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Reduction of wastage and improvement of productivity through lean thinking

Sheikh Sha Alam[1], Dr. Engr. Mafzal Ahmed[2*], Nura Alam Shiddique[3], Abu Bakkar Siddik[4], Susmita Roy Prianka[5], Rozina Aktar[6]

[1-2] Department of Textile Engineering, Port City International University, Chittagong-4225, Bangladesh
[3] Department of Textile Engineering, Khwaja Yunus Ali University, Sirajgonj, Bangladesh
[4] Department of Apparel Manufacturing and Technology, Sonargaon University, Dhaka-1215, Bangladesh
[5-6] Department of Apparel Merchandising & Management, BGMEA University of Fashion & Technology, Dhaka-1216, Bangladesh

Abstract
The aim of this project t is about reduction of wastage and improvement of productivity through lean manufacturing system in RMG sector. As the world market the number of competitors are increasing day by day and to meet up the present demand of ready-made garment industry, as soon as possible this sector must be adopted new technology as well as production process that will surely minimize the cost of production and produce defect free products. By completing this project, it has provided overall idea of how can it reduced the production wastage and in mean time how can it improved the productivity and these may be helpful to know about the improvement to make textile product and related organizations. The profit of a production based industry depend on how much they utilized their raw materials during production and how much they loss in processing. To control the excessive rate of wastage form every processing units, it will add the profit value and increase the maximum utilization of all resources as well as increase the productivity. This is a huge sector and yet to discover the whole.

Keywords: textile waste, productivity, lean manufacturing, ready made garment industry (RMG), 5S

1. Introduction

Small carmaker in Japan, with a background in textile looms was facing severe competition when it entered the car industry. The competition was from the big players - the likes of Ford and General Motors (GM). So the company which we now know as Toyota, decided to take a path less travelled and build quality, variety and flexibility in its operations and adapt itself to local demands, at a lower cost [1-3]. Years passed; the humble beginning of Toyota and its commitments to the manufacturing system, developed by it, earned accolades for the company and a lesson for others to emulate. Toyota pioneered the 'Toyota Production System' or 'Lean Manufacturing'. And a small beginning went on to write history. Today, Toyota is the world's largest car company, far ahead of Ford and GM [4, 6].

During the 1930s, Toyota realized that the Japanese market was too small and fragmented for the US production systems. They understood that Toyota could not get a share of the Japanese car market by continuing with established 'mass production' techniques [7, 10]. With limited working capital, market access in a small country, little resources and constraints on borrowings, Toyota needed to turn cash around quickly-from receiving the order to getting paid. Unlike Ford and GM, Toyota did not have the luxury of taking cover under high volume and economies of scale [5]. They needed to adapt Ford's manufacturing process to achieve high quality, low cost, short lead times, and flexibility simultaneously.

In the 1950s, Taiichi Ohno the then plant manager of Toyota had over decades of practice, come up with the new Toyota Production System (TPS). His ideas were inspired by a lot of industry and real life practices built upon his exposure to the American and Japanese car automobile and loom industry [8-10]. The idea of consumption driven material replenishment, which led to the iconic 'pull system' was inspired by American supermarkets where individual items were replenished as each item begins to run low on the shelf. That is, material replenishment is initiated by consumption. Pull systems formed the basis of JIT, one of the two pillars of TPS (the other is jidoka, built-in quality). Toyota borrowed the concept of 'internal customers' from the preaching of quality guru W. Edwards Deming. The definition of customer was broadened to include both the external buyers and the internal customers - 'the next process is the customer'. The Japanese phrase for this, atokotei wa o-kyakusama, became one of the most significant expressions in JIT, because in a pull system it means the preceding process must always do what the subsequent process says [11, 13].

By the 1960s, TPS had become a powerful philosophy. Toyota did take the first steps to spread lean by diligently teaching the principles of TPS to their key suppliers [12]. This moved its isolated lean manufacturing plants toward a total lean extended enterprise where everyone in the supply chain was practicing the same TPS principles. Ever since, many enterprises across the globe and across industry segments have walked this proven track to build their Lean enterprise [14-16].

Lean often refers to improving manufacturing processes' efficiency, but Lean is more than that. Its philosophy is about eliminating waste in all forms to make a process or business the best it can be. It also requires that the practitioners of Lean recognize that there is always room for improvement [15]. The three main categories of waste in the Lean methodology are "muda" (work that does not add value), "muri" (overburden), "mura" (unevenness). In

addition to eliminating waste, Lean emphasizes improving quality of the process/results. This means that if Lean is implemented successfully, better results should be attained with less effort/resources. Unfortunately, Lean does not come with an exact set of instructions. The methodology requires its practitioners to be creative in order to make their process more efficient and less wasteful [18, 21].

Lean Tools

There are different types of lean tools such as 5S, Visual displays, Standardization of work process, Quick Changeover, Error proofing, Kanban, Problem-solving, Workload balancing. The principal goal of lean manufacturing is to create a continuous flow of product from raw material to finished goods and on to the customer – no stoppages, no delays, no interruptions because of inventory scrap or yield issues, downtime or the other problems that occur in a typical manufacturing operation. One of the most critical principles of lean manufacturing is the elimination of waste (known as MUDA in the Garments Production System) [17]. Many of the other principles revolve around this concept. The simplest way to describe waste is as "Something that adds no Value." Our customers would not be happy to pay for any action that we take that does not add value to what they actually want and nor should we be. Your companies Profit is your selling price less your costs, no matter how you think about the selling price it is very much dictated by the market not by yourself. If you charge too much then your customers will go elsewhere, even if you charge too little you may lose customers as they will perceive there may be something wrong with what you are offering. Therefore the only way you have to improve your profits are to reduce your costs; this means removing all elements of waste from your processes [19].

The Seven Wastes

1. Overproduction: Simply put, overproduction is to manufacture an item before it is actually required. Overproduction is highly costly to a manufacturing plant because it prohibits the smooth flow of materials and actually degrades quality and productivity. The Toyota Production System is also referred to as "Just in Time" (JIT) because every item is made just as it is needed. Overproduction manufacturing is referred to as "Just in Case." This creates excessive lead times, results in high storage costs, and makes it difficult to detect defects. The simple solution to overproduction is turning off the tap; this requires a lot of courage because the problems that overproduction is hiding will be revealed. The concept is to schedule and produce only what can be immediately sold/shipped and improve machine changeover/set-up capability [15, 20-21].

2. Waiting: Whenever goods are not moving or being processed, the waste of waiting occurs. Typically more than 99% of a product's life in traditional batch-and-queue manufacture will be spent waiting to be processed. Much of a product's lead time is tied up in waiting for the next operation; this is usually because material flow is poor, production runs are too long, and distances between work centers are too great. Goldratt (Theory of Constraints) has stated many times that one hour lost in a bottleneck process is one hour lost to the entire factory's output, which can never be recovered. Linking processes together so that one feeds directly into the next can dramatically reduce waiting [15, 22].

3. Transporting: Transporting product between processes is a cost incursion which adds no value to the product. Excessive movement and handling cause damage and are an opportunity for quality to deteriorate. Material handlers must be used to transport the materials, resulting in another organizational cost that adds no customer value. Transportation can be difficult to reduce due to the perceived costs of moving equipment and processes closer together. Furthermore, it is often hard to determine which processes should be next to each other. Mapping product flows can make this easier to visualize [15, 21-22].

4. Inappropriate Processing: Often termed as "using a sledgehammer to crack a nut," many organizations use expensive high precision equipment where simpler tools would be sufficient. This often results in poor plant layout because preceding or subsequent operations are located far apart. In addition they encourage high asset utilization (over-production with minimal changeovers) in order to recover the high cost of this equipment. Toyota is famous for their use of low-cost automation, combined with immaculately maintained, often older machines. Investing in smaller, more flexible equipment where possible; creating manufacturing cells; and combining steps will greatly reduce the waste of inappropriate processing [15, 21].

5. Unnecessary Inventory: Work in Progress (WIP) is a direct result of overproduction and waiting. Excess inventory tends to hide problems on the plant floor, which must be identified and resolved in order to improve operating performance. Excess inventory increases lead times, consumes productive floor space, delays the identification of problems, and inhibits communication. By achieving a seamless flow between work centers, many manufacturers have been able to improve customer service and slash inventories and their associated costs [21-22].

6. Unnecessary / Excess Motion: This waste is related to ergonomics and is seen in all instances of bending, stretching, walking, lifting, and reaching. These are also health and safety issues, which in today's litigious society are becoming more of a problem for organizations. Jobs with excessive motion should be analyzed and redesigned for improvement with the involvement of plant personnel [15, 20-21].

7. Defects: Having a direct impact to the bottom line, quality defects resulting in rework or scrap are a tremendous cost to organizations. Associated costs include quarantining inventory, re-inspecting, rescheduling, and capacity loss. In many organizations the total cost of defects is often a significant percentage of total manufacturing cost. Through employee involvement and Continuous Process Improvement (CPI), there is a huge opportunity to reduce defects at many facilities [20].

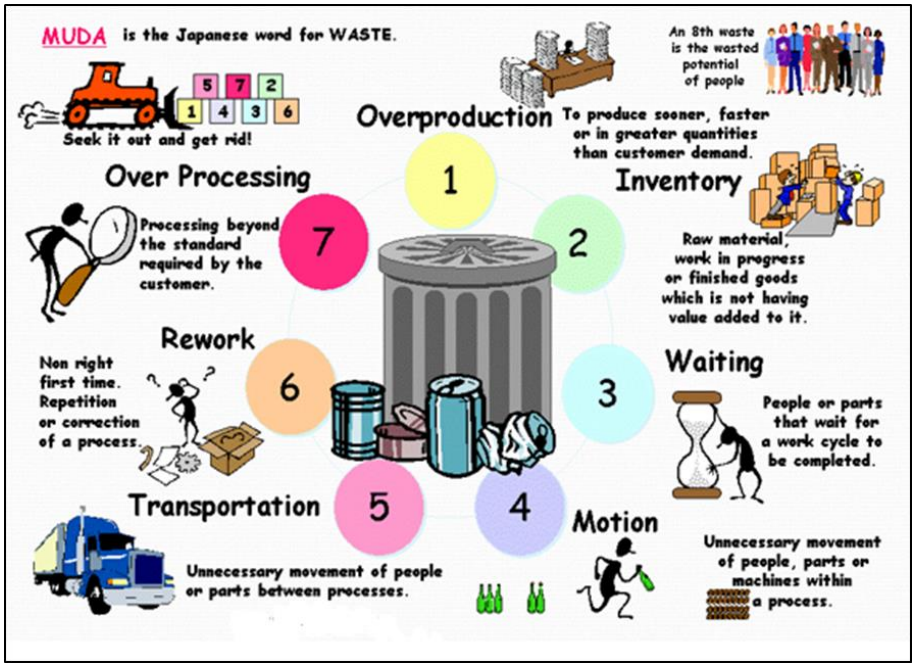


Fig 1: Seven wastes to reduce costs [15]

All of these wasteful motions cost you time (money) and cause stress on your employees and machines. So by lean manufacturing or lean production we can reduce wastage and also improve the productivity because if we can reduce the wastage the productivity improve automatically.

2. Materials and Methods

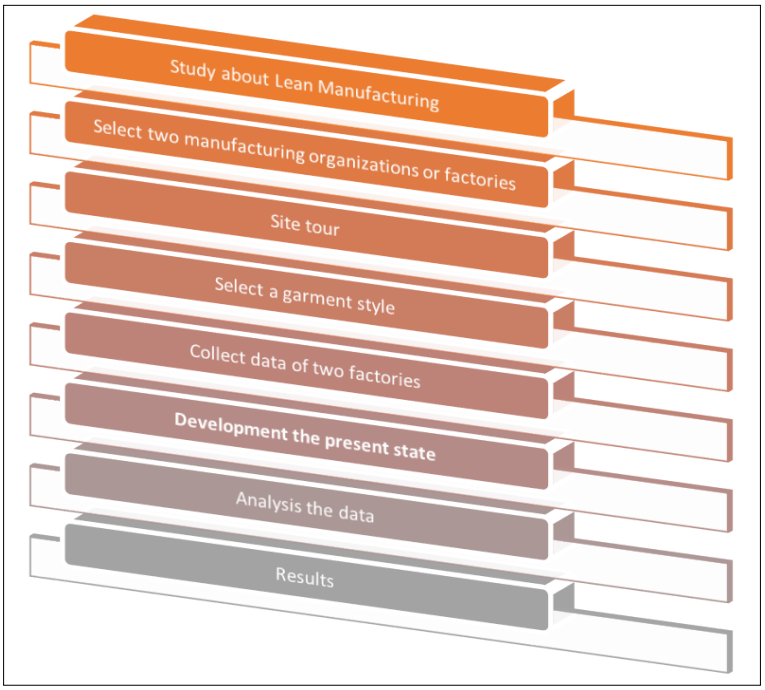
2.1. Materials

The project was conducted in Amber Textile Ltd, Dhaka, Bangladesh. To perform this project work different tools and equipment has been used to record the data and analysis. These are:

- Stopwatch
- Calculator
- Clipboard
- Pen
- Handy cam
- Thread consumption
- Measurement tape
- Sewing machine
- Garments pieces etc.

2.2. Methodology

Lean manufacturing or lean production is a systematic method originating in the Japanese manufacturing industry for the minimization of waste within a manufacturing system without sacrificing productivity, which can cause problems. Lean also takes into account waste created through overburden and unevenness in workloads. 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. To conduct this project work, the following steps, we have followed to complete the total work.



3. Results and Discussion

3.1. The Waste of Transport

Transport is the movement of materials from one location to another, this is a waste as it adds zero value to the product. Why would your customer (or you for that matter) want to pay for an operation that adds no value? Transport adds no value to the product, you as a business are paying people to move material from one location to another, a process that only costs you money and makes nothing for you. The waste of Transport can be a very high cost to your business, you need people to operate it and equipment such as trucks or fork trucks to undertake this expensive movement of materials.

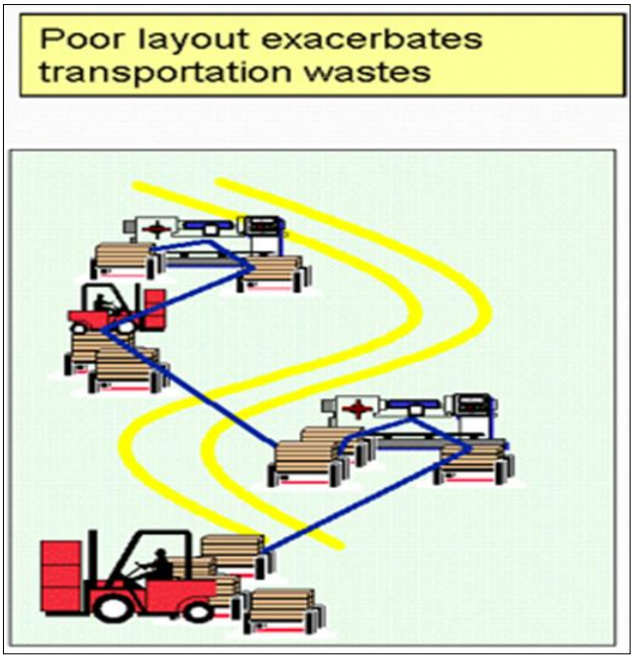


Fig 2: Transport system of garment manufacturing

2. The Waste of Inventory

Inventory costs you money, every piece of product tied up in raw material, work in progress or finished goods has a cost and until it is actually sold that cost is yours. In addition to the pure cost of your inventory it adds many other costs; inventory feeds many other wastes.

Inventory has to be stored, it needs space, it needs packaging and it has to be transported around. It has the chance of being damaged during transport and becoming obsolete. The waste of Inventory hides many of the other wastes in your systems.

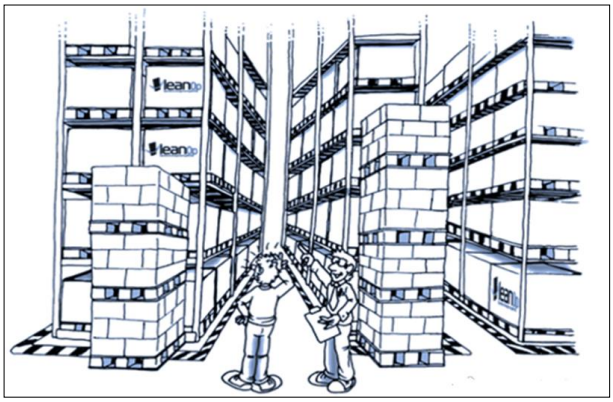


Fig 3: Inventory system to reduce waste [21]

3. The Waste of Motion

Unnecessary motions are those movements of man or machine which are not as small or as easy to achieve as possible, by this I mean bending down to retrieve heavy objects at floor level when they could be fed at waist level to reduce stress and time to retrieve. Excessive travel between work stations, excessive machine movements from start point to work start point are all examples of the waste of Motion.

All of these wasteful motions cost you time (money) and cause stress on your employees and machines, after all even robots wear out.

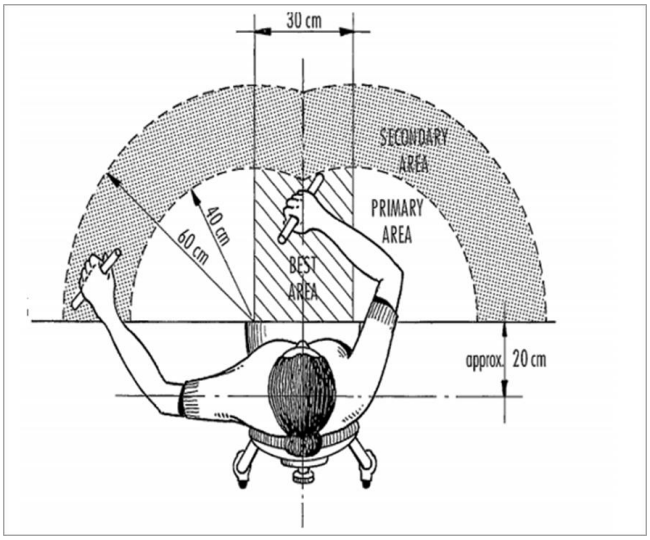


Fig 4: Excess motion of worker during working

4. The Waste of Waiting

How often do you spend time waiting for an answer from another department in your organization, or waiting for a delivery from a supplier or an engineer to come and fix a machine? We tend to spend an enormous amount of time waiting for things in our working lives (and personal lives too), this is an obvious waste. The Waste of Waiting disrupts flow, one of the main principles of Lean Manufacturing, as such it is one of the most serious of the seven wastes or 7 mudas of lean manufacturing.

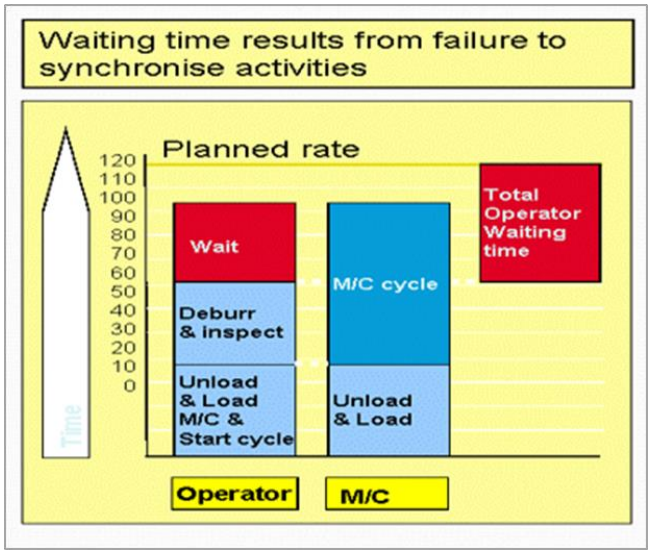


Fig 5: Operator waiting time

5. The waste of Overproduction

The most serious of all of the seven wastes; the waste of overproduction is making too much or too early. This is usually because of working with oversize batches, long lead times, poor supplier relations and a host of other reasons. Overproduction leads to high levels of inventory which mask many of the problems within your organization. The aim should be to make only what is required when it is required by the customer, the philosophy of Just in Time (JIT), however many companies work on the principle of Just in Case!

Fig 6: Waste of production

6. The Waste of Over-processing

The waste of over processing is where we use inappropriate techniques, oversize equipment, working to tolerances that are too tight, perform processes that are not required by the customer and so forth. All of these things cost us time and money.

One of the biggest examples of over-processing in most companies is that of the "mega machine" that can do an operation faster than any other, but every process flow has to be routed through it causing scheduling complications, delays and so forth. In lean; small is beautiful, use small appropriate machines where they are needed in the flow, not break the flow to route through a highly expensive monstrosity that the accountants insist is kept busy!

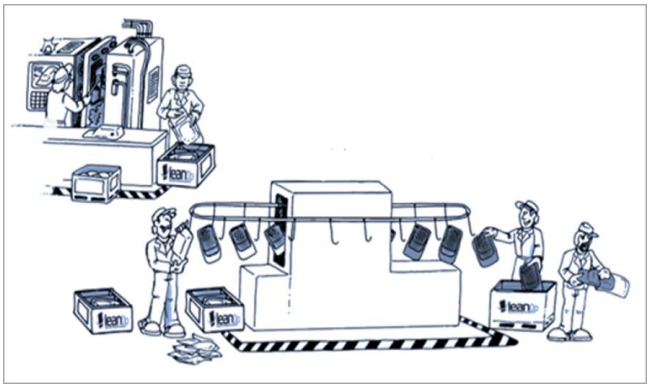


Fig 7: Waste of Over-processing [21]

7. The Waste of Defects

The most obvious of the seven wastes, although not always the easiest to detect before they reach your customers. Quality errors that cause defects invariably cost you far more than you expect. Every defective item requires rework or replacement, it wastes resources and materials, it creates paperwork, it can lead to lost customers.

The Waste of Defects should be prevented where possible, better to prevent than to try to detect them, implementation of pokayoke systems and autonomation can help to prevent defects from occurring.

Fig 8: Defect and rejection [22]

Benefits of Lean

Lean touches every aspect of manufacturing process as a discipline that is designed to reduce waste and create evenly distributed processes. Lean methodologies have a potential to generate significant quantitative and qualitative benefits. Lean manufacturing is normally known to benefit in the following ways:

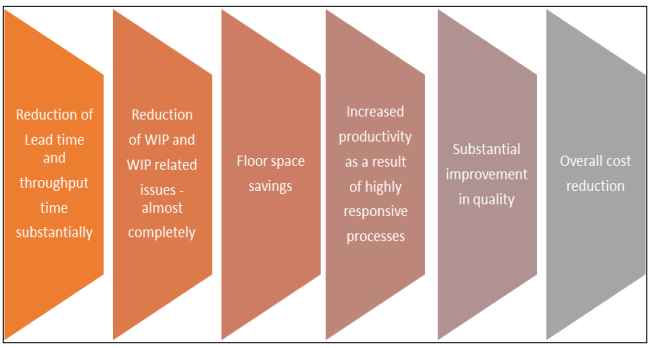


Fig 9: Lean benefits [23]

Above are the quantified and most common advantages but there are other qualitative advantages that come with lean manufacturing. Among them are:

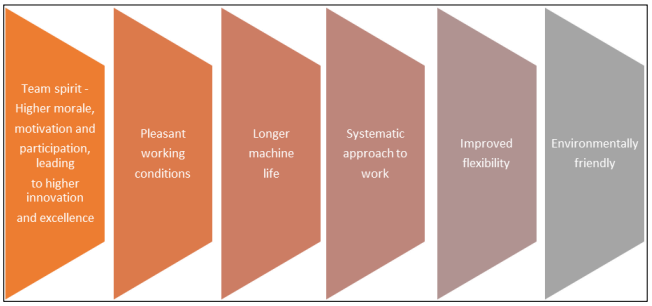


Fig 10: Lean advantages [23]

One improvement always stimulates a better change in some other area. This will lead to a huge change in the organization, even in the areas where one has not intended to have an improvement with the action he/she took. Therefore the synergy effect is a very important advantage in lean manufacturing. One more thing to remember in evaluating the advantages of lean manufacturing is that one should never count the individual improvements, like how well a department performs or how well a particular team

operates. All the advantages must be weighed according to their importance in the improvement of the total system.

Financial benefits of Lean

Table 1(a): Comparative study of two factories regarding lean application

KPIs	Conventional Factory	Lean Factory	Difference
Efficiency	45%	60%	33.33%
Reworks (in DHU)	20	9	-55%
Rejects (in %ages)	2.5%	1.5%	-40%
MMR	2.1	1.95	-7.14%
Average Lead time in Days	80-100	60-80	-20%
Annual Capacity (in Mn Pcs)	2	2	22%
Turnover (Mn USD)	9.4	11.5	22.34%
Profits	0.52	1.64	215.38%
PBT (%age of Turnover)	5.53%	14.26%	158%

An organization, Conventional factory is in the business of manufacturing and exporting formal and casual shirts, of approximately 20 minutes SAM. It has 500 sewing machines and works 300 days a year. The factory has been traditionally working at around 40 to 45 % efficiency, producing around 11 shirts per machine, thus shipping around 1.6 million shirts annually.

Another company Lean applied factory is in a similar business with similar cost structures. However, the company has been practicing Lean for the last one year and has been able to reach a certain maturity of implementations. At its current operating levels, it has been able to improve its productivity to 55% and reduce its MMR to 1.95, as against earlier 2.1. The key financial benefits that ABC Limited could reap as a result of Lean implementation are summarized.

Finally, many of the concepts we learn in Lean are different than managers, accountants, and other decision makers were taught. Some of the more interesting ones that we've encountered (and, address in our own lean implementations) include:

Table 1(b): Comparative study of two factories regarding lean application

Key concepts	Traditional factory	Lean implemented factory
Inventory	An asset, as defined by accounting terminology	A waste – ties up capital and increases processing lead-time
Ideal Economic Order Quantity & Batch Size	Very large – run large batch sizes to make up for process downtime	ONE – continuous efforts are made to reduce downtime to zero
People Utilization	All people must be busy at all times	Because work is performed based directly upon customer demand, people might not be busy
Process Utilization	Use high-speed processes and run them all the time	Processes need to only be designed to keep up with demand
Work Scheduling	Build products to forecast	Build products to demand
Labor Costs	Variable	Fixed
Work Groups	Traditional (functional) departments	Cross-functional teams
Accounting	By traditional FASB* guidelines	"Through-put" Accounting
Quality	Inspect/sort work at end of process to make sure we find all errors	Processes, products, and services are designed to eliminate errors

[*Source*: Financial Accounting Standards Board, USA]

4. Conclusion

Now, "quality" is the price of admission for entering the business environment. Many large manufacturers are demanding that suppliers adopt lean practices. Lean organizations are able to be more responsive to market trends, deliver products and services faster, and provide products and services less expensively than their non-lean counterparts. Lean crosses all industry boundaries, addresses all organizational functions, and impacts the entire system – supply chain to customer base. The main target was improving productivity & reducing wastage, for that reason we applied lean manufacturing process (7 wastage of lean manufacturing) on basis of Muda. We already describe process flow of lean manufacturing for the improving productivity & reducing wastage. If we can apply properly in our garments industry than it will be improve productivity & reduce wastage. After that we can get more productivity & wastage should be reduce.

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