

A close-up photograph of a burlap sack filled with dark brown, roasted coffee beans. Three metal scoops are partially buried in the beans, their handles extending upwards. The lighting is warm, highlighting the texture of the beans and the coarse weave of the sack. A small, faint white star is visible on the right side of the sack.

Lean System

Asst.Prof.Dr.Chaithanaskorn Phawitpiriyakliti

Phone :

081-922 9055

Email :

drru61@gmail.com

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Learning Objectives

1

To study the meaning and importance of the Lean system.

2

To study the 7 wastes (Muda) in operations.

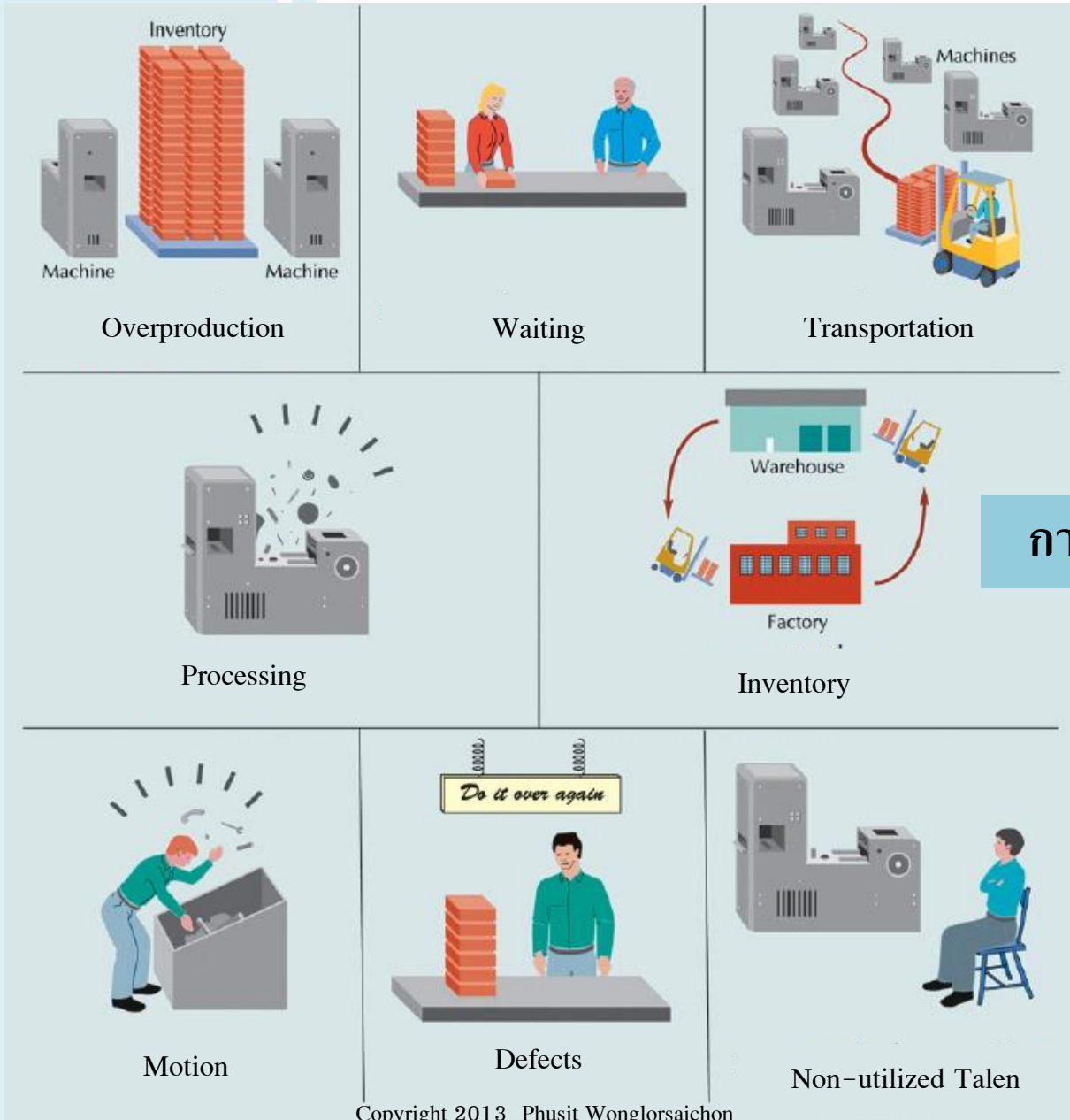
3

To study the guidelines and patterns for Lean implementation in operations.

4

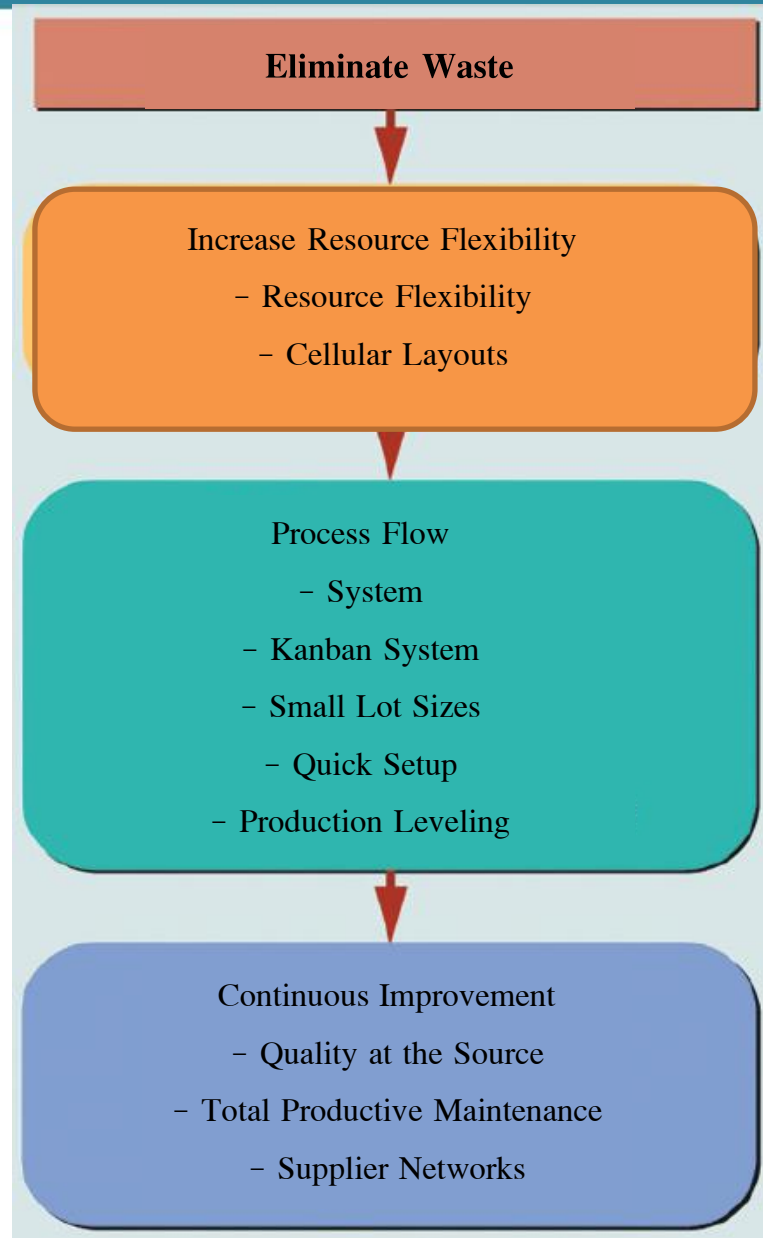
To study the benefits and applications of Lean production.

Definition and Importance of Lean System



การสูญเสียจากการดำเนินงาน

The Basic Elements of Lean Production



The Basic Elements of Lean Production

Flexible Resources

Concept: A model where employees are capable of working in various sections (Multifunctional Workers) and machines can perform multiple functions (General-Purpose Machines). This requires a work rotation schedule that displays the time taken to complete one work cycle based on assigned tasks, known as Cycle Time. This must align with the maximum time available for production to meet customer demand, known as Takt Time.

Benefits: This helps reduce waste caused by the time spent moving products to other machines, machine setup time, and waiting time at each machine.

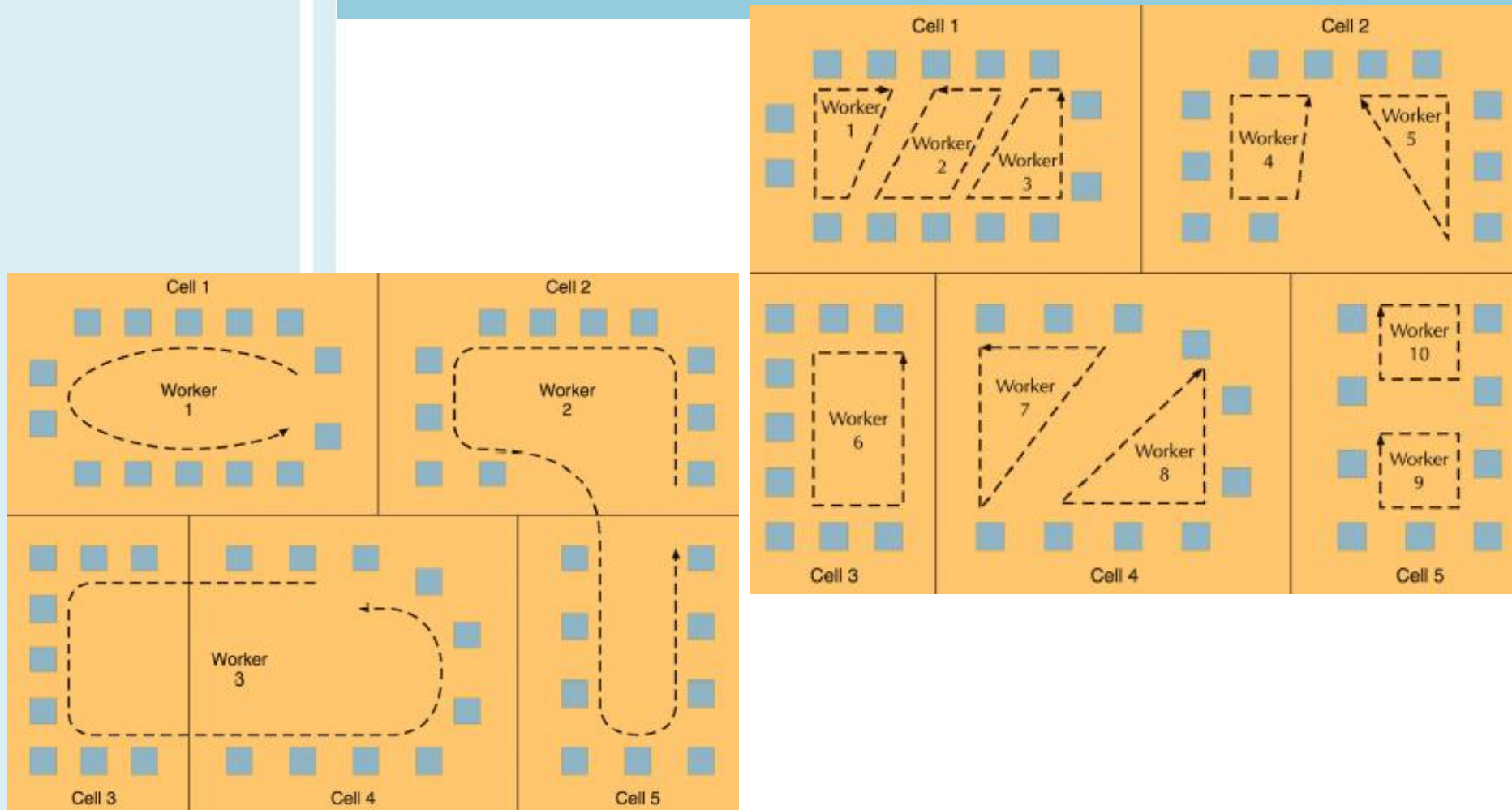
Cellular Layouts

Concept: This is a Cellular Manufacturing (Manufacturing Cells) approach, which involves grouping different types of machines in one location to produce similar parts. The layout is arranged like a small assembly line, typically in a U-shape (U-Shaped), where work moves within the cell.

Benefits: This helps reduce waste from machine setup time and allows for smaller production lot sizes, which leads to faster transportation and handling times.

Cellular Layouts

Small units and worker paths .



The length of the worker's travel path decreases as volume is reduced.

Pull System

This system was developed based on the concept of supermarket shelving, where products are replenished according to the amount purchased by customers. This triggers an order only when there is demand for the quantity sold, resulting in a reduction of inventory. This differs from conventional production systems where production is planned in advance, and each process is "pushed" to completion based on a predetermined quantity, known as a Push System. In contrast, in a Pull System, employees produce only when requested and stop production once the required quantity is met, which necessitates collaboration among workers.

It helps reduce waste caused by overproduction or underproduction and decreases the amount of inventory. However, the pull system must be used in conjunction with the Kanban system to increase control efficiency.

Kanban System

A card displaying items that contains basic information.

Kanban is associated with a fixed-quantity inventory system, which makes it clear when an order needs to be placed once the inventory level falls below the reorder point. This management system is also known as the Two-Bin Inventory System. The first bin contains the quantity ordered minus the reorder point, while the second bin contains the reorder quantity. A card detailing the product specifications is placed at the bottom of the first bin and is sent to the supplier once the first bin is empty. While the new materials are being ordered, the materials in the second bin are put into use.

The Basic Elements of Lean Production

Kanban System

However, the system may utilize only the second bin by placing an order card (Kanban) on top of it to trigger the ordering process. Once the materials arrive, the supplier then prepares the materials for the next order. Consequently, the inventory level will be equal to the amount used until the new order arrives; this is known as the Kanban Inventory System.

The Kanban system supports a pull system by controlling the movement of materials and production.

**Dual Kanban
System**

Withdrawal Kanban

Production Kanban

**Other types
of Kanban**

Square Kanban

Horizontal Kanban

Signal Kanban

Postal Kanban

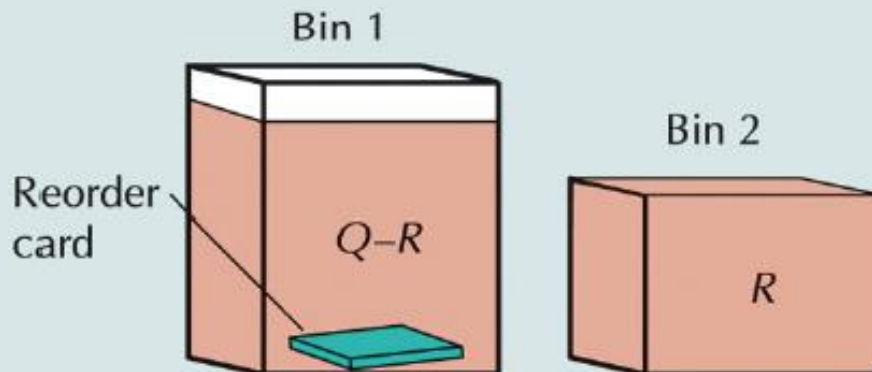
Kanban System

Barcode

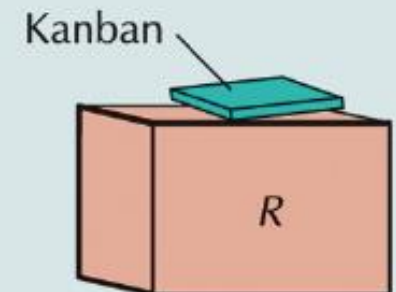


Traditional Kanban System

(a) Two-bin inventory system



(b) Kanban System

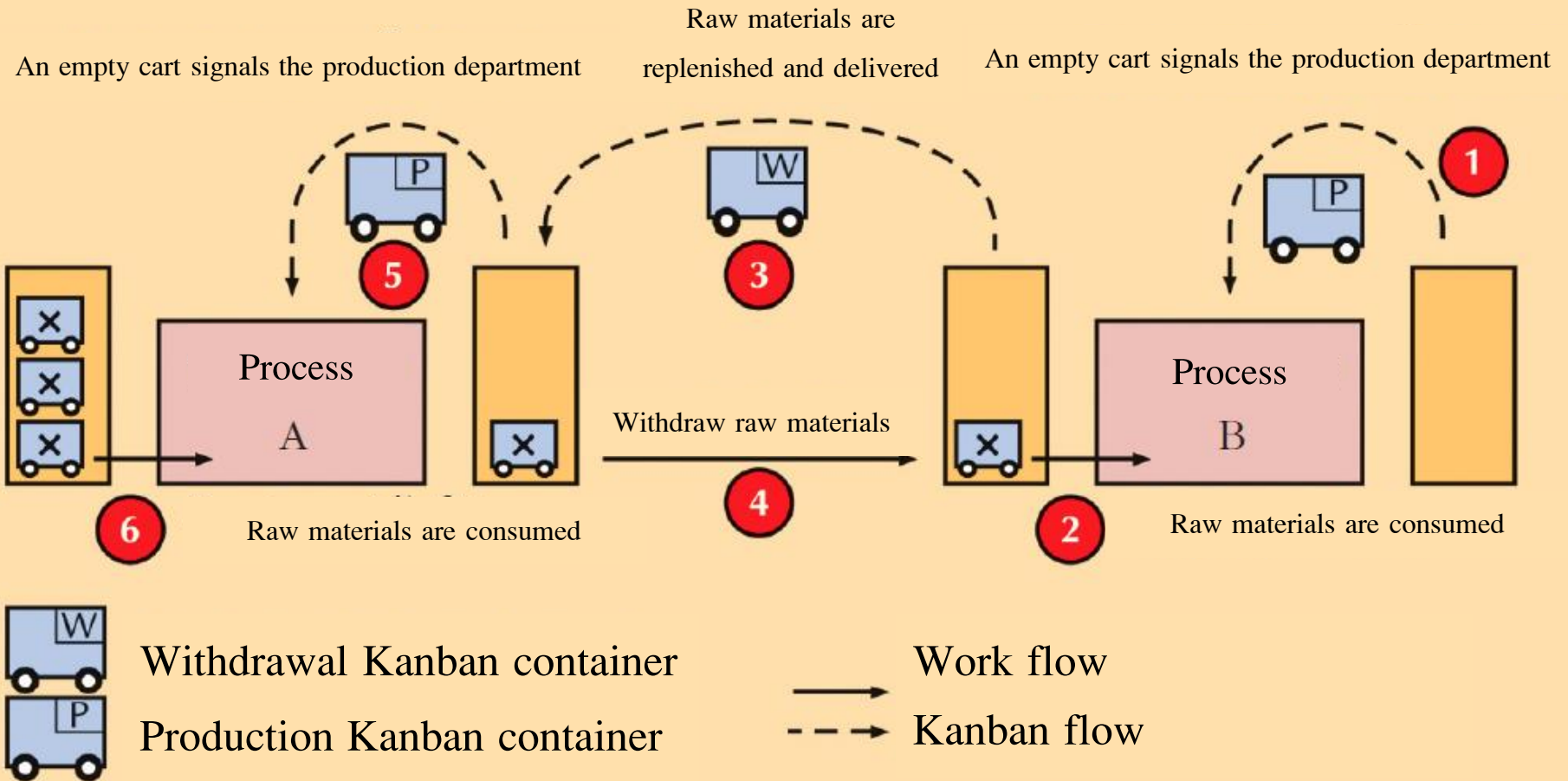


Q = order quantity

R = reorder point = demand during lead time

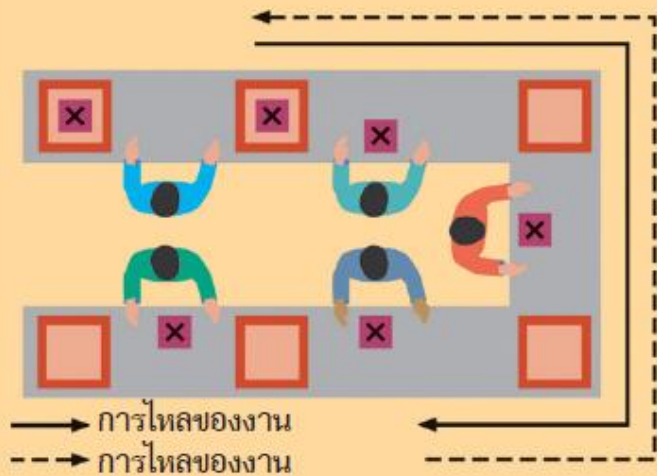
Kanban System

Dual Kanban System



Kanban System

(a) Square Kanban

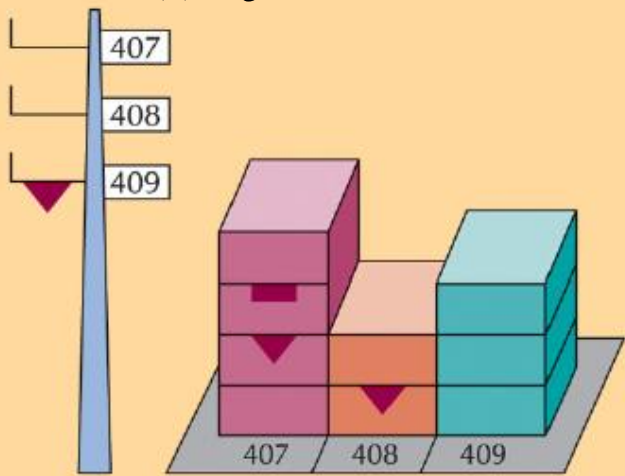


(b) Rack Kanban



Other Types of Kanban

(c) Signal Kanban



(d) Postal Kanban

65	66	67	68	69	70	71
72	73	74	75	76	77	78
79	80	81	82	83	84	85
86	87	88	89	90	91	92
93	94	95	96	97	98	99
100	101	102	103	104	105	106
107	108	109	110	111	112	113
114	115	116	117	118	119	120

Small Lots

- Requires less space and lower investment
- Produces small quantities per batch and places processes closer together, making transportation between workstations easier
- Enables thorough product quality inspection and reduces inventory levels
- Improves linkage among processes, helping to identify bottlenecks more quickly

Small-lot production should be used together with pull systems and Kanban systems.

Accurate control of demand and reliable material procurement help reduce safety stock, including the reduction of lead time, which is the time required from production through delivery. This helps minimize inventory holding.

Consists of four main components

Processing Time

Refers to reducing the number of process steps or improving the efficiency of workers and machines.

Move Time

Refers to reducing transportation distance in a simple manner and standardizing transportation routes.

Waiting Time

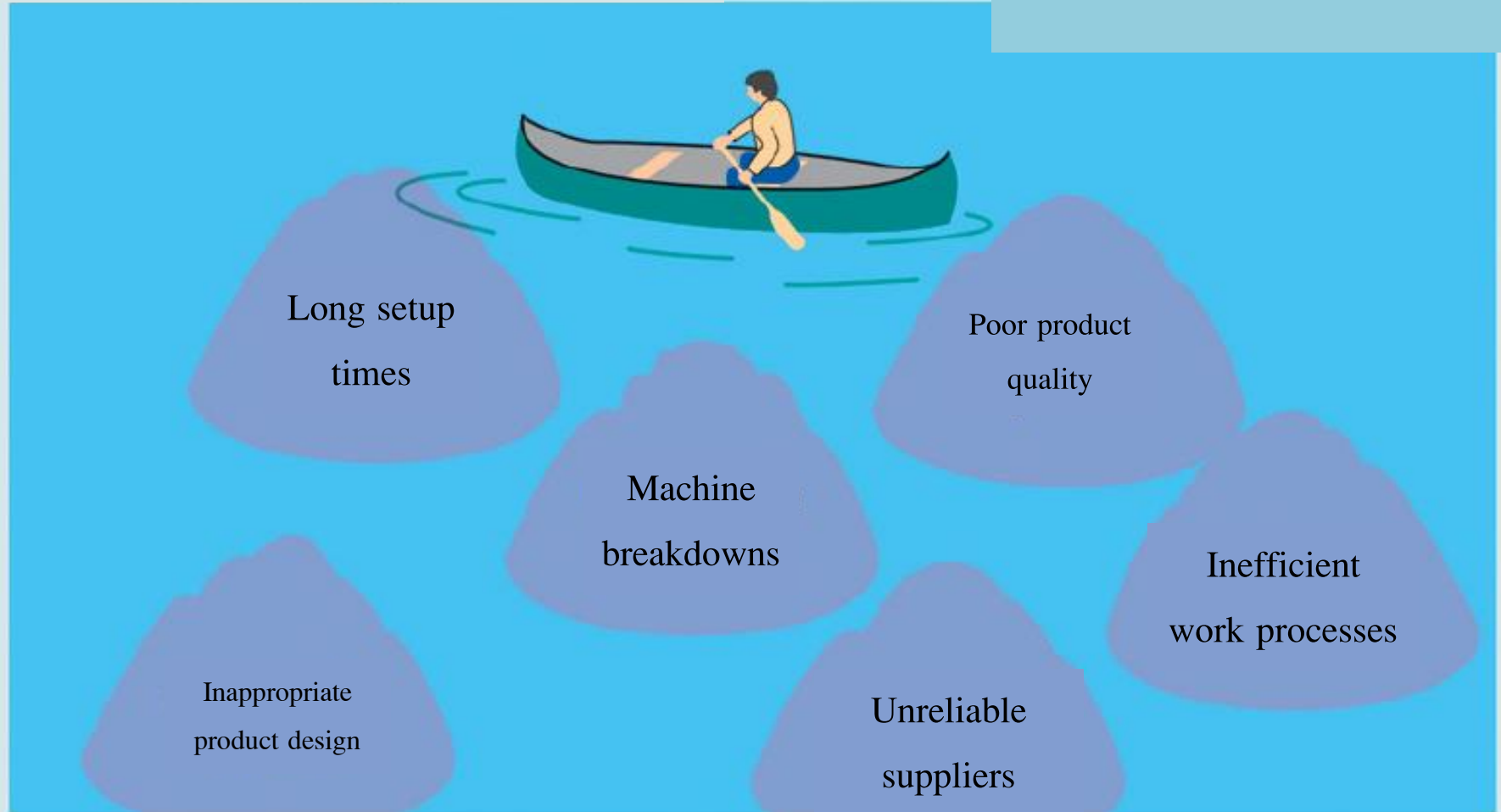
Refers to improving job scheduling and ensuring sufficient production capacity.

Setup Time

This is the period that causes the greatest bottleneck in the production process and can be reduced through quick setup techniques.

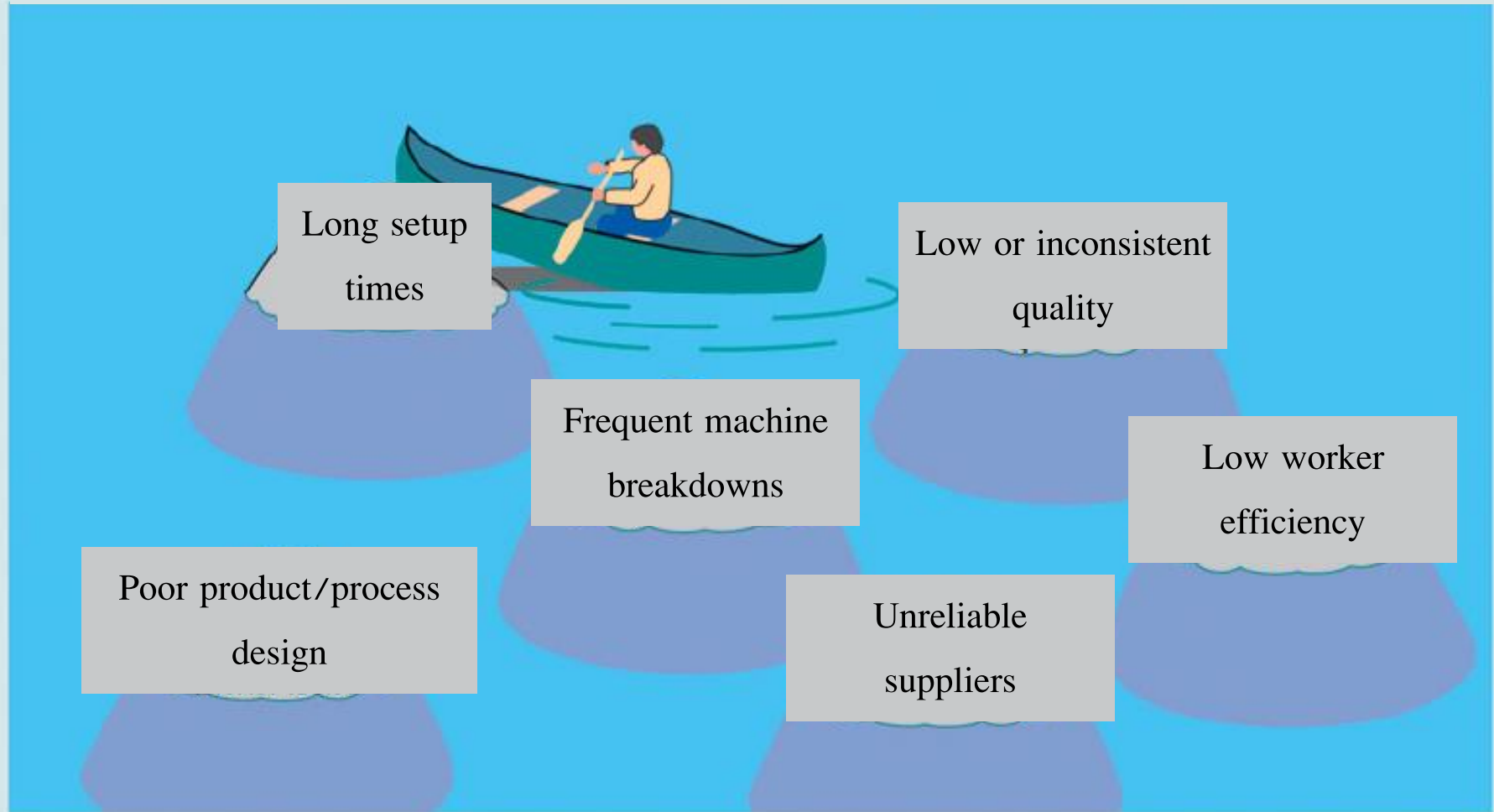
(a) Problems Hidden in Inventory

Reducing inventory levels helps reveal hidden problems, such as:



Reduced Inventory Levels Reveal Problems (Continued)

(b) Lower inventory levels expose various problems



SMED (Single Minute Exchange of Dies)

1. Separate Internal Setup from External Setup

Internal Setup



Can only be done when the production process is stopped.

External Setup

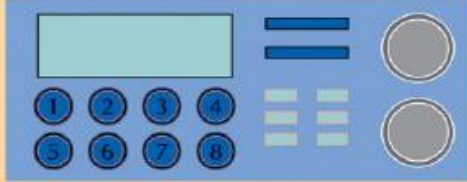


Can be done in advance.

2. Convert Internal Setup to External Setup
3. Streamline All Aspects of Setup
4. Perform Setup Activities in Parallel or Eliminate Them Entirely

Quick Setups

Design fixtures and setups so they are ready for immediate operation



e.g., preset car radio stations

Use quick-release fasteners



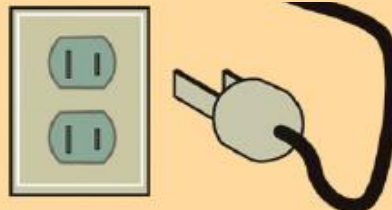
e.g., easy-insert key slots

Use positioning pins



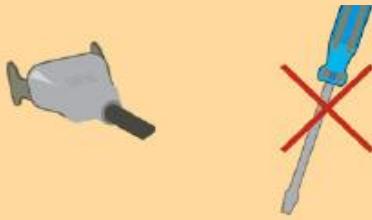
e.g., Lego-type locating blocks

Prevent incorrect positioning



e.g., plugs with unequal prong lengths

Eliminate the need for tools



e.g., screw-type computer cables

Make items easy to move



e.g., drawers in a wardrobe

General Techniques for Reducing Setup Time

Uniform Production Levels

- The lean production system aims to maintain uniform production levels by making production demand as consistent as possible at the final stage of the production line.
- Any changes that occur will impact upstream production components.
- The Kanban system helps absorb fluctuations in demand of approximately $\pm 10\%$ per month.

Uniform Production Levels (Continued)

- Reducing variability in daily demand or production orders through accurate forecasting enables production quantities to remain consistent for each model in each production run, day by day.
- Continuous demand throughout the planning period can be evenly distributed into equal daily production quantities and produced using a mixed-model production system with a uniform mix, which in turn ensures stable demand for components.

Basic Elements of Lean Production

Quality At The Source

Visual Control

- Enables problems to be identified visually, and allows employees to clearly understand product requirements.
- Visual quality control leads to error prevention systems (Poka-Yokes).

Kaizen

- A system of continuous improvement that requires the participation and cooperation of all employees at all levels.
- The key to effective Kaizen is identifying the root causes of problems and eliminating them to prevent recurrence.

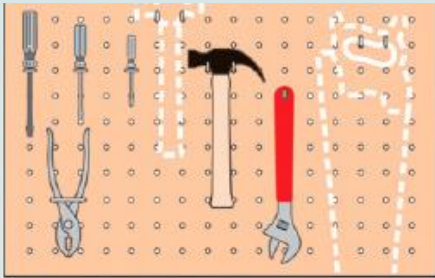
5 Whys

Jidoka

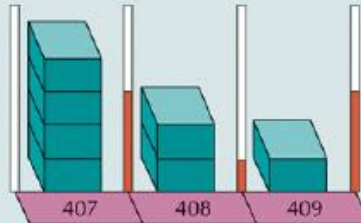
- Empowers employees to stop the production line when problems are detected and corrected.
- Employees can use signal systems (Andons) to indicate quality problems.
- Results in less workload than actual production capacity (Under-Capacity Scheduling).

Quality At The Source

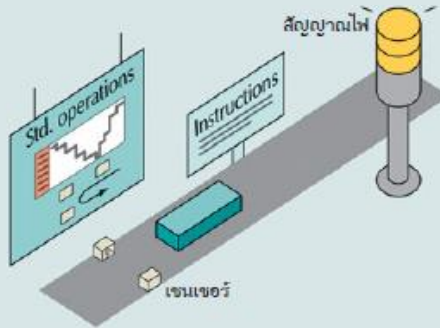
Tool shadow boards



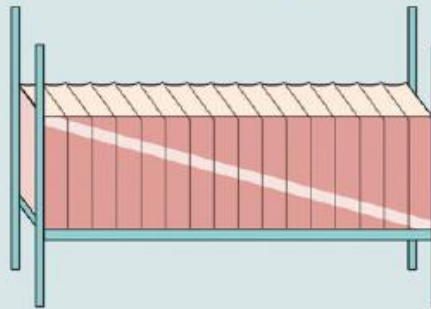
Visible Kanban systems



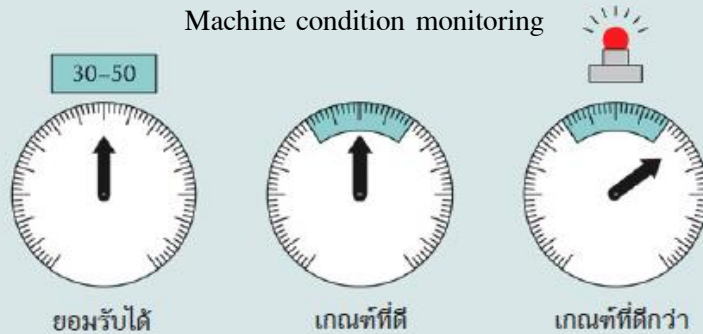
Workstations with visual signals



Balanced inventory racks



Machine condition monitoring



ตัวอย่างของการควบคุมด้วยสายตา

Total Productive Maintenance

- Integrates preventive maintenance principles with overall quality control.
- Employees in all departments participate in maintenance planning, machine care, defect reduction, identification of potential problem areas, and problem prevention.
- Includes 5S activities.

Total Productive Maintenance

Machinery cannot operate continuously without proper attention or maintenance, which can be classified into two types.

Breakdown Maintenance

Corrective actions taken when machinery fails or malfunctions.

Preventive Maintenance

A system of scheduled inspection and maintenance to ensure continuous machine operation. Reduces machine downtime, material loss, quality defects, production delays, and maintenance costs.

Total Productive Maintenance

5S Activities

1. Seiri

Separate necessary and unnecessary items; keep only what is needed and discard the rest.

2. Seiton

Arrange necessary items so they are easy to access, organized, and safe.

3. Seisou

Keep tools, machines, and workplaces clean at all times.

4. Seiketsu

Maintain and continuously apply the first three S's as standard practice.

5. Shisuke

Provide regular 5S training and cultivate discipline and adherence to rules among employees.

Key Requirements for Effective Maintenance

1. Designing products that can be easily manufactured using existing machines.
2. Designing machines that are easy to operate, adjust, and maintain.
3. Providing training and continuously monitoring employee performance in machine operation.
4. Purchasing machines with the highest possible production capability.
5. Designing preventive maintenance plans throughout the entire lifecycle of the machines.

Supplier Networks

- Supplier support is crucial to the success of lean production.
- Suppliers must be reliable and capable of delivering products that meet customer requirements.
- High-quality inputs help reduce inspection activities and inventory levels.
- Suppliers must respond to increasing customer demand by producing appropriate quantities at low cost, supported by lean delivery processes.

Supplier Networks (Continued)

1. Long-Term Supplier Contracts
2. Synchronized Production
3. Supplier Certification
4. Mixed Loads and Frequent Deliveries
5. Precise Delivery Schedules
6. Standardized, Sequenced Delivery
7. Locating in Close Proximity to The Customer

The Benefits of Lean Production



United States

Production lead time
reduced by up to 90%

Inventory reduced
by up to 70%

Labor costs reduced
by up to 50%

Space requirements
reduced by up to
80%

(Results depend on
the organization's
ability to apply
lean systems)

1. Reduced Inventory
2. Improve Quality
3. Lower Costs
4. Reduced Space Requirements
5. Shorter Lead Time
6. Increased Productivity
7. Greater Flexibility
8. Better Relations with Suppliers
9. Simplified Scheduling and Control Activities
10. Increased Capacity
11. Better Use of Human Resource
12. More Product Variety

Implementing Lean Production

Understanding Core Principles

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Adapting lean principles to each organization's environment



Core of the Lean System

1. Waste elimination
2. Faster changeovers and transitions
3. Close collaboration with suppliers
4. Continuous improvement for higher efficiency
5. Flexible use of resources
6. Strong focus on quality
7. Visualizing and exposing problems
8. Team-based problem solving

Lean Production in the United States vs. Japan

Lean System in the United States

- ❖ Factories are generally larger in scale.
- ❖ Supplier delivery frequency is lower.
- ❖ Higher inventory levels due to longer transportation times.
- ❖ Kanban usage is relatively limited compared to Japan.
- ❖ Employee-oriented response systems differ from Japanese lean factories.
- ❖ Employees often engage in physical exercise during line stoppages, which is common practice.

Drawbacks of Lean Production

Lean Production System

- Not suitable for all types of organizations.
- Not ideal for products with very low production repetition, especially in high-volume mass production environments.

Core Principle of Lean Production: Creating Flow

- Producers must understand the maximum time employees can spend producing to meet customer demand (Takt Time).
- Establish work schedules for each process.
- Use Kanban to control production.

Implementing Lean Production

Drawbacks of Lean Production (continued)

Lean systems may not be suitable for companies where:

Customer demand is highly volatile. There is a high variety of products with low production volume per product (resulting in many Kanban cards). Products require highly specialized skills or customized operations. There is no Kanban system for processes that have not yet been properly designed.

Lean production can encounter problems when:

There are sudden or unpredictable changes in customer demand.

Lean production must be aligned with:

Products

Processes

Customers

Risk assessment

Business environmental uncertainty

Adjustment to real operating

conditions

Lean Service

- ✓ Improving work processes to increase efficiency
- ✓ Supporting rapid change and adaptability
- ✓ Strengthening relationships with suppliers
- ✓ Quickly and effectively solving problems caused by changing customer needs
- ✓ Providing services at lower cost
- ✓ Increasing service variety

Examples of services applying Lean principles

1. Lean Retailing
2. Lean Banking
3. Lean Health Care

Implementing Lean Production

Leaning the Supply Chain

Learning about Lean in the Supply Chain

“Pull” system: ensuring smooth flow of raw materials throughout supplier networks. Supporting continuous order fulfillment. Adapting production to changing customer requirements.

Companies must

- ❖ Exchange information and coordinate demand forecasting and production planning
- ❖ Replenish inventory with key suppliers and sub-suppliers throughout the supply chain
- ❖ Coordinate extensively with external organizations
- ❖ Apply information technology to support efficient lean supply chain development

Implementing Lean Production

Lean and Six Sigma System

Lean focuses on

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Six Sigma focuses on



Integrated systems used together for process improvement

- Eliminating waste and improving processes
- Continuous improvement (Kaizen)
- Empowering employees to work as teams and develop problem-solving skills

- Reducing variation and improving process capability
- Using statistical tools to solve complex problems
- Supporting breakthrough improvements

Together, both systems accelerate process improvement and lead to sustainable results.

Lean and the Environment

Lean plays an important role in:

- ❖ Reducing raw material costs, energy costs, and legal compliance costs
- ❖ Reducing major health and safety risks for employees
- ❖ Learning to identify environmental waste

Companies that offer environmentally friendly products and services can

- Increase market share
- Achieve sustainable competitive advantage

Lean Consumption

Principles of Lean Consumption

The consumption process covers: Site/location selection, Purchasing, Installation, Usage, Maintenance, Repair and Reuse

Lean consumption can be achieved by

- 1) Identifying what products customers want, where they want them, and when they want them
- 2) Making fast and complete decisions to solve customer problems
- 3) Reducing the number of problems that customers need to deal with

Questions

Q & A

Asst.Prof.Dr.Chaithanaskorn Phawitpiriyakliti

Phone :

081-922 9055

Email :

drru61@gmail.com