



Lean Manufacturing

The way to Manufacturing Excellence

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Chapter 1

Lean Manufacturing -Introduction

A 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. 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!

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. 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. 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. 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.

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. 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.

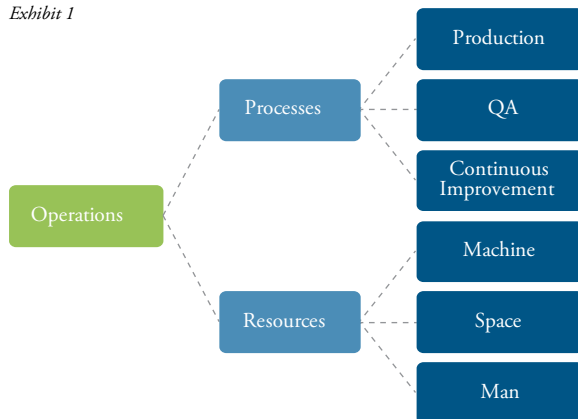


Chapter 2

The Need to go Lean

Manufacturing processes are driven by three controls – cost, quality and delivery and the garment manufacturing industry is no exception to it. Any intervention that can add value to one or more of these can take some burden off from the management system. This boils down to optimization of turnaround time / cycle time, greater product variety and quality and the most economical output. If one can achieve the stated, the competition would be viewed as co-existence, profits would soar and the expansion plans would turn into a reality. But the question that haunts is “how?” They may have already tried a hand at various systems to ease out the flow and add the required dimension, but nothing other than the unnecessary administrative and financial burden would have been added. Lean touches the following aspects of an organization.

Exhibit 1



Lean as a manufacturing philosophy aims at the following benefits:

- It creates a robust inter-dependent support system for all components of operations
- Reduces the administrative costs entailed in other popular methods
- Focuses on waste reduction
- Specially emphasises on unnecessary cost generating points

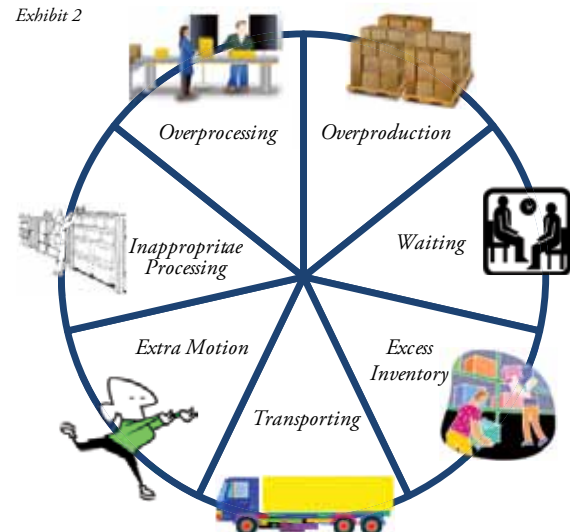
- Imparts a better control over day to day activities
- Reduces the cycle time
- Implements socially answerable techniques
- Promotes environment friendly practices
- Potentially acts as a powerful tool for competitive co-existence

The entire offerings can be simply summed up as an optimized manufacturing system that is low on resources and high on deliveries. Lean manufacturing is about “delivering the extra-ordinary through ordinary resources by building extra-ordinary processes”. The processes are built on the guidelines of reduction of waste and losses.

The Seven Types of Waste

Waste is defined as anything that does not add value to the final product. Every organization wastes certain amount of its resources. Therefore it is important to have a closer look at these wastes. For the ease of understanding, these wastes are categorized in to seven categories. Every waste one will come across in the organization or even in day-to-day life, will fall into one of these categories:

Exhibit 2



1. Overproduction: Lean manufacturing relies on manufacturing at the rate of customer demand. Production should be scheduled according to demand both in terms of volume and time. Demand is both external and internal. Thus, sewing should produce as much as finishing needs, and finishing should schedule its performance to the delivery timelines and quantities. Producing more than required is a waste of unwanted or mistimed value addition.

For example, high cut to ship ratio is an indicator of overproduction.

2. Waiting: Whenever the pieces are not moving or being processed, the waste of waiting occurs. 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. Linking processes together so that one feeds directly into the next can dramatically reduce waiting.

For example fabric, waiting to be cut and unshipped finished cartons, WIPs within cutting sewing, finishing sections waiting to be processed either due to capacity shortfall or non receipt of trims and accessories.

3. Excess 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.

For instance, any WIP which is more than the requirement will cause excess inventory, thereby causing pressures of extended lead times, and hence, higher working capital cost.

4. Transportation: Transporting products between processes is a cost incursion which adds no value to the product. Excessive movement and handling can cause damage and are an opportunity for quality to deteriorate and quantity to dwindle (lost WIP).

Unplanned workflow management in material warehouse, cutting, sewing, finishing and finished warehouse increase the material movement. This is the primary cause of high Man-Machine Ratio(MMR) in a factory. As any form of material movement would require extra manpower and space, which gets added into the MMR and required area causing higher overheads and hence increased product cost.

5. Excess Motion: This waste is related to ergonomics and is seen in all instances of bending, stretching, walking, lifting, and reaching out to pick up garment pieces which can be lessened.

Examples are ill-defined work stations, adding up to extra work content, as a result of extra body movement. Workstation should be defined for an easier pickup and dispose of garment parts along with trims in distinctly separate areas.

6. Inappropriate Processing: Correct tooling for the job is necessary to complete an operation. Correct tools are not the tools which are expensive or complex. They are the best tools for the particular purpose. Using inappropriate tools in the manufacturing process is a waste because it will take more resources and also it may not deliver the expected result.

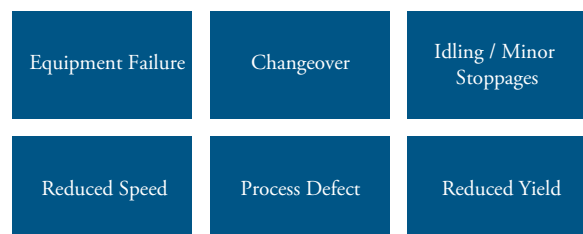
Example: Trouser/ Denim pocket facing attach operation, which can be done by one machine cover stitch machine but is planned with one over lock and one lockstitch. This adds cost to the garment without adding value.

7. Defects: Having a direct impact on the bottom line, quality defects resulting in rework or scrap are a tremendous cost to organization. Associated costs include quarantining inventory, re-inspecting, rescheduling, and capacity loss.

Higher rate of reworks and high number of rejections caused due to incorrect work processes or failure to identify the same at the right time and place are indicators of defects. The defect in garments like skip stitches, needle holes, stains causes lot of back and forth in material movement- negatively affecting productivity and Line supervisor focus.

Further to the enumerated wastes or 'muda', most operations often suffer one or all of the six big losses. Many a times, such losses are not even known or monitored, and are assumed as 'intrinsic' to the process. These losses may be in form of:

Exhibit 3



Lean manufacturing is a systematic discipline or application of philosophy to have a process that is optimized with lesser wastes and lesser potential losses. Application of Lean Manufacturing requires a clear focus on all components and functions within an organization. We will take a holistic view on Lean application in apparel manufacturing processes in the subsequent chapters.

Chapter 3

Apparel Manufacturing – The Lean Approach to Processes

Like any other manufacturing process, apparel manufacturing involves the conversion of raw materials like fabric and trims into apparel products using resources like man, machine, space, utilities and following a certain chain of processes and functions (production, quality and continuous improvements) in the key areas of material storage, cutting, sewing and finishing. Let us examine how Lean touches and influences the processes. Processes may be evaluated from four major perspectives- Pre production planning, production, quality and continuous improvements for the simplicity of understanding. However, they are inter-related, and each intervention has a bearing on the other. Clinically pointing out a Lean advantage to a particular benefit area may not be right, as any intervention touches and enhances several aspects of operations. For instance, while JIT may be classified as a production technique, it helps quality assurance strongly by simply preventing the 'magnitude' of a 'mistake'.

Below is an attempt to emphasize the application of Lean tools in various areas on an indicative basis. The span of every tool is more expansive and wide-encompassing, and not necessarily confined to the classification.

Production: Lean Way

Lean Manufacturing is a responsive, continuously flowing, pull-driven, leveled out system of manufacturing aided by a robust support system. Let us examine the methodologies in some detail.

- Manufacturing around the Takt Time: Simply put, Takt time is defined as the rate of customer demand. It is christened as the 'heart beat' of Lean manufacturing.
 - » Takt time = Rate of Customer demand = Desired Pace of Production = Net Available Time to Work/ Customer Order Size.
 - » Let us assume a factory of 200 manned machines across cutting, sewing and finishing, that works for 480 minutes a day, 25 days a month. This factory has a machine downtime of 7%, and has defect level of 15%. Average repair time per defect is 5 minutes.
 - » If the total order for this factory in a month is 50,000 garments, the Takt Time will be calculated as below:
 - » Time available = $480 \times 200 \times 25 = 24,00,000$ Minutes
 - » Time Discounted for Machine Downtime = 1,68,000; Available = 22,32,000 minutes
 - » Time Discounted for alterations = 37,500 Minutes
 - » Net Time Available = 21,94,500 Minutes
 - » Order Size = 50,000 Garments
 - » Takt Time = $21,94,500 / 50,000 = 43.89$ Minutes per garment
 - » The factory should produce one garment in every 44 minutes per machine, or ~11 garments per day per machine, or 2200 garments altogether per day.

Since sewing is the key function in the garment manufacturing, required cutting and finishing capacities are allocated to the specific order.

Now, this is the rate of external customer demand. This needs to be converted into internal takt time between cutting, sewing and finishing, and then further into takt time allocation for the various operations or processes in cutting, sewing and finishing on the basis of resources in each process.

- **Internal Customer Protocols:** Internal Customer Protocols is the foundation of Lean Production Planning. Every process should be planned as a supplier or a customer to its preceding and succeeding process. Thus Sewing is a customer to Cutting and a supplier to finishing. Within Sewing, the first operation, say a run-stitch operation, is a supplier to the next operation say a topstitch operation. Therefore, the processes should follow the same protocols as the final customer follows with the factory or company – the protocol of delivering the right quantity or numbers at specified intervals (scheduling) and delivering the right quality (to be explained in lean tools for QA processes) so that the flow of the process is adhered to. Accordingly, there should be a method of scheduling, leveling, self-check and audit.

Exhibit 4:

S. No.	Tool	Definition
1	Jidoka	QA approach to “Right First Time”
2	Poka Yoke	Mistake proofing
3	Andon	Visual control for exception management
4	Just in time	Single piece flow, planned around the Takt time
5	SMED	Reduction in Changeover time
6	TPM	Total Productive Maintenance – Preventive, Predictive, Autonomous
7	5S	Workplace Management
8	Value Stream Mapping	Optimizing Non value added works
9	Root Cause Analysis	Through Ishikawa Diagram, 5 Whys
10	Kaizen	Continuous Improvement

- **Continuous Flow:** In order to maintain a continuous flow in the systems and processes, planning of movement of the pieces is done. This is done so that there is no such case where there are machines that are kept idle, helping in a single/minimum WIP flow. Single piece flow helps in building quality, creating flexibility and reducing the cost of

inventory simultaneously. It is worth noting that Lean manufacturing does not mean single piece in every process. WIP is always planned in line with Takt time scheduling and lean maturity of the operations – and it must be adhered to as defined.

- **Pull Systems:** Taiichi Ohno rightly says “The more inventory a company has, the less likely they will have what they need”. As also discussed earlier, it is important to produce only as per the customer requirement, allowing a natural pull to be generated. This pull will be across departments, where one department will produce the required goods only as per the requirement of the next department. This is where the tool of Kanban finds its use.

A perfect flow system would be a zero-inventory system. But when pure flow is not possible, because the processes are spaced at a distance or when the cycle times to perform each operation varies a great deal, as it often is in the garment industry, the next best choice is the Kanban system.

What this means is that, whenever we are unable to create a one piece flow of the pieces in the factory, the next best thing is a pull system with defined inventory. This leads us to the concept of a “Supermarket”.

In any supermarket, whenever a product is picked by the customer, it is simultaneously replenished by the supermarket personnel. The personnel is not simply pushing inventory onto the shelf, nor is ordering anything from the suppliers, but just replenishing the products as and when required by the customer, so that it doesn’t dry out. The processes are scheduled in a manner that it is the process replenishing the product instead of a personnel. This also requires careful leveling and Kanban space planning to keep required checks and balances, and a visual tool to accentuate ‘pull’. Drawing a parallel to the garment industry, a supermarket is created between any two connected processes, where one process needs goods from the previous stage.

- **Value Stream Mapping:** Elimination of the waste from a process can happen only after identification of waste. Value stream mapping is the process of categorizing a complete chain of process into Value Added Work (VAW) and Non Value Added Work (NVAW). A value adding element is one which is carried by the final product. A non-value adding element is not carried by the final product. All non-value adding elements may not be possibly eliminated, but the process needs to analyze and decide which NVAWs are essential, and which can be eliminated. An example is notches used for matching of parts. Notch is not a value addition to the product, but it is required to ensure correct matching quality. Therefore, it is an essential NVAW.



Ticketing of inner parts which do not need a shade matching may be an example of dispensable NVAW.

- **Load Leveling:** When we talk of any form of line balancing, it is important to balance out production in all regards. This is done in the form of distribution of workload, to keep the process ‘evenly balanced’ with ‘distributed load’. This process is called heijunka.
- **Visual Controls:** MIS is an integral part of manufacturing. However, to be used as a process improvement tool, MIS should be real time, simple, accessible to the eyes at point of operation, and should

Case 1: Implementation of Pull System and Kanban in a Shirt Manufacturing Unit in Chennai, India

The Problem: The production facility of the client was not streamlined, which resulted in WIP accumulation in cutting as well as sewing sections. The loading on different sections was not as per priority, but as per capacity.

What We Did: The cutting and sewing sections were streamlined using the “Pull System”. This helped in managing the WIP. Further, the concept of baker’s trolley was implemented in the factory, where separate sections contained separate parts, and the amount of WIP flowing into the lines could be kept constant. Borrowing from the lean tools of Heijunka and Kanban, the concept of “Supermarket” was used at these sections, by which only a fixed WIP was stored in the supermarket. If more than the designated amount came in, an alarm was raised and the bundles were taken back. Also, the assembly supermarket was kept in sync with the cutting supermarket using the challan system.

Result: There was a reduction in the WIP from about 30,000 pieces of cutting and 70,000 pieces of sewing to a combined WIP of about 14,000 pieces. Further, the entire factory worked on a pull system, which streamlined the processes in the factory, eliminating bottlenecks and smoothening production.

invite action. Visual controls should be extensively implemented at all control points, WIP storage and transfer points. This greatly helps in defining the action plans for surplus, shortage and exceptions arising in the supplier processes.

Quality – Lean Way

Robust planning of Quality Assurance system is the pillar for effective implementation of Lean Manufacturing. ‘RFT’ or Right First Time philosophy is one of the pillars that hold Lean systems. RFT is achieved through disciplined intervention of tools such as ‘Jidoka’, ‘Poka Yoke’ and ‘TQM’. RFT is a discipline that helps build ‘internal customer’ protocols for QA system, thereby reducing the overall defect levels and thus enabling continuous flow. Let us examine Lean approach and tools to quality assurance in some detail.

- **Jidoka** is an approach to produce right parts, stop producing wrong parts and evolve the process continuously to do so. In some translations, it is referred to as ‘autonomation’ or ‘automation with a human touch’ where the automatic machine is supposed to check its output and stop when it is not producing as per specifications. In broader parlance, it means that a process should enable its sub-processes to check their output, correct it and stop themselves from producing further if they fail to do so, and seek help.

In order to build the culture of producing the right quality products the first time, the first step is to define what is right quality, what is wrong quality, and what is acceptable quality. The operators need to be trained on process components of these elements. This can be done by developing visual examples of acceptable and non acceptable components and parts. Involvement of process owners be it line in-charge or supervisors is important here to pass on the knowledge to the operators.

Also, internal customer protocols need to be defined here, so that the operators can check the pieces themselves before passing them. The next process or the operator should do a pre-acceptance check and reject an unacceptable WIP.

Furthermore, quality needs to be built into the process. Deskilling of operations by re-engineering of the workstation, installing jigs and automation are some of the ways of building in quality on the workstation for an output of high quality.

This entire approach of building the culture of quality in the process is loosely referred to as Jidoka. Jidoka is necessarily supported with an integrated exception management system, called ‘Andon’.

- **Andon:** Andon is both a process and a tool. Any alarm (light, signal, buzzer etc.) that is physically designed into the production system to be raised in case of a non-conformity is referred to as an andon.

As per The Toyota Way, “One of the leading American students of TPS, Alex Warren, former Executive Vice President, Toyota Motor Corporation, Kentucky, defined jidoka and andon and how it relates to employee empowerment: In the case of machines, we build devices into them, which detect abnormalities and automatically stop the machine upon such an occurrence. In the case of humans, we give them the power to push buttons or pull cords called andon cords which can bring our entire assembly line to a halt. Every team member has the responsibility to stop the line every time they see something that is out of



standard. That is how we put the responsibility for quality in the hands of our team members. They feel the responsibility, they feel the power. They know they count.”

The culture to stop the work to fix problems needs to be implemented in the work system. Whenever there is any quality related issue, an alarm needs to be raised, the production needs to be stopped, the problem needs to be identified and fixed, and only then, production should be restarted. The idea is to stop the process from knowingly generating unacceptable outputs. Andons can also be planted away from the process at audit locations to keep a guard on a defect that may have happened inadvertently, and alarm immediate corrective and preventive action.

- **Mistake Proofing:** Mistake proofing is implemented by using simple objects like fixtures, jigs, gadgets, warning devices, paper systems, and the like to prevent people from committing inadvertent mistakes. These objects are known as poka yoke devices, and this method of error proofing is known as Poka Yoke.
- **Standardized Work:** A core principle of lean manufacturing is that standardized tasks are the foundation for continuous improvement and employee empowerment. For any operation in garment manufacturing, standard ways and methods need to be developed. Standard work sheets and the information in them are critical elements.

Toyota President Cho describes it this way:

Our standardized work consists of three elements takt time (time required to complete one job at the pace of customer demand), the sequence of doing things or sequence of processes, and how much inventory or stock on hand the individual worker needs to have in order to accomplish that standardized work. Based upon these three elements, takt time, sequence, and standardized stock on hand, the standard work is set.

If any forms of defect are caught at any stage of production, the quality manager’s primary role should be go and check if the standard way of doing the job was followed or not. That will give the answers to the problems.

Standard work sheets and the information contained in them are important elements of the Toyota Production System. For a production person to be able to write a standard work sheet that other workers can understand, he or she must be convinced of its importance. High production efficiency has been maintained by preventing the recurrence of defective products, operational mistakes, and accidents, and by incorporating workers’ ideas. All of this is possible because of the inconspicuous standard work sheet.

-Taiichi Ohno (Source: *The Toyota Way*)

Case 2: Implementation of lean Concepts in a Quality improvement program in Bangladesh for a German Trade Body

The Problem: Unorganized housekeeping, leading to an unarranged workplace.

What We Did: Implemented the 5S cycle of Sorting, Straightening, Shining, Standardizing and Sustaining to organize the work place for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new order, also instilling ownership of the process in each employee.

Results: A workplace which is organized with better housekeeping.

- **Workplace Management:** It is said, “You never get a second chance to make the first impression!” A place for everything, and everything at its place. Cleanliness, hygiene and higher degree of process quality. Transparent operations facilitated by appropriate visual controls. These are some of the manifestations of a sublime operations’ philosophy, called 5S.

5S is not only about housekeeping or organizing the workplace; it also touches every aspect of organizational process including productivity, quality and information system.

A clean working area would ensure that the garment does not get stained. This would in turn contribute towards the reduced efforts in cleaning the garment in the finishing department. It would also lead to fewer rejections due to dirt and stains on the garments. Hence, by keeping the working area neat and clean and free from undesired items, the factory can very easily cut down on the cost of quality.

- **Root Cause Analysis:** A thorough Root Cause Analysis helps to identify, sort, and display possible causes of a specific problem or quality characteristic. This can be done by using various tools like Ishikawa Diagrams, the 5 Why Analysis etc.

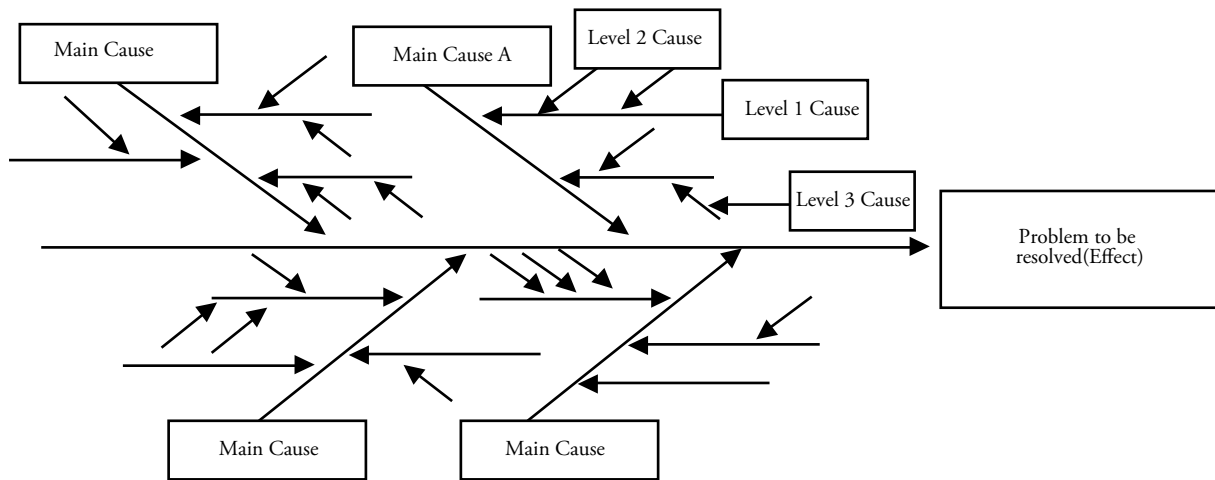
An Ishikawa diagram graphically illustrates the relationship between a given outcome and all the factors that influence the outcome. A typical Ishikawa diagram looks like this:

The 5 Why Analysis is a process whereby, if one repeatedly asks the question “Why” five times, one can peel away the layers of symptoms that can lead to the root cause of a problem. For instance a garment manufacturer, XYZ can use it this way:

1. Why our customers are unhappy? Because our on-time shipment in the last 2 months has been very poor.
2. Why has our on-time shipment in the last 2 months been so poor? Because our production was running behind schedule.
3. Why was our production running behind schedule? Because our fabric wasn’t moving to cutting section on time.



Exhibit 5



4. Why was our fabric not moving to cutting section on time? Because fabric inspection has rejected a large amount of fabric for not meeting quality standards.

5. Why are we rejecting so much fabric? Because sourcing of fabric was switched to a cheaper supplier that has inconsistent quality.

As we can see, this analysis gives us the final answer to the most important question that the company was facing.

Continuous Improvement: Lean Way

One of the most important steps in lean manufacturing is to become a learning organization through relentless reflection and continuous improvement. A lean implementation process is never complete; it needs to build upon itself. Implementation of Lean Tools is the beginning, relentless up-gradation, analysis and improvement on shortcomings and effective utilization of cumulative knowledge and experience in the organization are essential milestones of everyday lean journey.

The key philosophies in the path of Lean are:

Genchi Gembutsu: Genchi Gembutsu means ‘Go and see for yourself’. It means thorough participation in understanding and improving processes. It is important for process owners to have a fair understanding of their process components. They should solve problems and improve processes by going to the source and personally observing and verifying data on all possible occasions. The approach needs to be vociferously emphasized at all levels. Theorizing on the basis of what other people or the computer screen report may not always be a great approach. Improvements come only from detailed understanding.

Case: This Multi-Needle Chain-stitch machine used for front plackets in shirts was generating defects – there were many instances of uneven sewing width on the two sides of the placket. Alerting the QC station to watch out for this defect, opening the seams in several shirts and re-doing them had almost become a norm for many days, until when the Maintenance Manager decided to look at this machine. After a few minutes of keen observation, he could figure out that these machines typically generated more vibration than the single needle lockstitch machines. The folder attached to the machine used to deviate from its original position causing width variation. An additional screw was fixed on both sides and the problem was solved.

Hansei: Hansei means ‘Reflection’ or analysis of a process or activity that may have generated a bad output. The objective is to understand, learn and improve. Mistakes are a reality, and learning from mistakes is non-negotiable activity.

The idea is to encourage and acknowledge employees to introspect the shortcomings, feel sorry about it, learn, develop an alternate course of action and move on. There may be wider hansei sessions periodically to openly identify all the shortcomings and develop counter-measures to avoid repeating mistakes.

Kaizen: ‘Kaizen’ means ‘Continuous Improvement’. Kaizen is an approach to continuously upgrade the tools, methods or processes to deliver better value. Kaizen is implemented using various methods such as internal evaluation of process, use of infinite knowledge available with all the employees, root cause analysis for improvements etc.

Chapter 4

Apparel Manufacturing – The Lean Approach to Resources

The three key resources in any manufacturing process are Technology, Space and People. While people constitute the software, intellectual and implementation part of the process, the machines together with people become the execution part. Apparel especially is a labour intensive process but with very high dependence on technology. Generally, it is a one person one machine manufacturing process, adding up to make a chain or line. Therefore, very high technology uptime (amount of time the machine is running) becomes a key ingredient to output. Equally important is the person who is running the machine, as most machines are non-automated ones run by a person operating them. Naturally, the approach has to be:

- High degree of technology maintenance for maximum up-time
- Quick Response of maintenance in case of a unplanned downtime
- High degree of employee training, development and motivations
- Responsive mindset

Lean Approach to Technology Management

Machine maintenance is not a standalone activity. In order to ensure a high machine up-time, it needs to be

running when required, at optimum speed, delivering quality output, and adjusted to the process requirement. (Thus, a feed off the arm machine maintained absolutely well, equipped with the best of motor and puller, to be used in a side seam operation is useless, if it is not equipped with a suitable lap seam folder of required gauge and adjusted with desired alignment and fabric compatibility)

The key tools or principles for Technology Management through Lean can be summarized as:

- TPM or Total Preventive Maintenance
- SMED or Single Minute Exchange of Dies or Quick Changeover
- Technology Induction

Total Preventive Maintenance (TPM): Total Productive maintenance system should aim at three pronged benefits:

- Significantly Lower Unplanned Downtime
- Quick response in case of a downtime
- Higher Overall Equipment Effectiveness

TPM aims to achieve the above by a structured total productive maintenance approach, detailed below:

Structured Preventive Maintenance: In preventive maintenance, all equipments are grouped for a fixed maintenance cycle at periodic (pre-defined) intervals. For this, a defined checklist is created. It is also facilitated with a colour-coded maintenance visual control chart.

Autonomous Maintenance: In this form of maintenance, certain routine maintenance activities are executed by the user (operator). This can include cleaning, lubrication, needle change, threading, tension checking etc. This form of maintenance is facilitated with structured maintenance training for the user.

Root Cause Analysis for all unplanned downtime: Any kind of breakdown of machines is analyzed for its root cause. Recurring problems, such as skip stitches, folder mis-alignment, high needle breakages etc. are eliminated by the fundamental correction approach. Occasional problems are analyzed and eliminated by corrective methods implemented in the prevention process to avoid recurrence

Planning for Quick response in case of a downtime: This is done through parallel preparations. The functions keeps a real time update of processes and plans buffer/standby machines that can be plugged in on immediate requirement. This tool works especially for low capital cost technologies, as in the garment industry.

Predictive Maintenance: A combination of QR, preventive maintenance and downtime analysis creates way for predictive maintenance. The function matures to a stage where it can predict with higher accuracy of certain downtimes related to specific processes.

Once this knowledge is developed, this predictive maintenance approach can be merged into preventive maintenance in certain cases

Overall Equipment Effectiveness (OEE): OEE is a product of machine uptime, adherence to rated capacity or planned speeds and adherence to output quality. Therefore, Equipment utilization is quality output from the machine at planned speed with planned up-time. TPM function plays the role of ensuring that the machine is maintained to deliver its optimum capacity.

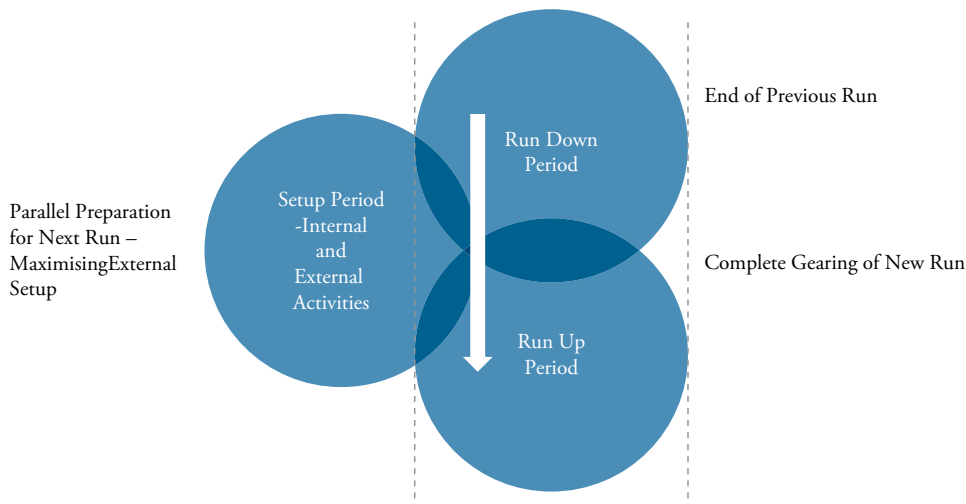
OEE can be a powerful benchmark in technology intensive industries, such as textiles, where it serves as the yardstick of productivity and quality of machine output vis-à-vis its potential. Equipments with higher OEE can simply qualify for an additional investment decision in case of a capacity expansion. Lower OEE indicates one or more of the following:

- lower machine usage
- lower output
- Higher downtime

Above can be on account of sub-optimal process definition, poor training or a fundamental irregularity with the equipment type or maintenance.

SMED or Quick Changeover: Changeover is the process of converting a line or machine from producing one product to another. This leads to a lot of time spent in an activity that actually has no end usage, and eats up a lot of time that is meant for production. To reduce the changeover time, sequential processes need to be converted into parallel processes. The activities that can be moved out of the line should be moved out for external setup, and can be plugged back subsequently. Within mandatory internal setups, activities can be scheduled

Exhibit 6



or pre-planned in a manner that the speed of process changeover is maximized (instead of experimenting with real time hits and misses).

Case 3: Setting up a World class Management System on the Principles of lean Manufacturing at a Manufacturing facility in Lahore, Pakistan

The Problem: Setting up a factory that works on lean concepts with minimized changeover time.

What We Did: SMED guidelines were implemented across factory to ensure “No Zero Output Day” during style changeovers. The IE team was trained on SMED guidelines. Lean 101 workshop was conducted for all departments including merchandising, fabric and exports. Kaizen events were organized. Concepts taught included standardization of the quality criteria across employees, reduction in machine downtime. The processing department conducted a Kaizen event on “How to control the width variation on compactors”.

Results: Reduction in style changeover time from 450 minutes to 185 minutes.

In the garmenting setup, SMED can prove to be a very effective tool during style changes. During this process, a lot of time goes to waste to set up and arrange the desired machinery. In many cases, even a simple thing like adjustment of machine tension is arrived at after a lot of time spent in trials. There are instances of substantial changeover activities even when the product type is same, but there are little variations like gathers, pleats etc. The situation is worse in case of units handling small orders, involving short cycles and frequent style changes. SMED approach can be depicted as below:

Technology Induction: Technology that should be used in the lean processes must be reliable, thoroughly tested and should be made convenient for usage by the people. There is no point in introducing a cutting edge, out of the world technology which the user cannot understand, relate to and use. However, it does not mean that the process should not keep pace with ongoing developments. Whenever a new technology is planned, there should be a thorough analysis on its relevance to the factory, and a detailed induction plan should be in place. Technology’s role should be to assist people drive the company goals faster and its induction should be clearly driven by the desired role.

Lean Approach to Space Management

Space planning should aim at optimization of two important wastes – excess motion and excess transportation. Layout planning that facilitates continuous flow while ensuring waste reduction helps optimize the space requirement for a manufacturing

process. Lean layouts are designed to optimize production per space used, by avoiding extra storage, WIP and reverse movements. It is made by streamlining all operations. Reverse movements and criss-cross movements add a lot to process time or resources.

Lean manufacturing focuses on making layouts either linear or cellular or an optimized combination to minimize movements.

Lean Approach to Man Management

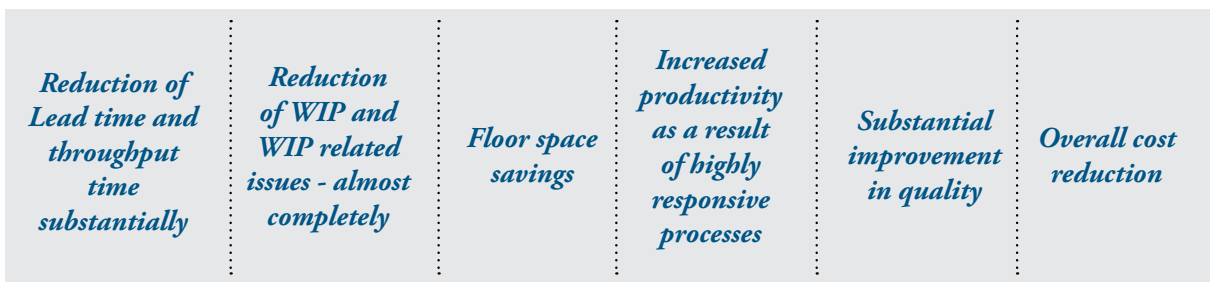
Every activity in apparel manufacturing has a human touch to it. Therefore, utilization of obvious and latent capabilities of manpower is critical to the performance of the organization. As Mr. Fujio Cho, former President of Toyota Motors reiterates: “At Toyota, we get brilliant results from average people managing a brilliant process; others get average results from brilliant people managing broken processes”. Toyota system approaches this critical resource as below:

- **Leadership Development:** Lean systems call for internal capability development. The focus should be to develop leaders from within the organization, rather than scouting from outside. These leaders MUST be the role models of the company’s philosophy and way of doing business. They should understand the daily work of the company in detail so that they can be the best instructor of the company’s Lean philosophy.
- **Developing Exceptional People, Teams and Culture:** The HR team should look to create a strong and stable culture in which the company values and beliefs are shared. People should be trained and retrained to work within the corporate philosophy to achieve the desired results. Teamwork should also be encouraged, so that teams can move towards a common goal.
- **Building Consensus:** ‘Buy in’ or appreciation of why something needs to be done is very important to build ownership within an individual or team. An implementation should be preceded by a thorough evaluation of its merits. One should not pick a single direction without considering all the alternatives to arrive at a convincing agreement on the course of action.
- **Involving the Extended Network of People:** It is critical to involve the extended network of people around the organization in the process of lean. This involves the fabric and trims suppliers, the buying offices, and even the buyer for that matter. The factory should be driven to improve its own systems and then show the people around as to how that improves their work.

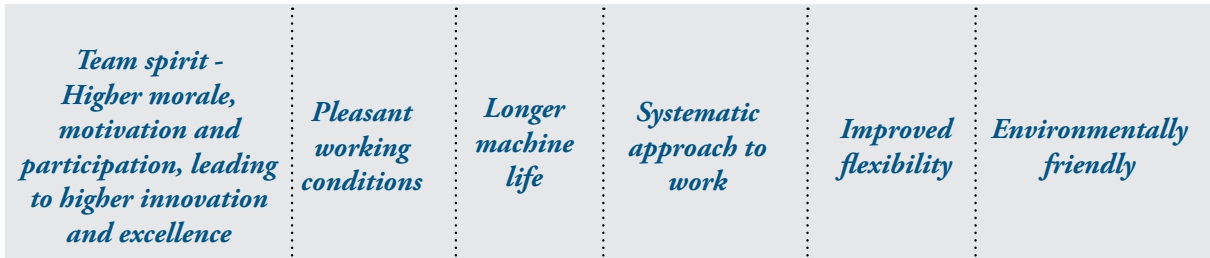
Chapter 5

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:



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



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: A Case Study

An organisation, XYZ Limited 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 ABC Limited 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 .

KPIs	Conventional Factory	Lean Factory	Variance
	XYZ Ltd.	ABC Ltd.	
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%

Chapter 6

Lean Manufacturing: Role of Leadership and Human Resources

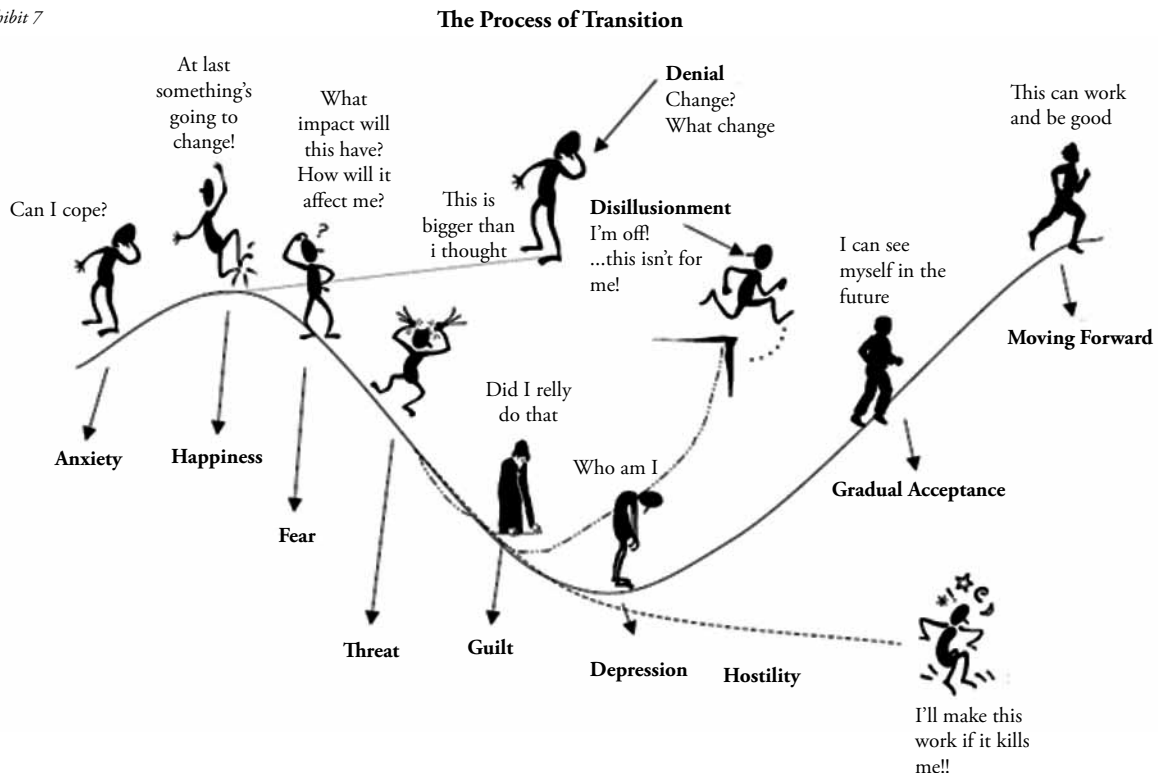
The Lean way was born in the automobiles industry where application of machinery and technology is far -far higher than in the apparel industry. Lean advocated the empowerment of manpower in an industry where manpower involvement is relatively low. The industry was still revolutionized by Lean concepts, where people were empowered to run machines, assemblies and processes by well defined processes and even stop it at ignoring the huge running cost that company would lose.

The Apparel Industry has always moved towards low cost location. Human-ware becomes a key business driver along with other factors like raw material and location advantages. Machinery and technology assist the human element in the apparel trade. Lean could possibly

revolutionize this industry by taking the immense human capital alongside. The human element of lean is in total sync with the people's side of apparel trade.

People participation is the core of Lean implementation program. Unlike the machinery which depreciates overtime, people with innate and acquired skills develop into long term assets, and become the core to the continuous improvement of the organization. The role of leaders and HR as a main change agent and their contribution in creating, identifying and developing people and leaders is a key to lean implementation. The table below depicts the mindsets during various stages of a change. HR can play a constructive role in smoothening adverse phases of change.

Exhibit 7



Source: www.businessballs.com



The challenge in the people management is how to prevent the initial feelings of anxiety, happiness, fear not converting into threat, guilt, and depression. Rather than leap frog them to acceptance and moving forward an organization can look at achieving its defined goals by people participating in the change and growing as leaders.

HR assists the organization leadership in the change management. The key issues to be addressed are

- Why Change?
- What's there for people in the Change process?
- How to convert the initial insecurity to the “Positive mind frame” of leaders in their areas of focus within the organization.
- Develop a framework where results are an outcome of a “right process”. Designed and implemented by people. A clear appraisal policy based on process and delivered results go a long way to assure people about the objective nature of “Change”.
- The long term objective is to develop exceptional people and teams who follow company's philosophy (The Toyota way).

The Human Resource department can significantly speed up the success and benefits of the Lean initiative. The Leadership and the HR team needs to lay a foundation of the Lean culture by initiating the following functions

- Right Recruitments and Internal Selections.
- Defining people development framework and appraisal systems.
- Clearly defining the expectations from teams and individuals, SMART goals (Specific, Measurable, Attainable, Realistic and Tangible).
- Encourage brainstorming and counseling sessions.
- Encourage the Lean drive through the organization through awareness campaigns.

The idea is to integrate the departments and functions of an organization into a team.



Chapter 7

Why Lean Implementation Sometimes Fails?

Lean is a ‘way of working’ towards elimination of waste. It requires transition of behavior and methodology that may be deep rooted within an organisation. When an organisation chooses to go Lean, it also stirs the entire system. Not surprisingly, there will be instances where it is said to have been of a limited advantage, if at all.

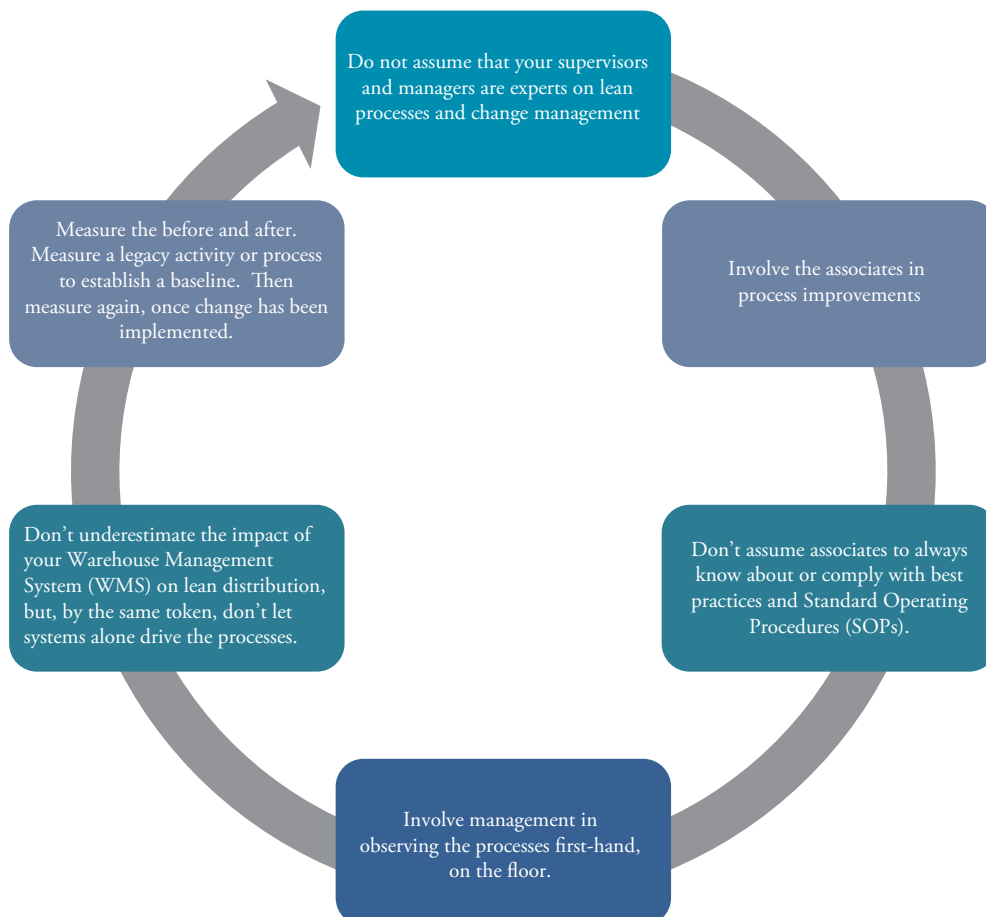
Lean is a fail-proof system – an effort that is supposed to eliminate waste cannot generate waste, an effort that surfaces problems cannot itself be a problem, and an

effort that makes one responsive cannot be unresponsive. However, it may also be natural to sometimes get shocked by the realization of waste within our system, to get muddled by knowing our problems and to resist a blow that tries to wake us up from the slumber and make us responsive. And so it is easy to say that the messenger who is trying to wake us up be shown the door.

Some of the reasons why Lean methodologies may fail to see the light of day could be:

Exhibit 8

Snippet: Key Pointers for Successful Implementation



- **Lack of long term support and drive by Top Management:** Lean is a methodology which aids continuous improvement. Top management must acknowledge the fact that lean manufacturing is a long term philosophy, and at the end of the day, it WILL give the desired goals.

It is a pursuit where short term setbacks might need to be embraced for long term benefits. So the initial setbacks on achievement of a key objective should not be the reason for scaling down of ambitions or diluting the efforts. The leaders need to always focus on “Continuous Improvement” and not get overly excited or de-motivated by the initial results. Simultaneously, the program drive reduces once the “newness” of the Lean gimmick dies down. In such cases, the management needs to firmly demonstrate the seriousness to embed Lean thinking in the culture.

- **Buy-In of the Team Missing:** A lot of times, the people working in the factory are not clear why Lean is being implemented and why such changes are being done to the various systems and processes. In that case, the team will never buy in to the concepts of lean. “Lean becomes one of the organization gimmicks which customers talk about for good factories”.

Lean should come out as a drive by the people and for the benefits of organization as a whole and hence its people, assisted by organization leaders. Otherwise it becomes an extra activity required to be done causing one of the lean waste “Overburden”.

- **Lack of Consensus:** Any decisions that are made in the implementation of the project should be made by consensus, thoroughly considering all the options and implementing the decisions rapidly. No one should pick a single direction and go on that path until one has thoroughly considered all the alternatives. This process is called Nemawashi.
- **Lack of Lean Culture and Discipline:** Lean culture can be defined as a work environment which respects people and their thoughts but discipline can integrate them in terms of defined processes.

One reason for failure of Lean is lack of this understanding and discipline among the employees. Employees can often be tempted to go back to the old ways of doing a particular work because they were more ‘used to’ it. That is where they get it wrong, and the entire Lean process can go to waste. Here the leaders would be the key driving force in the entire Lean implementation project.

- **Not combining the right Lean Tools:** There are tools that can function alone, like 5S, but in most cases all the tools are interrelated. For instance, JIT can’t be attained without the involvement of TPM and TQM.

Thus, not combining the right lean tools can also lead to failure of lean. It’s about identifying waste and removing it with a right approach. Example: going to a single piece flow without attending to what makes the system work will make the effort fail, even causing huge losses and loss of faith in lean initiatives.

- **Continuity and Sustenance of Implementation:** Lean manufacturing is a never ending process. It may not create initial wonders. It’s a process that takes time and resources. It is then the responsibility of the top management that they are not discouraged by the teething problems and give up on the entire process. What is then needed is sustenance of the efforts. Another case is when lean has been successfully implemented, but not followed up with the same passion. Lean is for enterprises that aim at long term value. It is not meant for advocates of crisis management. It is for enterprises that want to stay away from long term crisis. Rome was not built in a day, and Toyota became the world’s largest carmaker after 70 years of existence.
- **Change Management:** Lean manufacturing brings about a variety of changes in the organizational structure and working environment. People may be receptive to changes, but it is human if they are not. The HR team has to help in managing the change in such a way that people are positive towards it. It always helps to keep all the people in the loop when discussing the impact that the changes will incur in their life.

To Summarize...

“Until senior management gets their ego out of the way and goes to the whole team and leads them all together.... Senior management will continue to miss out on the brain power and extra ordinary capabilities of the employees. At Toyota, we simply place the highest value on our team members and do the best we can to listen to them and incorporate their ideas into the planning process”

-Alex Warren, Toyota Motor Manufacturing, Kentucky. The Toyota Way

Lean production raises the threshold of acceptable quality to a level that mass production cannot easily match. It offers ever-expanding product variety and rapid responses to changing consumer tastes. It lowers the amount of high-wage effort needed to produce a product, and it keeps reducing it through continuous incremental improvement. Lean can deliver huge benefits to any business by following a proven path

Snippet: No enterprise can ever be totally Lean

Lean is a pursuit to manufacturing perfection. Perfection is relentless and evolving, and hence elusive. However, the journey to perfection is full of rewards. The maturity of lean implementation may vary and 'total lean' may continue to be elusive throughout the organizational life. It is often seen that no factory can be totally lean, even if the level of implementation is very high. Though, partial lean is not bad either.

A lean enterprise is one that:

- Plans its sourcing, production and deliveries on the basis of 'Takt Time'
- Is alive to identifying and eliminating waste
- Is alive to value added and non value added activities in its processes, and tries to reduce NVAWs continually
- Understands the negative impact of having WIP, and continuously works on improving its processes to reduce WIPs to surface the problems and make its system 'responsive'
- Understands the importance of 'Right First Time' and 'Internal Customers' and drives its quality assurance processes accordingly
- Understands the immense potential of its people, the cost of an idle machine, the evils of a sub-optimal process and the hidden learning in a failed process, a down machine and an error prone human.
- Practices 5S as a way of organizational life

A Lean enterprise is one that is on a never ending journey since the entire above have to be done everyday, relentlessly. A lean enterprise is one that knows, 'it can never be totally lean'

approach. Success can be achieved provided the commitment is there at a senior level and that companies recognize the need for some external support. And a word of caution, **Lean is not about some slogans and 5S posters, it is a way of organizational life far beyond the visual comprehensions of the method.**



About - Apparel Operations

One of Technopak's oldest divisions, Apparel Operations, has unparalleled expertise in apparel manufacturing and best practices implementation. This division provides assistance to clients in initiating the apparel business and re-engineering existing operations. Our extensive Body of Knowledge and Best Practice know-how help clients to set-up manufacturing systems, train personnel and achieve high levels of performance to enhance profitability.

Technopak has in-depth understanding of all operational processes of apparel manufacturing. We have assisted in diagnostics, reengineering, process improvement, lean tools implementation, middle management & operator training and start up of numerous factories, in dozens of countries, and in several product categories. Our global footprints include hundreds of clients in Bangladesh, Pakistan, China, Sri Lanka, Kenya, Senegal and Pakistan. Over 98% of our clients who were surveyed wanted to engage Technopak again and even proposed to recommend us to friends and colleagues. Broad scope of our interventions include:

Factory Start Up

Activities can be broadly mentioned as:

Planning and Design of Factory

- Selection of Technology
- Designing of Production System
- Plan the Factory Layout

Selection & Training of Middle Management

- Define Organization Structure
- Assistance in Recruitment and Training of Middle Management

Implementation

- Engineer Operations and Systems
- Implement AAMTà and Build up of Efficiencies
- Implement Production and Quality Procedures
- Implement Best Practices and Processes – Lean, Six Sigma, TOC Principles.

Business Process Reengineering (BPR)

BPR interventions include organizational restructuring and process reengineering, as well as the deployment of an integrated information system. Technopak, through innovative solutions, helps organization to streamline their processes, enabling smooth functioning across various departments. Our innovative process solutions help transform the average factory by:

- Improving the planning processes and target setting & communication
- Improving throughput and order fulfillment efficiencies
- Establishing and driving performance (KPI) monitoring tools
- Improving overall performance by Implementing Best Practices and Processes – Production Engineering, Lean, Six Sigma, TOC.



About Technopak

India's leading management consulting firm with more than 20 years of experience in working with organizations across consumer goods and services.

Founded on the principle of “concept to commissioning”, we partner our clients to identify their maximum-value opportunities, provide solutions to their key challenges and help them create a robust and high growth business models.

We have the ability to be the strategic advisors with customized solution during the ideation phase, implementation guide through start-up and a trusted advisor overall.

Drawing from the extensive experience of 150+ professionals, Technopak focuses on six major divisions, which are Fashion & Textile, Retail & Consumer Goods, Healthcare, Education, Food & Agriculture and Leisure & Tourism.

Our key services are:

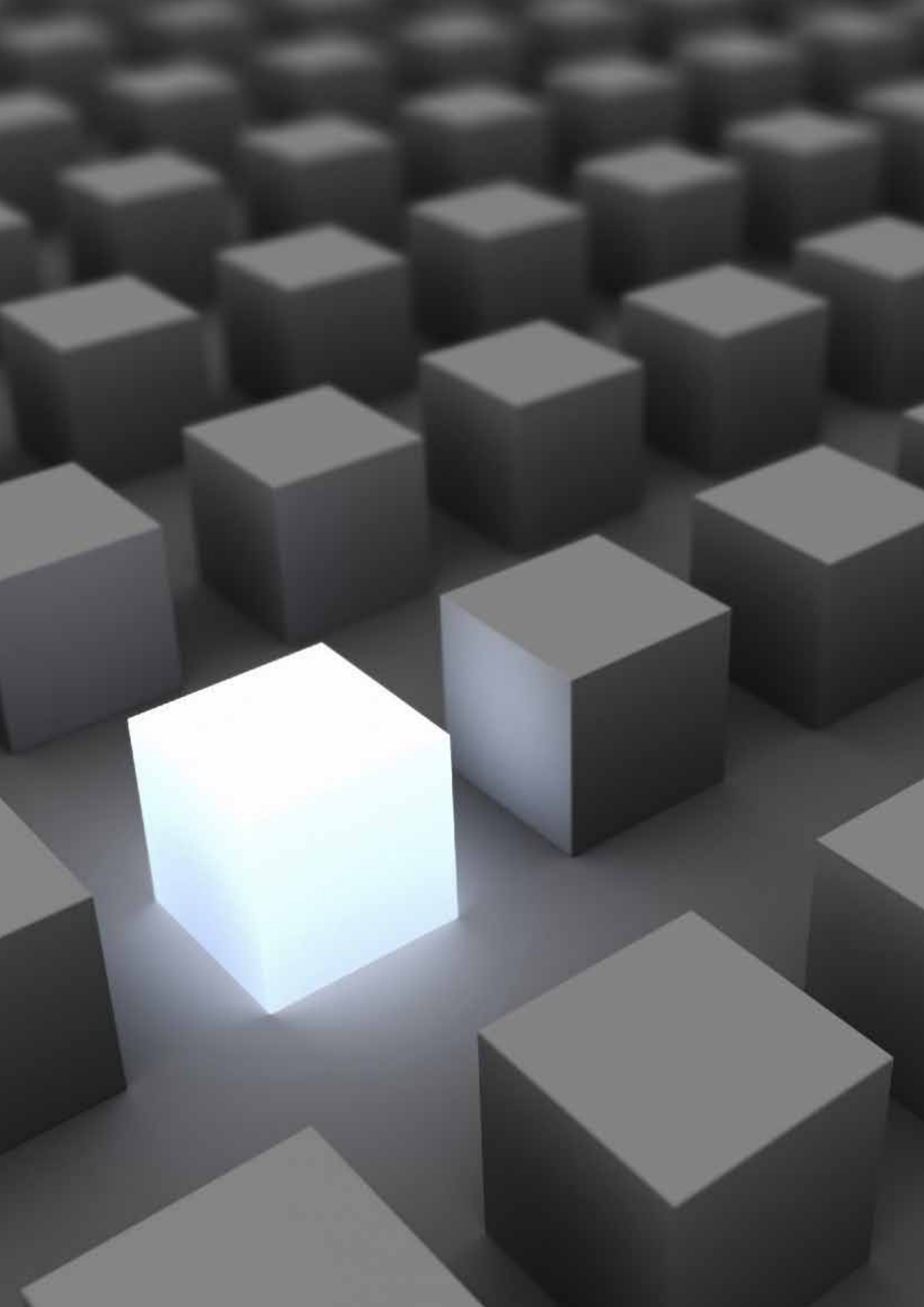
Business Strategy. Assistance in developing value creating strategies based on consumer insights, competition mapping, international benchmarking and client capabilities.

Start-Up Assistance.: Leveraging operations and industry expertise to ‘commission the concept’ on turnkey basis.

Performance Enhancement. Operations, industry & management of change expertise to enhance the performance and value of client operations and businesses.

Capital Advisory. Supporting business strategy and execution with comprehensive capital advisory in our industries of focus.

Consumer Insights. Holistic consumer & shopper understanding applied to offer implementable business solutions.



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