping. Each workplace should have proper layout display
V. **Sustain:** Properly trained team / individuals which practice 5S without being told. Series of audits are done to understand the effectiveness

Advantages of the lean system in apparel industry

1. Waste Elimination
2. Work place Standardization
3. Effective plant layout.
4. Quality will be enhanced at source level.
5. Increase the Productivity by 30% from the existing level.
6. Reduction of Production cost & other Overheads.
7. Reduce the Risk of non-compliance and
8. Late Delivery.

7 Wastes of Lean in Garment Manufacturing

7 wastes of lean manufacturing:

7 types of wastes and non-value adding activities are as following.

T – Transportation
E – Excess Inventory
E – Excess Motion
W – Waiting
O – Over production
O – Over processing
D – Defects

To make it easy to remember 7 wastes, memorize the word **TEEWOOD** with initials of 7 wastes. In the following, 7 wastes are explained briefly with examples of garment industry activities

5. Project Description

Wastes of Lean in Garment Manufacturing

7 types of waste and non-value adding activities are described in given below

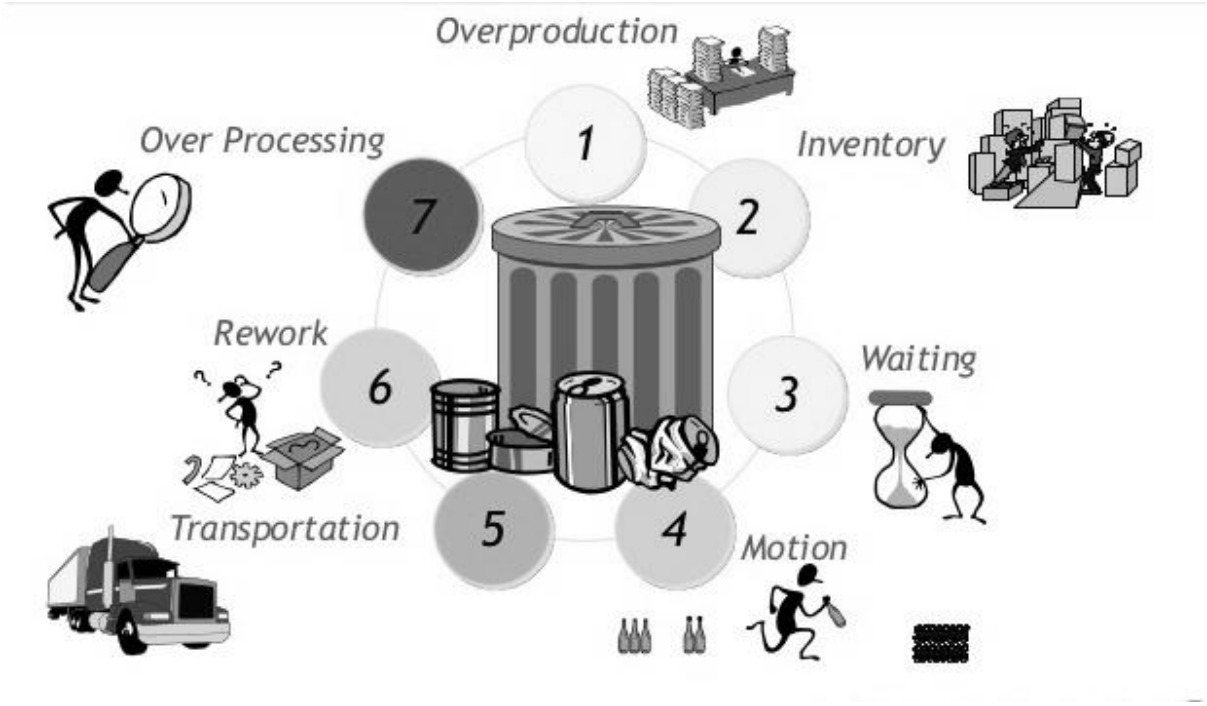

Fig: 7 types waste of lean manufacturing

Transportation

When work is transferred from one place to another is a non-value added activity. Moving cuttings from cutting department to sewing lines, transporting stitched garments from sewing floor to finishing department, Moving garment bundles in the line using center table or trolley. Where transportation can't be eliminated, think how transportation time can be reduced. By using overhead transportation rail in sewing lines, transportation of bundles or single pieces can be automated.

Excess inventory

Inventories of a factory represent those items which are either in the process of manufacturing or idle resources (material) of a factory or materials in stock. And excess inventory means keeping or generating inventory for the following process more than the demand of the following process. Excess inventory is found in fabric and trim stores, cutting racks, finishing trolleys. Excess inventories are wastes for the factory, as per lean philosophy. Inventory is money. When inventory piled up in stores and on floors, you areblocking your money and are blocking your working space. Even in a sewing line excess work-in-process (WIP) are considered as excess inventory.

Excess motion

In workstations where operators sew garments, press-men press garments, workers finish and pack garments, excess motions exits there. Excess motion at workstations is found due to poor training of workers in working methods and habit of working in traditional ways. In the factories where there are engineering department to designs workstation layout, operators may use excess motion due to poor workstation layout.

Waiting

This waste is defined as people or things waiting around for the next action. This term has been discussed in an earlier published article as one of the non-productive times in production.

In garment factory, waiting as waste is found in all processes. Like, sewing operators wait for cuttings (no feeding), supervisors waits for final instruction and go ahead for quality approvals. Merchandisers wait for buyer approvals. Waiting is a visible waste in manufacturing as operators and other employees produce nothing while they wait for work or due to other reasons. Few other examples of such waste are – delay in sourcing materials, cutting delays due to fabric approvals and consumption approval.

Over Production

This waste can be simply defined as doing or making things those are not required now. Over production generate excess inventory. In the garment factories, over production is found in cutting department and in sewing operations.

For example, if daily production demand from sewing is 5000 pieces, and factory makes/cuts more than that that quantity (demand), factory is producing excess units of garments than needed by the following process for the day (finishing). Over-production cause imbalance in work in process (WIP).

Over processing

This waste can be defined as doing task or adding features to the product those are not requirement from the customer. In garment construction, some operations may not be essential to give the final look and construction. Example: Multiple checking in finishing (initial checking, pre-final checking and final checking).

Defects

Producing defects while making garments are waste of money and effort. Defects in garment manufacturing are like shade variation, wrong cutting, stitching defective garment etc. In case defective garments are made, factory needs to alter and repair those defective garments before handing over to the buyer. Repair work costs money and time. In lean manufacturing factories aim to produce garments right first time.

Wastes	Causes of Defects	Responsible for this defects			
		Man	Machine	Material	Others
Transportation	Poor plan layout	✓			
	Large storage area				
	Poor understanding of the process flow for production	✓			
	Longer lead times		✓	✓	

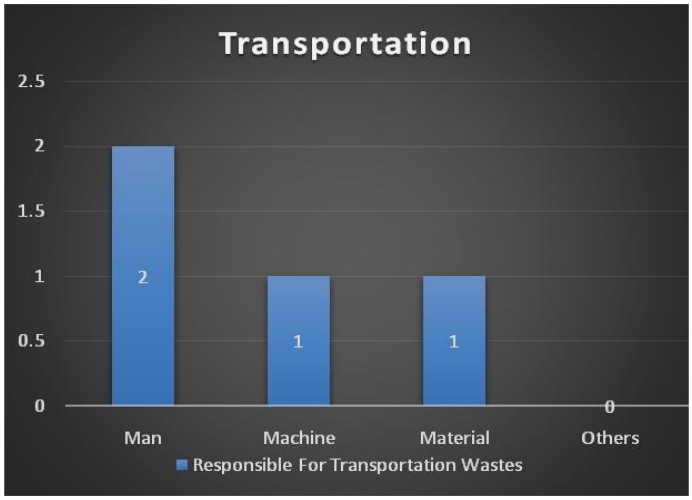

Figure 1: Responsible for transportation waste

Excess inventory

Wastes	Causes of defects	Responsible for this defects			
		Man	Machine	Material	Others
Inventory	Unlevelled scheduling	✓	✓	✓	
	Poor market forecast	✓	✓		
	Unbalanced work load	✓	✓		✓
	Unreliable shipment by suppliers	✓			✓

Excess motion

Wastes	Cause of defects	Responsible for this defects			
		Man	Machine	Material	Other
Motion	Large items located on upper or lower shelf	✓	✓		
	A machine that unnecessary traveling distances	✓			
	Finding unnecessary equipment and tools for concern production process	✓			
	Unnecessary motion form work place to retrieve materials or utilize machines	✓			
	Unplanned tools for work place	✓			
	Lack of space in organization in manufacturing area for keeps the components	✓			

Waiting

Wastes	Cause of defects	Responsible for this defects			
		Man	Machine	Material	Others
Waiting	Poor scheduling of production process	✓	✓		
	Time taken for signature approval higher officials to take require decision	✓			
	Improper arrangements of machines for process sequence	✓			
	In adequate servicing of machines	✓	✓		

6. Methodology of the Study

In this part we include 7wastes major causes and who mostly responsible for 7wastes. Below given 7wastes causes table with their graphical view:

Over Production

Wastes	Cause of defects	Responsible for this defects			
		Man	Machine	Material	Others
Over Production	Challenge of the production manager is to allocate right responsibilities	✓			
	Challenge of the production manager is to allocate right responsibilities	✓			

Over processing

Wastes	Cause of defects	Responsible for this defects			
		Man	Machine	Material	Others
Over processing	Style changes without process changes	✓			
	Lack of information about process	✓			✓
	Customer true requirement not properly defined	✓			
	Redundant approvals	✓			
	Over processing to accommodate expected down times		✓		

Defects

Wastes	Cause of defects	Responsible for this defects			
		Man	Machine	Material	Others
Defects	Seaming defects	✓	✓	✓	
	Sewing defects	✓	✓	✓	
	Placement defects	✓		✓	
	Fabric defects	✓		✓	✓
	Embroidery defects		✓		

7. Results and Discussion

Wastes	Causes of Defects	Man	Machine	Material	Others
Transportation	Poor plan layout	✓			
	Large storage area				
	Poor understanding of the process flow for production	✓			
	Longer lead times		✓	✓	
Inventory	Unlevelled scheduling	✓	✓	✓	
	Poor market forecast	✓	✓		
	Unbalanced work load	✓	✓		✓
	Unreliable shipment by suppliers	✓			✓
Extra Motion	Large items located on upper or lower shelf	✓	✓		
	A machine that unnecessary traveling distances	✓			
	Finding unnecessary equipment and tools for concern production process	✓			
	Unnecessary motion form work place to retrieve materials or utilize machines	✓			
	Unplanned tools for work place	✓			
	Lack of space in organization in manufacturing area for keeps the components	✓			
Waiting	Poor scheduling of production process	✓	✓		
	Time taken for signature approval higher officials to take require decision	✓			
	Improper arrangements of machines for process sequence	✓			
	In adequate servicing of machines	✓	✓		
Over Production	Challenge of the production manager is to allocate right responsibilities	✓			
	Challenge of the production manager is to allocate right responsibilities	✓			
Over processing	Style changes without process changes	✓			
	Lack of information about process	✓			✓
	Customer true requirement not properly defined	✓			
	Redundant approvals	✓			
	Over processing to accommodate expected down times		✓		
Defects	Seaming defects	✓	✓	✓	
	Sewing defects	✓	✓	✓	
	Placement defects	✓		✓	
	Fabric defects	✓		✓	✓
	Embroidery defects		✓		

Figure 2: Chart of total 7 wastes causes

In our project we describe 7wastes and their causes which raising manufacturing cost of products. For owners or clients waste is anything that creates any value.
Above given chart we see all wastes responsible causes percentage

Transportation
- Man-40%
- Machine-40%
- Materials- 20%

Inventory
- Man-40%
- Machine-20%
- Materials-20%
- Others-20%

Motion
- Man-100%

Waiting
- Man-60%
- Machine-40%

Over Production
- Man-100%

Over processing
- Man-60%
- Machine-20%
- Others-20%

Defects
- Man-20%
- Machine-20%
- Materials-40%

8. Conclusion

The concept of Lean Manufacturing is new in Bangladesh, and proactive organizations have already been observed to implement this tool in their functional departments. This is primarily due to the multitude of cost advantage which arises from having Lean Manufacturing.

7 wastes analysis, it has been found that a lot of unnecessary items exist in the garment firms like garment waste material and unwanted tools and equipment's.The garment worker will feel more comfortable at work and the continuous improvement actions will tends to minimum waste and good quality of items, which improves the firm's competitiveness and profitability

9. Recommendations

On the basis of the finding of the study it was evident that banana was profitable enterprises and they can generate income earnings and employment opportunity to the rural people of Bangladesh. But some problems and constraints bared to attain the above mentioned objectives. The policy makers should, therefore, take necessary measures. According to the findings of the study; some policy recommendations may be advanced which are likely to be useful for policy formulation.

On the basis of the findings of the study, the following specific recommendation may be made for the development of banana sector.

a) As most of the banana farmers are technically efficient at present production technology, improved method of production technology with sufficient storage ability should be introduced.
b) Operating capital is a problem for the resource poor farmers of the study area. Institutional credit program should be launched aiming at particularly the small and medium farmers. The commercial bank should be encouraged to provide loans at a low interest rate to enable farmers to operate their farming on commercial basis.
c) As banana is profitable enterprise, government and concern institutions should provide adequate extension program to expand their area and production.
d) To avoid price fluctuation, support price should be ensured to the farmers.
e) Banana based cropping pattern should be developed and disseminated to those areas of Bangladesh where their production is suitable.
f) Government should take necessary measures to lower the price of inputs which have positive significant impact on yield. It will increase the net benefit of banana producers.
g) Banana farmers had to sell their product at low price during harvesting or just after harvest. An appropriate storage scheme should be developed so that the farmers are not forced to sell their product at low price in harvest period.
h) Development of transportation system is essential for the improvement of trading and reducing cost of banana.
i) Steps should be taken to ensure fair price, quality of product, floor price, and the stability of production.
j) Market cost is high because of inadequate information, infrastructure, high price risk etc.

Moreover, a large number of people were involved in the production and marketing of banana. So, the farmers and intermediaries could be more benefited financially if production and marketing of banana were well expanded.

10. Limitations of the Study

- This research is about 7 wastes, but the lean principles can be implemented in all areas of the garments floor also like knitting, cutting, sewing and finishing. Implementation of 7 wastes lots of improvements in Garments production.
- This study cannot correlate all these data to their equivalent financial values.
- We had a very limited time. In spite of our willing to study more details it was not possible to do so.

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