

JIT and Lean Operations

When you complete this chapter you should be able to:

- 1. Define just-in-time, TPS, and lean operations**
- 2. Define the seven wastes and the 5 Ss**
- 3. Explain JIT partnerships**
- 4. Determine optimal setup time**

Learning Objectives

When you complete this chapter you should be able to:

- 1. Define kanban**
- 2. Compute the required number of kanbans**
- 3. Explain the principles of the Toyota Production System**

JIT/Lean Operations

Good production systems require that managers address three issues that are pervasive and fundamental to operations management: eliminate waste, remove variability, and improve throughput

Just-In-Time, TPS, and Lean Operations

- ◆ **JIT is a philosophy of continuous and forced problem solving via a focus on throughput and reduced inventory**
- ◆ **TPS emphasizes continuous improvement, respect for people, and standard work practices**
- ◆ **Lean production supplies the customer with their exact wants when the customer wants it without waste**

Just-In-Time, TPS, and Lean Operations

- ◆ **JIT emphasizes forced problem solving**
- ◆ **TPS emphasizes employee learning and empowerment in an assembly-line environment**
- ◆ **Lean operations emphasize understanding the customer**

Eliminate Waste

- ◆ **Waste is anything that does not add value from the customer point of view**
- ◆ **Storage, inspection, delay, waiting in queues, and defective products do not add value and are 100% waste**

Ohno's Seven Wastes

- ◆ **Overproduction**
- ◆ **Queues**
- ◆ **Transportation**
- ◆ **Inventory**
- ◆ **Motion**
- ◆ **Overprocessing**
- ◆ **Defective products**

The 5 Ss

- **Sort/segregate** – when in doubt, throw it out
- **Simplify/straighten** – methods analysis tools
- **Shine/sweep** – clean daily
- **Standardize** – remove variations from processes
- **Sustain/self-discipline** – review work and recognize progress

The 5 Ss

- **Sort/segregate** – when in doubt, throw it out
- **Simplify/straighten** – methods analysis tools

- **◆ Two additional Ss**

- **◆ Safety – build in good practices**

- **◆ Support/maintenance – reduce variability and unplanned downtime**

Remove Variability

- ◆ **JIT systems require managers to reduce variability caused by both internal and external factors**
- ◆ **Variability is any deviation from the optimum process**
- ◆ **Inventory hides variability**
- ◆ **Less variability results in less waste**

Sources of Variability

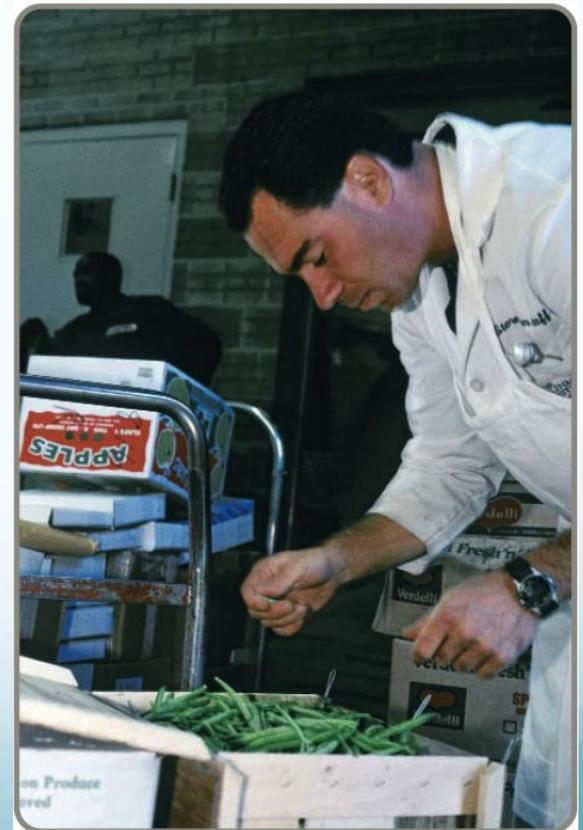
- 1. Incomplete or inaccurate drawings or specifications**
- 2. Poor production processes resulting in incorrect quantities, late, or non-conforming units**
- 3. Unknown customer demands**

Improve Throughput

- ◆ **By pulling material in small lots, inventory cushions are removed, exposing problems and emphasizing continual improvement**
- ◆ **Manufacturing cycle time is reduced**
- ◆ **Push systems dump orders on the downstream stations regardless of the need**

Just-In-Time (JIT)

- Powerful strategy for improving operations
- Materials arrive where they are needed when they are needed
- Identifying problems and driving out waste reduces costs and variability and improves throughput
- Requires a meaningful buyer-supplier relationship



JIT and Competitive Advantage

JIT TECHNIQUES:

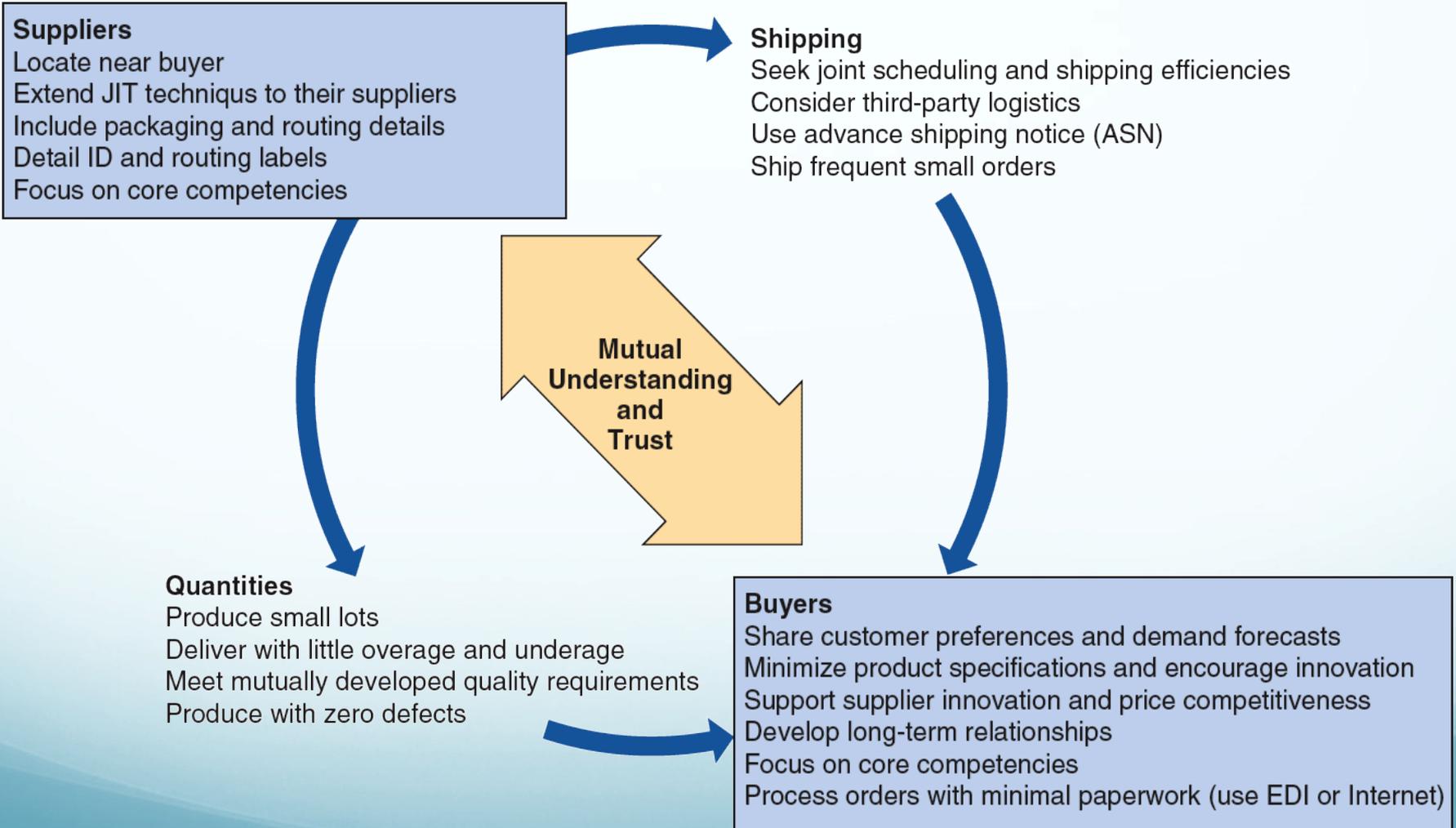
Suppliers:	Few vendors; Supportive supplier relationships; Quality deliveries on time, directly to work areas.
Layout:	Work-cells; Group technology; Flexible machinery; Organized workplace; Reduced space for inventory.
Inventory:	Small lot sizes; Low setup time; Specialized parts bins
Scheduling:	Zero deviation from schedules; Level schedules; Suppliers informed of schedules; Kanban techniques
Preventive maintenance:	Scheduled; Daily routine; Operator involvement
Quality production:	Statistical process control; Quality suppliers; Quality within the firm
Employee empowerment:	Empowered and cross-trained employees; Training support; Few job classifications to ensure flexibility of employees
Commitment:	Support of management, employees, and suppliers



JIT Partnerships

- ◆ **JIT partnerships exist when a supplier and purchaser work together to remove waste and drive down costs**
- ◆ **Four goals of JIT partnerships are:**
 - ◆ **Removal of unnecessary activities**
 - ◆ **Removal of in-plant inventory**
 - ◆ **Removal of in-transit inventory**
 - ◆ **Improved quality and reliability**

JIT Partnerships



JIT Layout

Reduce waste due to movement

JIT Layout Tactics

Build work cells for families of products

Include a large number operations in a small area

Minimize distance

Design little space for inventory

Improve employee communication

Use poka-yoke devices

Build flexible or movable equipment

Cross-train workers to add flexibility

Distance Reduction

- ◆ **Large lots and long production lines with single-purpose machinery are being replaced by smaller flexible cells**
- ◆ **Often U-shaped for shorter paths and improved communication**
- ◆ **Often using group technology concepts**

Impact on Employees

- ◆ **Employees may be cross trained for flexibility and efficiency**
- ◆ **Improved communications facilitate the passing on of important information about the process**
- ◆ **With little or no inventory buffer, getting it right the first time is critical**

JIT Inventory

Inventory is at the minimum level necessary to keep operations running

JIT Inventory Tactics

Use a pull system to move inventory

Reduce lot sizes

Develop just-in-time delivery systems with suppliers

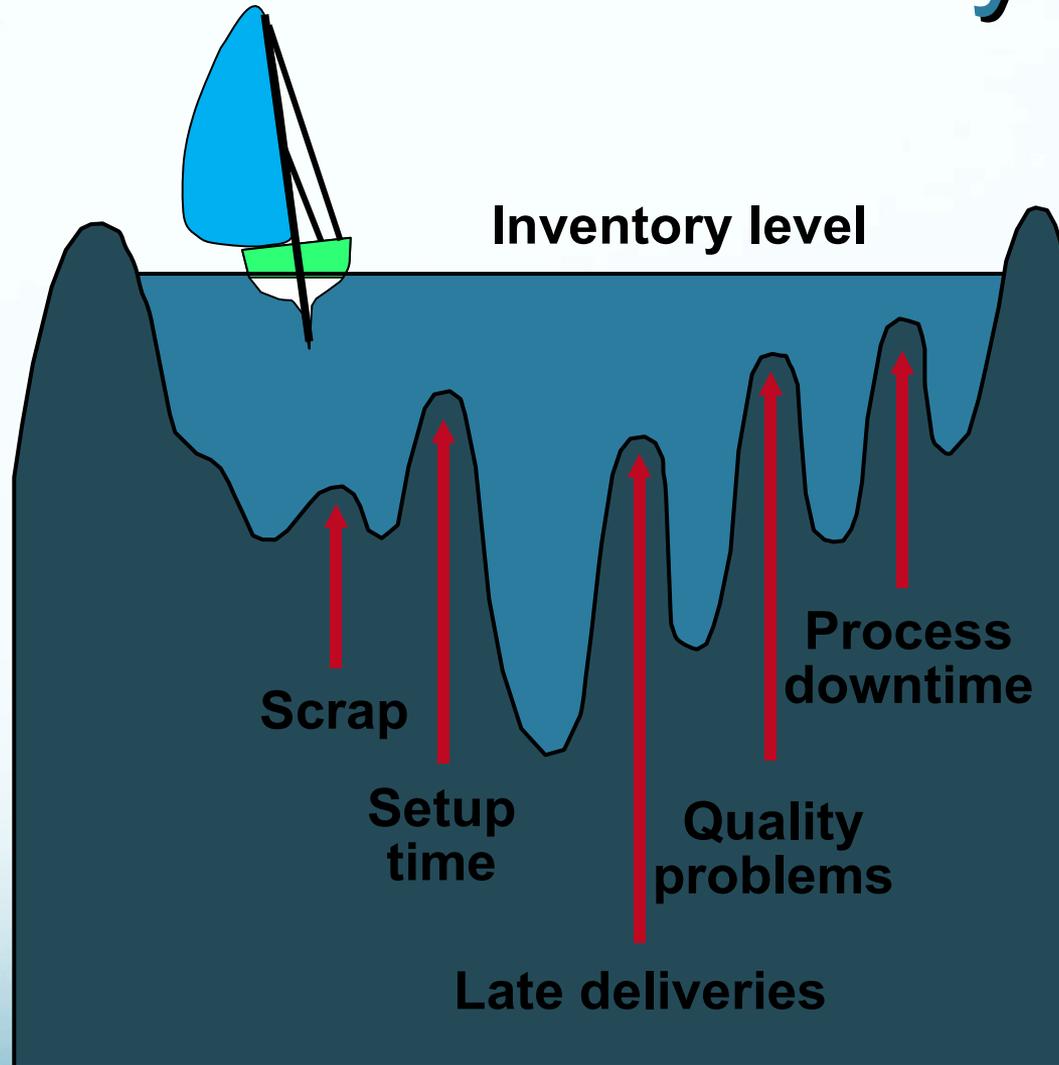
Deliver directly to point of use

Perform to schedule

Reduce setup time

Use group technology

Reduce Variability

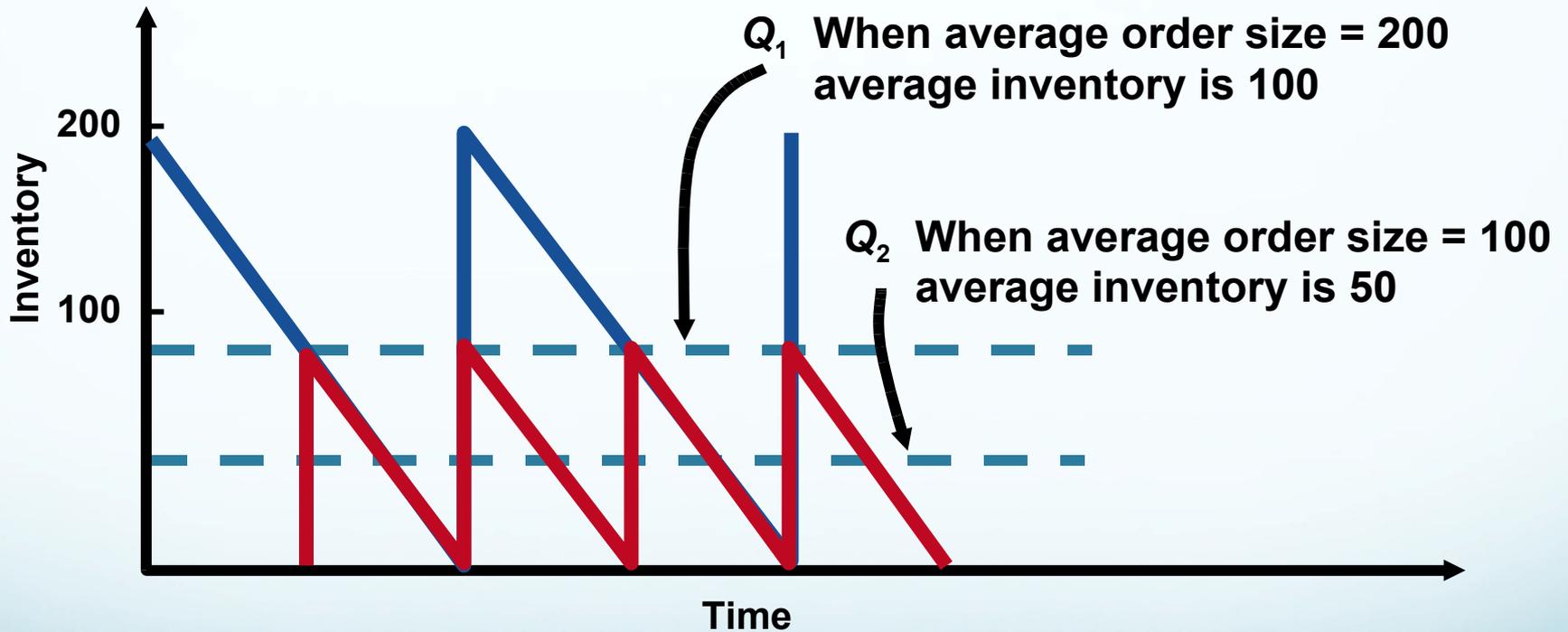


Reduce Inventory

- Reducing inventory uncovers the “rocks”
- Problems are exposed
- Ultimately there will be virtually no inventory and no problems
- Shingo says “Inventory is evil”



Reduce Lot Sizes



Reduce Lot Sizes

- ◆ **Ideal situation is to have lot sizes of one pulled from one process to the next**
- ◆ **Often not feasible**
- ◆ **Can use EOQ analysis to calculate desired setup time**
- ◆ **Two key changes necessary**
 - ◆ **Improve material handling**
 - ◆ **Reduce setup time**

Lot Size Example

D = Annual demand = 400,000 units

d = Daily demand = 400,000/250 = 1,600 per day

p = Daily production rate = 4,000 units

Q = EOQ desired = 400

H = Holding cost = \$20 per unit

S = Setup cost (to be determined)

$$Q = \sqrt{\frac{2DS}{H(1 - d/p)}} \qquad Q^2 = \frac{2DS}{H(1 - d/p)}$$

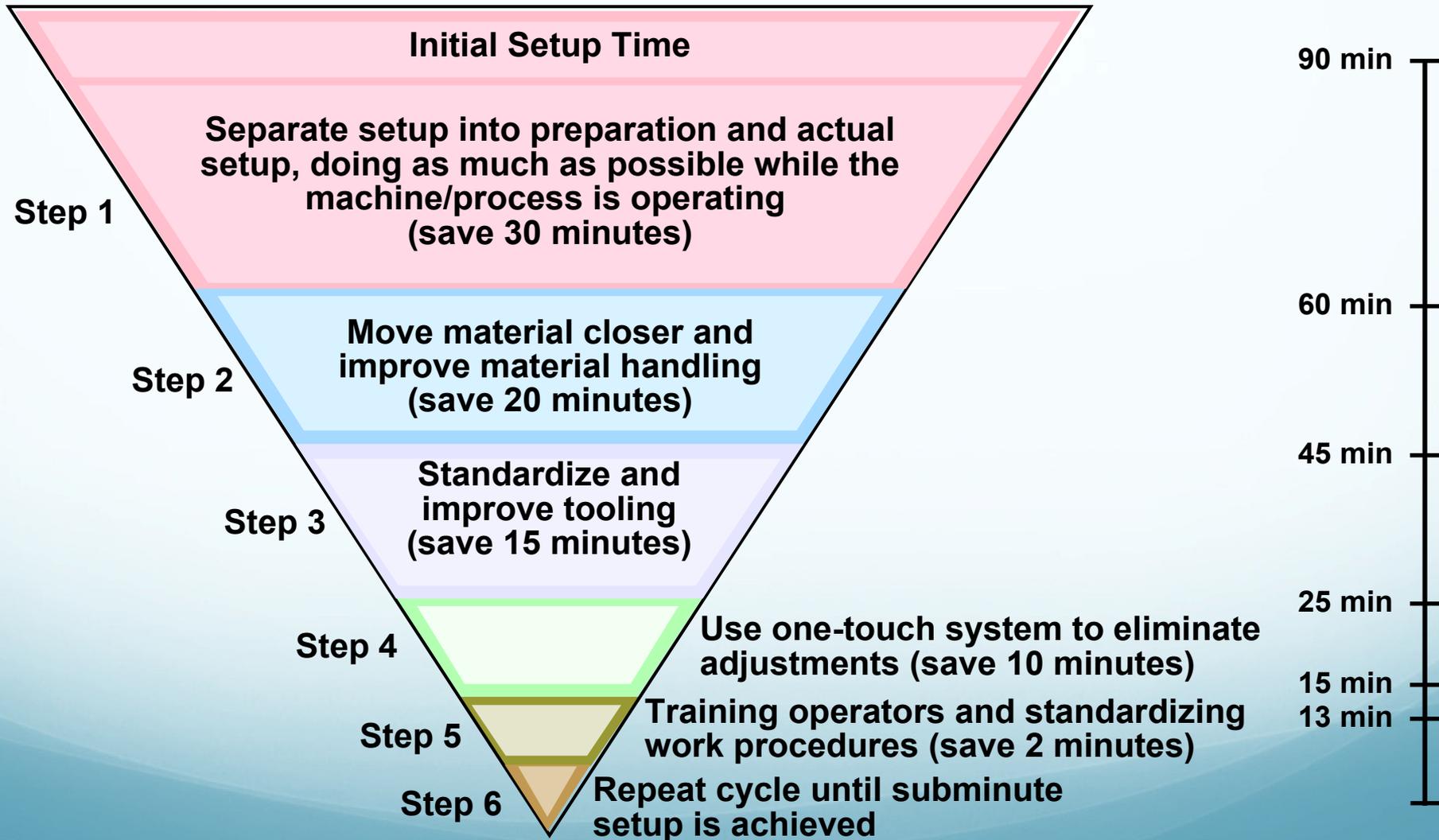
$$S = \frac{(Q^2)(H)(1 - d/p)}{2D} = \frac{(3,200,000)(0.6)}{800,000} = \$2.40$$

Setup time = \$2.40/(\$30/hour) = 0.08 hr = 4.8 minutes

Reduce Setup Costs

- ◆ **High setup costs encourage large lot sizes**
- ◆ **Reducing setup costs reduces lot size and reduces average inventory**
- ◆ **Setup time can be reduced through preparation prior to shutdown and changeover**

Reduce Setup Times



JIT Scheduling

Better scheduling improves performance

JIT Scheduling Tactics

Communicate schedules to suppliers

Make level schedules

Freeze part of the schedule

Perform to schedule

Seek one-piece-make and one-piece move

Eliminate waste

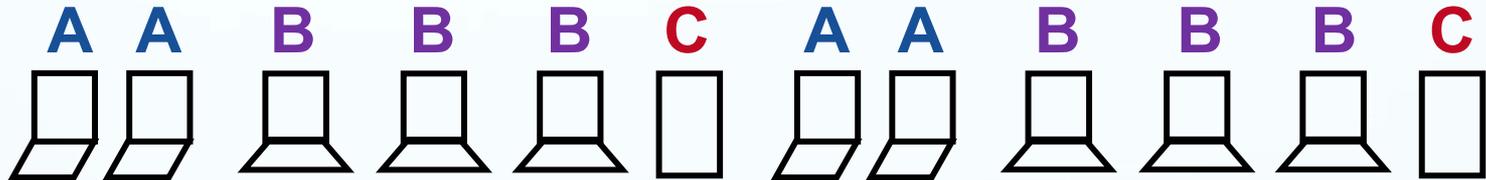
Produce in small lots

Use kanbans

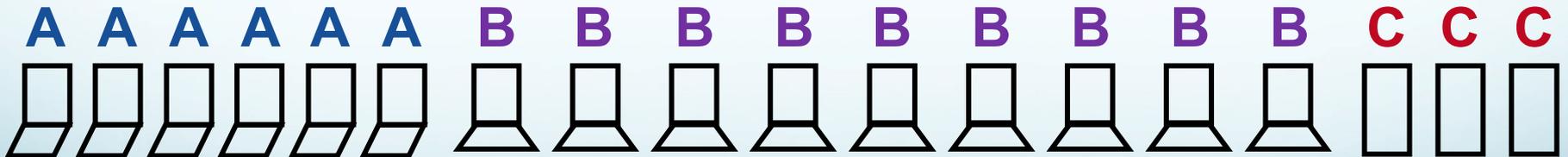
Make each operation produce a perfect part

Scheduling Small Lots

JIT Level Material-Use Approach



Large-Lot Approach



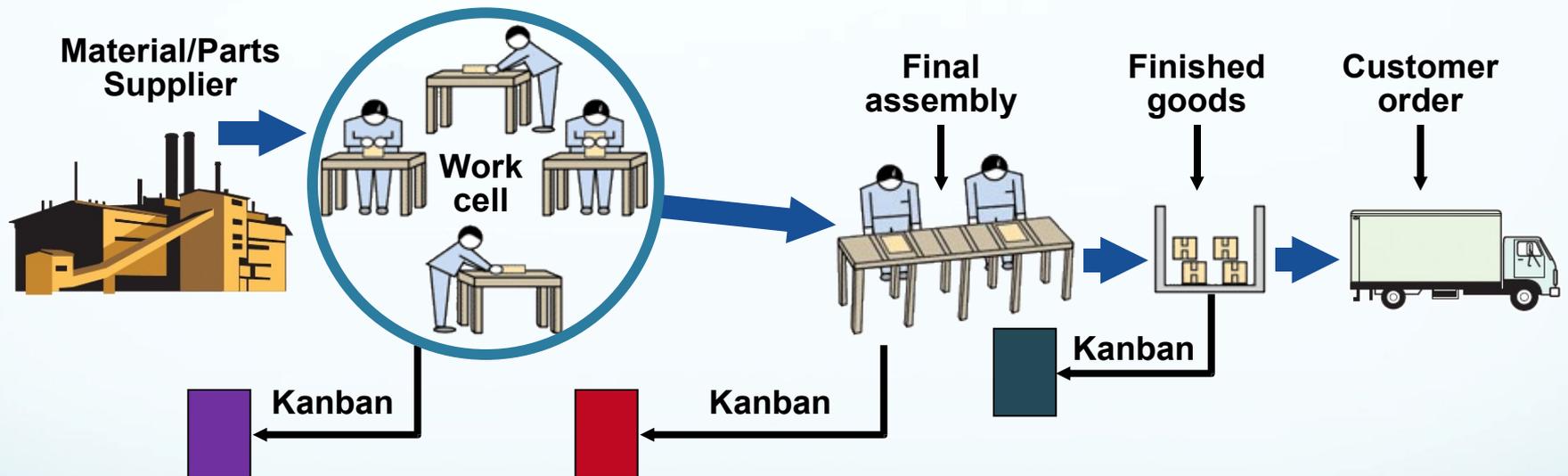
Time

Kanban

- ◆ **Kanban is the Japanese word for card**
- ◆ **The card is an authorization for the next container of material to be produced**
- ◆ **A sequence of kanbans pulls material through the process**
- ◆ **Many different sorts of signals are used, but the system is still called a kanban**



Kanban



More Kanban

- ◆ **When the producer and user are not in visual contact, a card can be used**
- ◆ **When the producer and user are in visual contact, a light or flag or empty spot on the floor may be adequate**
- ◆ **Since several components may be required, several different kanban techniques may be employed**

The Number of Kanban Cards or Containers

- ◆ Need to know the lead time needed to produce a container of parts
- ◆ Need to know the amount of safety stock needed

$$\text{Number of kanbans (containers)} = \frac{\text{Demand during lead time} + \text{Safety stock}}{\text{Size of container}}$$

Number of Kanbans Example

Daily demand = 500 cakes

Production lead time = 2 days

**(Wait time +
Material handling time +
Processing time)**

Safety stock = 1/2 day

Container size = 250 cakes

Demand during lead time = 2 days x 500 cakes = 1,000

$$\text{Number of kanbans} = \frac{1,000 + 250}{250} = 5$$

Advantages of Kanban

- ◆ **Allow only limited amount of faulty or delayed material**
- ◆ **Problems are immediately evident**
- ◆ **Puts downward pressure on bad aspects of inventory**
- ◆ **Standardized containers reduce weight, disposal costs, wasted space, and labor**

JIT Quality

- ◆ **Strong relationship**
 - ◆ **JIT cuts the cost of obtaining good quality because JIT exposes poor quality**
 - ◆ **Because lead times are shorter, quality problems are exposed sooner**
 - ◆ **Better quality means fewer buffers and allows simpler JIT systems to be used**

Toyota Production System

- ◆ **Continuous improvement**
 - ◆ **Build an organizational culture and value system that stresses improvement of all processes, kaizen**
 - ◆ **Part of everyone's job**
- ◆ **Respect for people**
 - ◆ **People are treated as knowledge workers**
 - ◆ **Engage mental and physical capabilities**
 - ◆ **Empower employees**



Toyota Production System

- ◆ **Standard work practice**
 - ◆ **Work shall be completely specified as to content, sequence, timing, and outcome**
 - ◆ **Internal and external customer-supplier connection are direct**
 - ◆ **Product and service flows must be simple and direct**
 - ◆ **Any improvement must be made in accordance with the scientific method at the lowest possible level of the organization**

Building a Lean Organization

- ◆ **Transitioning to a lean system can be difficult**
- ◆ **Lean systems tend to have the following attributes**
 - ◆ **Use JIT techniques**
 - ◆ **Build systems that help employees produce perfect parts**
 - ◆ **Reduce space requirements**

Building a Lean Organization

- ◆ **Develop partnerships with suppliers**
- ◆ **Educate suppliers**
- ◆ **Eliminate all but value-added activities**
- ◆ **Develop employees**
- ◆ **Make jobs challenging**
- ◆ **Build worker flexibility**