

Kombolcha Institute of Technology(KIOT)

Course Title :

Lean System Engineering

Target group:

2nd Year Garment Engineering Student

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Course objective after completion of the course, you will be able to:

- Understand about the Lean, history of Lean.
- Know about the elements and classification of Lean.
- Students will be able to present an argument on why Lean is a superior environment to Mass production.
- Compare and contrast the culture, organizational structure and leadership in Mass and Lean environments.
- To understand Types of Waste in Apparel industry and why waste elimination is a core component of Lean Manufacturing.
- List and describe lean functionality
- Understand A3 thinking and draw an A3.


Chapter One

The Birth of Lean Manufacturing

- Definition of lean system
- Revolution on manufacturing system
- Craft Production and Mass Production
- Ford System and other Developments
- Birth of Lean Production
- Toyota production system

INTRODUCTION

- Lean manufacturing is a philosophy pioneered by Toyota Motors (and codified by James P. Womak's The Machine that Changed the World: The Story of Lean Production)
- Lean Manufacturing is a systematic approach for achieving the shortest possible cycle time by eliminating the process waste through continuous improvement



Waste (“muda” in Japanese) is
‘anything other than the *minimum*
amount of equipment, materials,
parts, space, and worker’s time,
which are absolutely essential to
add value to the product.’

— Shoichiro Toyoda
Founder, Toyota



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Revolution of manufacturing system

Craft Manufacturing

- Late 1800's
- Car built on blocks in the barn as workers walked around the car.
- Built by craftsmen with pride
- Components hand-crafted, hand-fitted
- Good quality
- Very expensive
- Few produced



Prior to the Industrial Revolution

- most products were manufactured by craft techniques
- This required:
- development of skills
- sources of materials and energy
- sales and distribution
- relationship of craftsman or designer with client or consumer.

Small scale production methods

- *craft production* - A small-scale production process centered on manual skills
- *one-off production* - An individual (often craft-produced) article or a prototype for larger-scale production.

Craft Production

- Works if
- Small economies of scale
- High value of the product
- Area of lower labor costs (relative)
- High flexibility in manufacture (specialized individual orders)

Craft Production

- May be an option in developing countries when Economic development, infrastructure and market needs are considered,
- In developed countries it gives rise to the "master craftsman"



Traditional View of Manufacturing

- A key objective was to fully utilize production capacity so that more products were produced with fewer workers and machines.
- This thinking led to large queues of in-process inventory waiting at work centers.
- Large queues meant workers and machines never had to wait for product to work on, so capacity utilization was high and production costs were low.
- This resulted in products spending most of their time in manufacturing just waiting, an arrangement that is unacceptable in today's time-based competition.

Mass Manufacturing

- Assembly line - Henry Ford 1920s
- Low skilled labor, simplistic jobs, no pride in work
- Interchangeable parts
- Lower quality
- Affordably priced for the average family
- Billions produced - identical



Traditional Manufacturing

Traditional “mass production” manufacturing systems are characterized by:

- High volume production of identical products. (Low variety/high volume)
- High direct labor costs.
- Production organized around large “batches” between operations.
- High inventory levels (raw, WIP, finished).
- Long lead times and long cycle times.
- A focus on individual labor and machine efficiency.
- Management of quality through inspection and rework rather than prevention.
- Strong functional organizations and strong divisions between the functions.

In these manufacturing companies, there are very high levels of inventory, and long delays in the time from purchasing raw materials to actually selling the product and receiving revenues.

In traditional companies lead times often exceed three to six months, and inventory can equal to 30% to 40% of total annual sales. These systems are increasingly being replaced by “lean” manufacturing systems based on the Toyota Production System.

Weakness of traditional system -

- Risk related to forecasts.
- Long overall business cycle.
- Buffers in various stages leading to slackness in the system.
- Encourages departmental focus.

■ Wastes associated with traditional system –

- Waste due to waiting time of men, machine, material
- Waste due to un-necessary movement of material.
- Waste due to In-process inventory.
- Waste due to producing defective goods.

Birth of Lean Production

- After World War I, Henry Ford and General Motors' Alfred Sloan moved world manufacture from centuries of craft production-led by European firms-into the age of mass production.

Largely as a result, the United States soon dominated the global economy.

- After World War II, Eiji Toyoda and Taiichi Ohno at the Toyota Motor Company in Japan pioneered the concept of lean production.

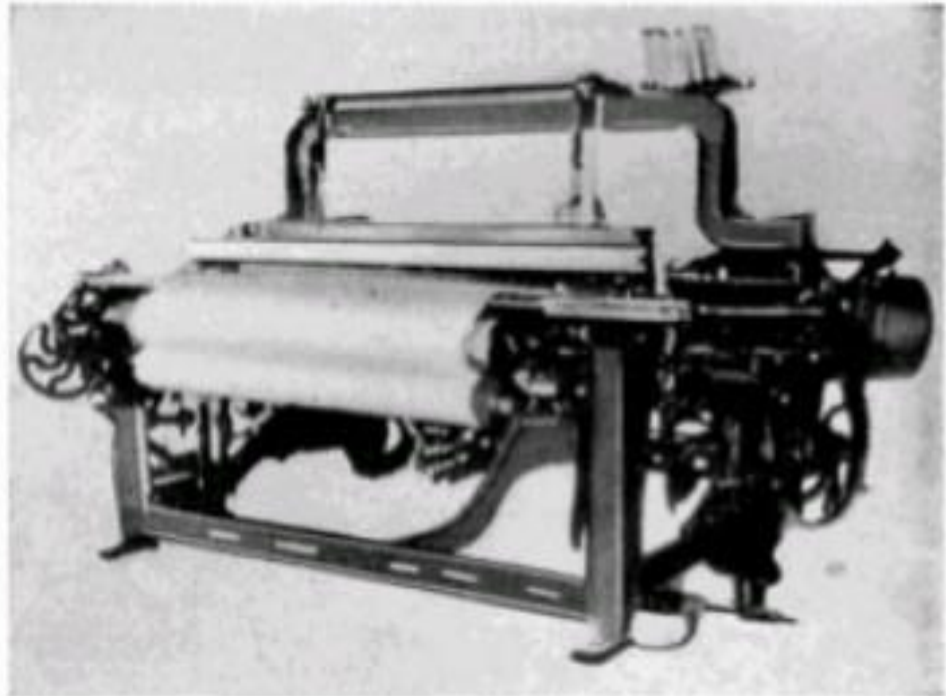
The rise of Japan to its current economic preeminence quickly followed, as other Japanese companies and industries copied this remarkable system.



Kiichiro Toyoda

(June 11, 1894 – March 27, 1952)

He was a Japanese entrepreneur and the son of Toyoda Loom Works founder Sakichi Toyoda. His decision to take Toyoda Loom Works into automobile manufacturing would create what would eventually become Toyota Motor Corporation, the world's largest automobile manufacturer.



He invented the system called “Just In time”

Lean Basics - History



Henry Ford (July 30, 1863 – April 7, 1947)

He was an American industrialist, the founder of the Ford Motor Company, and sponsor of the development of the assembly line technique of mass production.

His introduction of the Model T automobile revolutionized transportation and American industry.



Lean Basics - History



Taiichi Ohno (February 29, 1912 – May 28, 1990)

He was a Japanese businessman.

He is considered to be the father of the Toyota Production System,

He wrote several books about the system, including Toyota Production System





Jams P. Womack

He is a author of "The Machine That Changed the World". The book has been translated into eleven languages.

He was the research director of the International Motor Vehicle Program (IMVP) at the MIT in Cambridge, and is the founder and chairman of the Lean Enterprise Institute.



Lean Manufacturing

- Cells or flexible assembly lines
- Broader jobs, highly skilled workers, proud of product
- Interchangeable parts, even more variety
- Excellent quality mandatory
- Costs being decreased through process improvements.
- Global markets and competition.



Lean Manufacturing Characteristics

- Focus is on the improvement of resource utilization:
 - Equipment setup time reduced
 - Scheduled machine maintenance
 - Orderly, clean workplace
 - Pull production being used
 - JIT inventory control
 - Factory layout in workcell arrangement by products
 - Active error elimination
 - Improved quality, etc.

Lean vs. mass Production

Factor	Mass production	Lean production
Skill level of work force	Narrow skilled professional	Multi skilled professional
Machine Layout	Single purpose	Multi purpose
Production method	High volume standardized product	Customer focused production process.
Inventory	Large Buffer Stock	Minimum in process inventory
Product Flow	Single product	Mixed flow
Lead time	Very high	Less

Toyota Production System (TPS)

- Definition: The production system developed by Toyota Motor Corporation to provide best quality, lowest cost, and shortest lead time through the elimination of waste.
- TPS is comprised of two pillars, Just-in-Time and Jidoka (autonomation) , and is often illustrated with the "house" shown on the next slide.
- TPS is maintained and improved through iterations of standardized work and kaizen (continuous improvement), following Plan–Do–Check–Act (PDCA Cycle from Dr. Deming), or the scientific method.

House of Toyota



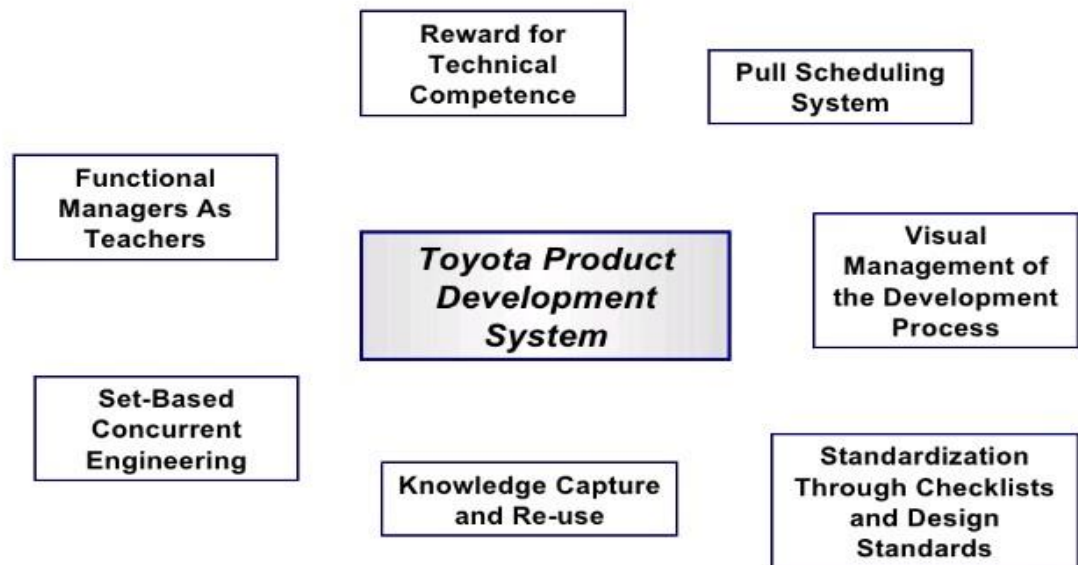
Toyota Production System "House"



Toyota Production System

- Philosophy. (Long term thinking)
- Process (Eliminate waste).
- People & partner (Respect, challenge & grow them).
- Problem solving (Continuous improvement & learning).

Key Elements of the TPDS



Key Elements of the TPDS

Element	Description
<i>Manager=Teacher</i>	<ul style="list-style-type: none">•Managers are the most technically competent engineering•Their primary role is to teach by asking questions
<i>Reward for Technical Competence</i>	<ul style="list-style-type: none">•Authority in the system derives from technical knowledge•“At Toyota, your boss can always do your job better than you.”
<i>Pull Scheduling</i>	<ul style="list-style-type: none">•No elaborate sub-schedules; chief engineer sets “key integrating events”•Work is “pulled” to these events•Milestones are never missed
<i>Set-Based Concurrent Engineering</i>	<ul style="list-style-type: none">•Multiple alternatives developed for each sub-system•Combinations that meet performance tradeoffs “survive”
<i>Knowledge Capture & Re-use</i>	<ul style="list-style-type: none">•Standardized “performance tradeoff” data collected for each alternative•Engineers required to be knowledgeable about all solutions
<i>Standardization</i>	<ul style="list-style-type: none">•Detailed engineering checklists and design standards used to assure focus on product performance
<i>Visual Management</i>	<ul style="list-style-type: none">•Visual control boards used to track all aspects of the product development process