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JIT, TPS, and Lean Operations

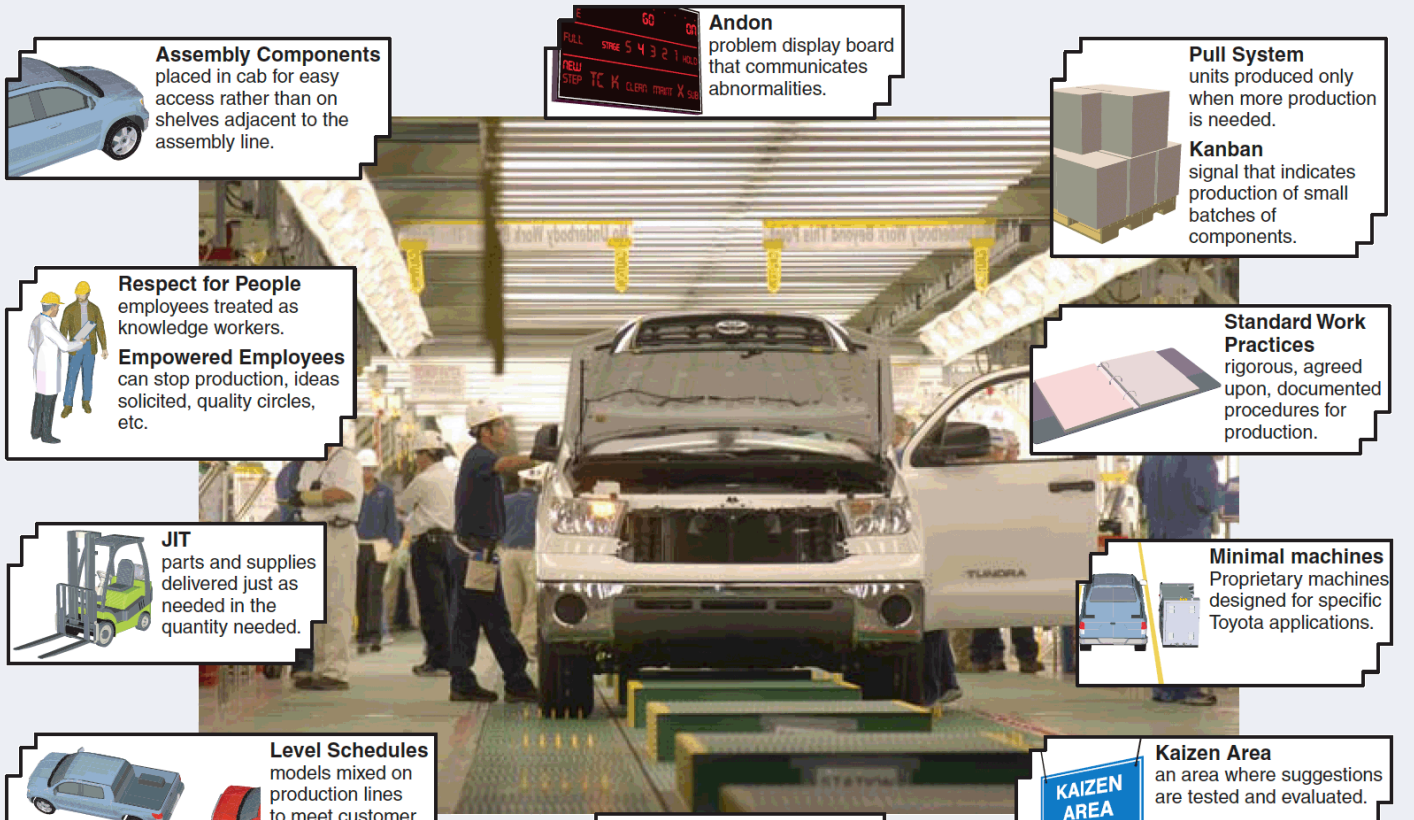
Toyota Motor Corporation

- Largest vehicle manufacturer in the world with annual sales of over 9 million vehicles
- Success due to two techniques, JIT and TPS
- Continual problem solving is central to JIT
- Eliminating excess inventory makes problems immediately evident

Toyota Motor Corporation

- Central to TPS is employee learning and a continuing effort to produce products under ideal conditions
- Respect for people is fundamental
- Small building but high levels of production
- Subassemblies are transferred to the assembly line on a JIT basis
- High quality and low assembly time per vehicle

TPS Elements



Assembly Components
placed in cab for easy access rather than on shelves adjacent to the assembly line.

Andon
problem display board that communicates abnormalities.

Pull System
units produced only when more production is needed.

Kanban
signal that indicates production of small batches of components.

Respect for People
employees treated as knowledge workers.

Empowered Employees
can stop production, ideas solicited, quality circles, etc.

Standard Work Practices
rigorous, agreed upon, documented procedures for production.

JIT
parts and supplies delivered just as needed in the quantity needed.

Minimal machines
Proprietary machines designed for specific Toyota applications.

Level Schedules
models mixed on production lines to meet customer orders.

Kaizen Area
an area where suggestions are tested and evaluated.

Jidoka
machines with built-in devices for monitoring performance and making judgements.

1. **AGC Automotive Americas** — Glass assemblies
2. **ARK Inc.** — Industrial waste management, recycling
3. **HERO Assemblers LLP** — Assembly of tire onto wheel
4. **HERO Logistics LLP** — Logistics
5. **PPG Industries Inc.** — Glass assemblies
6. **Reyes Automotive Group** — Interior/exterior parts
7. **Tokai Rika** — Functional parts

7 Suppliers inside the main plant

JIT/TPS/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 focuses on **continuous forced problem solving**
- TPS emphasizes **continuous improvement, respect for people, and standard work practices** in an assembly-line environment
- Lean operations **emphasize understanding the customer**

Just-In-Time, TPS, and Lean Operations

- Tepat waktu (*just-in-time* - JIT) adalah pendekatan **pemecahan masalah berkesinambungan** dan diwajibkan melalui terobosan dan pengurangan sediaan.
- Sistem Produksi Toyota (*Toyota Production System* - TPS) dengan penekanan pada **continuous improvement**, menghargai sumber daya manusia, dan praktik kerja standar, khususnya disesuaikan dengan lini perakitan.
- Operasi ramping (*lean operations*) menyediakan pelanggan tepat apa yang dibutuhkannya, yaitu **memahami Pelanggan**.

Eliminate Waste

- Waste adalah segala sesuatu yang **tidak memberikan nilai tambah**, Jika Pelanggan tidak mau membayarnya itu adalah Waste.
- 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

Ohno's Seven Wastes

1. **Overproduction** (Produksi berlebih): Memproduksi lebih dari yang dipesan pelanggan atau memproduksi lebih awal (sebelum dibutuhkan) adalah waste. Persediaan atau semacamnya adalah waste.
2. **Queues** (Antrean): Waktu yang tidak dipergunakan untuk apa pun dan menunggu adalah buangan (tidak memberikan nilai tambah).
3. **Transportation** (Transportasi): Pemindahan material antara pabrik atau antara sentra kerja dan penanganan lebih dari sekali adalah waste.

Ohno's Seven Wastes

4. **Inventory** (Persediaan): Bahan mentah yang tidak dibutuhkan, kerja dalam proses (WIP), barang-barang sudah selesai, dan pasokan operasi berlebih tidak memberikan nilai tambahn sehingga merupakan buangan.
5. **Motion** (Gerakan): Gerakan perlengkapan atau orang yang tidak memberikan nilai tambah adalah buangan.
6. **Overprocessing** (Proses berlebih): Kerja dilakukan pada produk yang tidak memberikan nilai tambah adalah buangan.
7. **Defective products** (Produk yang tidak efektif): Barang yang dikembalikan, klaim garansi, pekerjaan ulang, dan sisa-sisa adalah Waste.

Eliminate Waste

- Other resources such as energy, water, and air are often wasted
- Efficient, sustainable production minimizes inputs, reduces waste
- Traditional “housekeeping” has been expanded to the 5Ss

The 5Ss

- **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 5Ss

- Sort/segregate – when in doubt, throw it out, Letakkan apa yang diperlukan dan keluarkan apa pun yang tidak dibutuhkan dari area kerja
- Simplify/straighten – methods analysis tools, Atur dan pergunakan sarana-sarana metode analisis untuk meningkatkan kelancaran aliran pekerjaan dan mengurangi gerakan waste.
- Shine/sweep – clean daily, Bersihkan setiap hari; hilangkan segala bentuk kotoran, kontaminasi, dan timbunan yang kacau balau dari area kerja.
- Standardize – remove variations from processes, Hilangkan keragaman dalam proses kerja dengan mengembangkan prosedur operasi standar dan daftar periksa.
- Sustain/self-discipline – review work and recognize progress, Teliti secara berkala untuk mengenali upaya-upaya dan memotivasi agar **continuous improvement**.

The 5 Ss

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

Two additional Ss

- Safety – built in good practices, Menciptakan keamanan kerja yang baik ke lima kegiatan tersebut.
- Support/maintenance – reduce variability and unplanned downtime, Mengurangi keragaman, waktu bongkar yang tidak direncanakan, dan biaya. Memadukan antara tugas pembersihan (*shine*) sehari-hari dengan pemeliharaan preventif.

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

- Poor production processes resulting in improper quantities, late, or non-conforming units
- Unknown customer demands
- Incomplete or inaccurate drawings, specifications, or bills of material

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Both JIT and inventory reduction are effective tools in identifying causes of variability

Improve Throughput

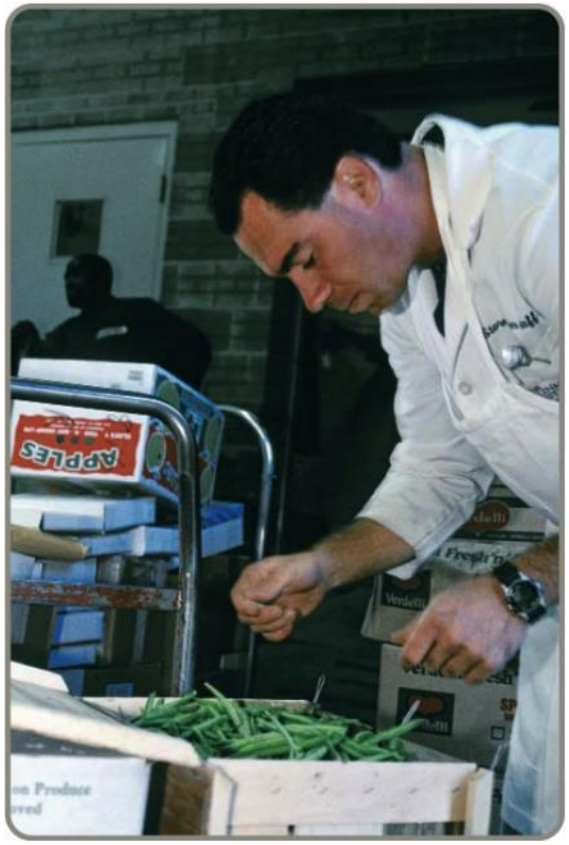
- The time it takes to move an order from receipt to delivery
- The time between the arrival of raw materials and the shipping of the finished order is called **manufacturing cycle time**
- A **pull system** increases throughput

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

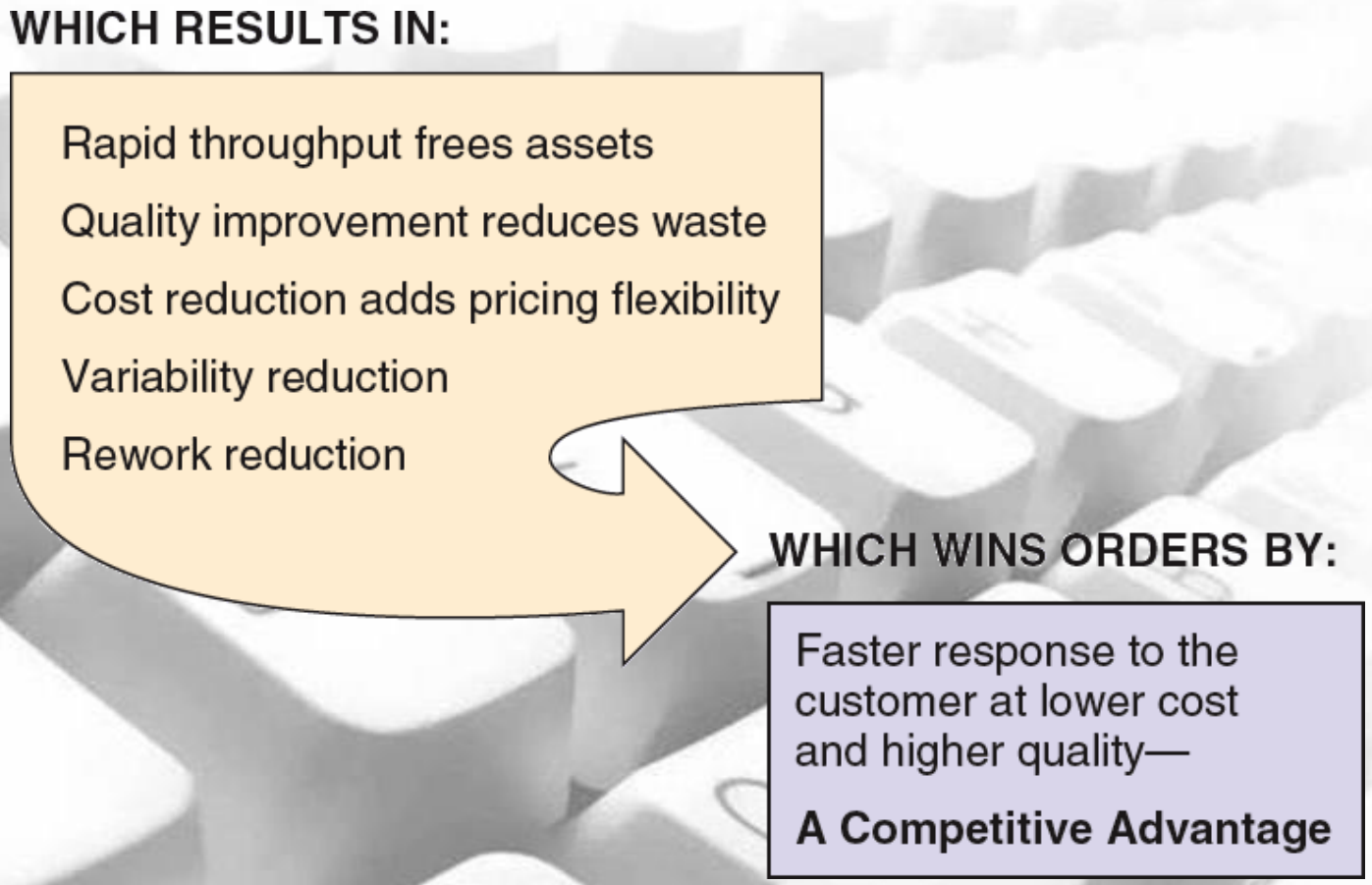


JIT and Competitive Advantage

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

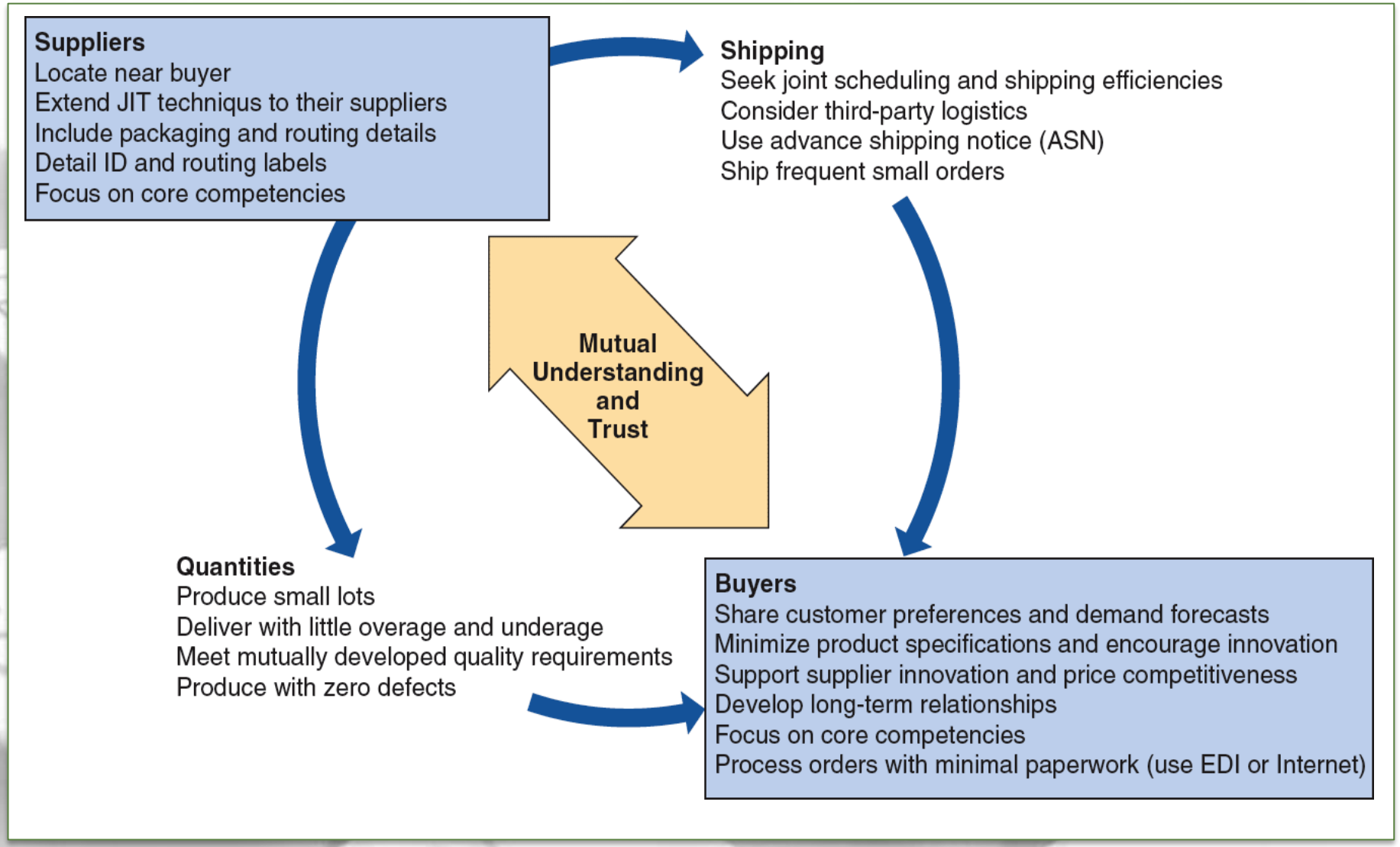
JIT and Competitive Advantage



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



Concerns of Suppliers

- *Diversification* – ties to only one customer increases risk
- *Scheduling* – don't believe customers can create a smooth schedule
- *Lead time* – short lead times mean engineering or specification changes can create problems
- *Quality* – limited by capital budgets, processes, or technology
- *Lot sizes* – small lot sizes may transfer costs to suppliers

JIT Layout

- Reduce waste due to movement

TABLE 16.1

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

Increased Flexibility

- Cells designed to be rearranged as volume or designs change
- Applicable in office environments as well as production settings
- Facilitates both product and process improvement

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

Reduced Space and Inventory

- With reduced space, inventory must be in very small lots
- Units are always moving because there is no storage

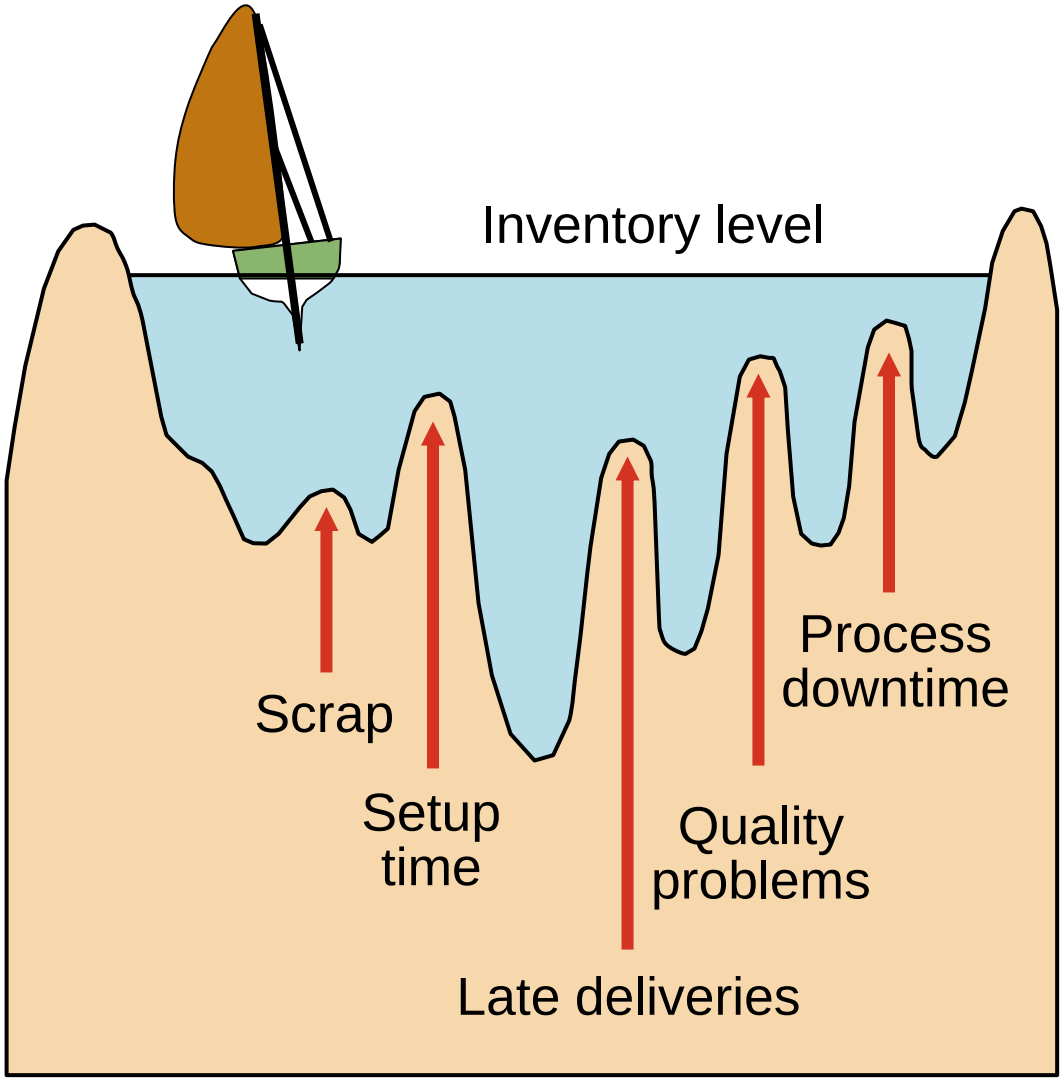
JIT Inventory

- Inventory is at the minimum level necessary to keep operations running

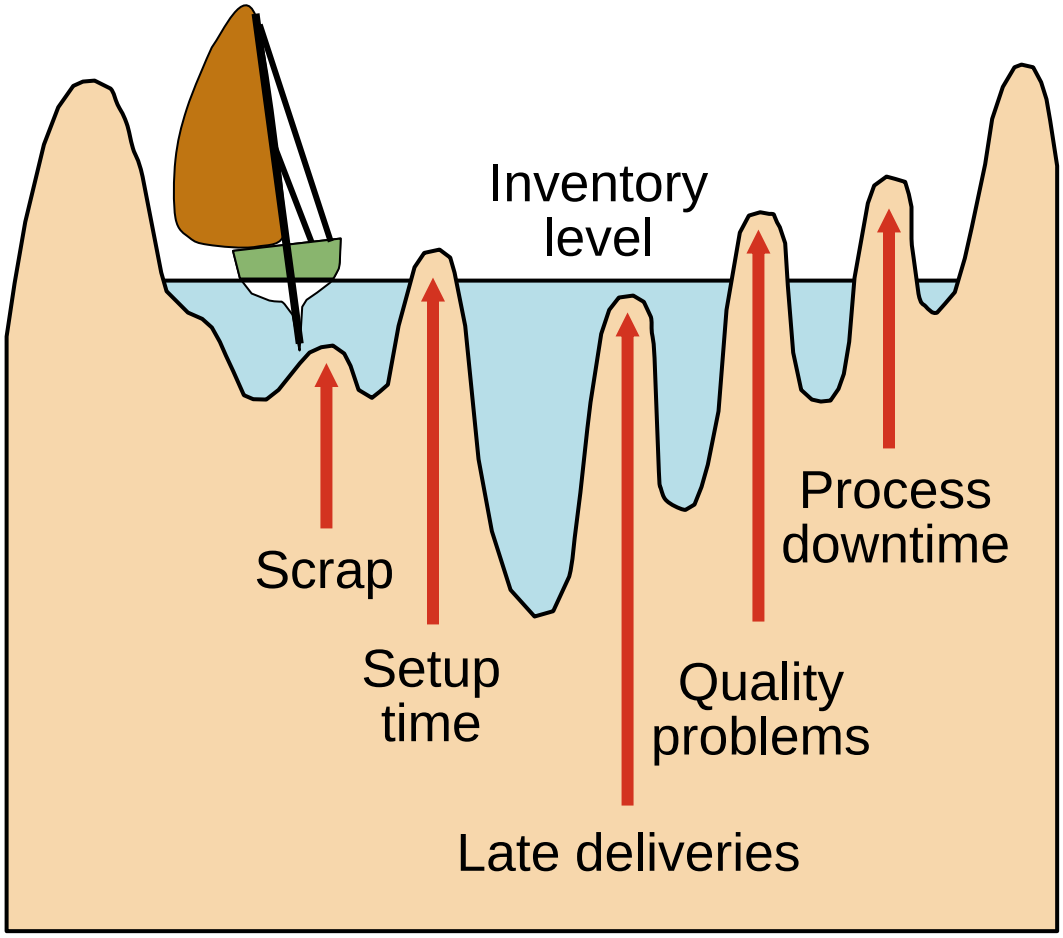
TABLE

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

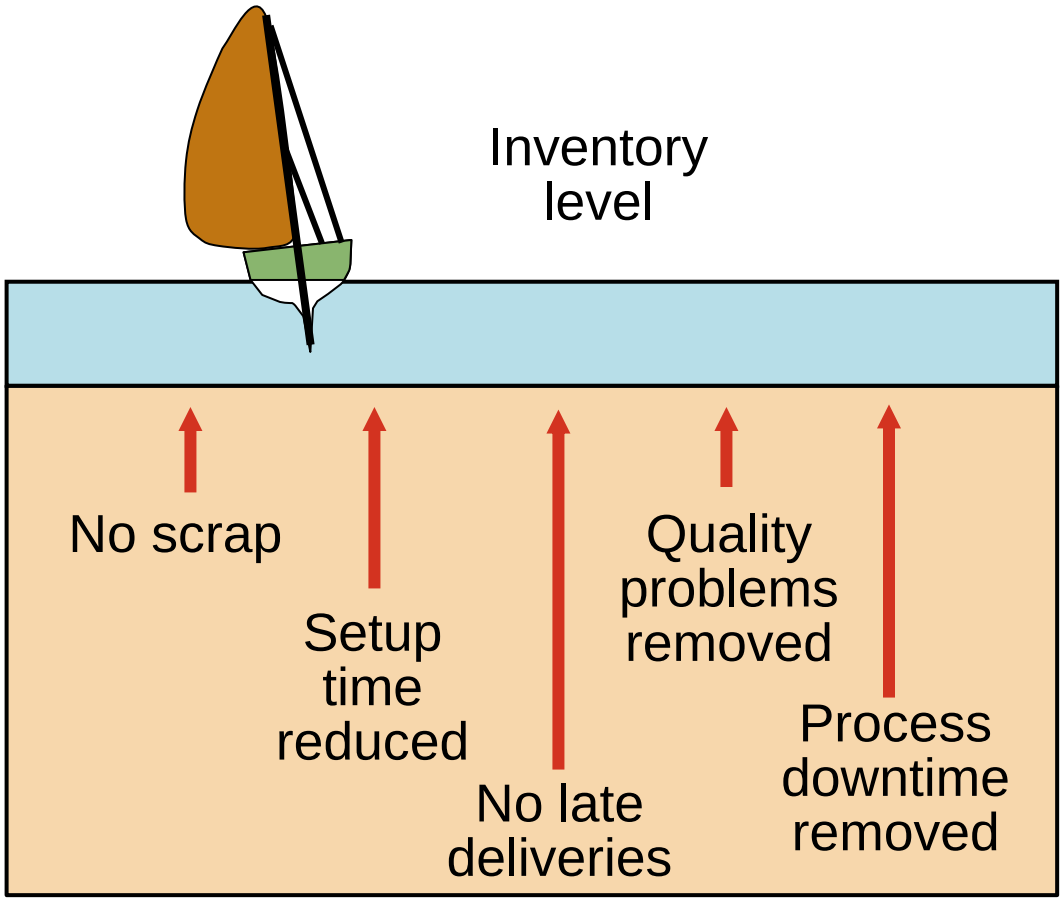
Reduce Variability



Reduce Variability



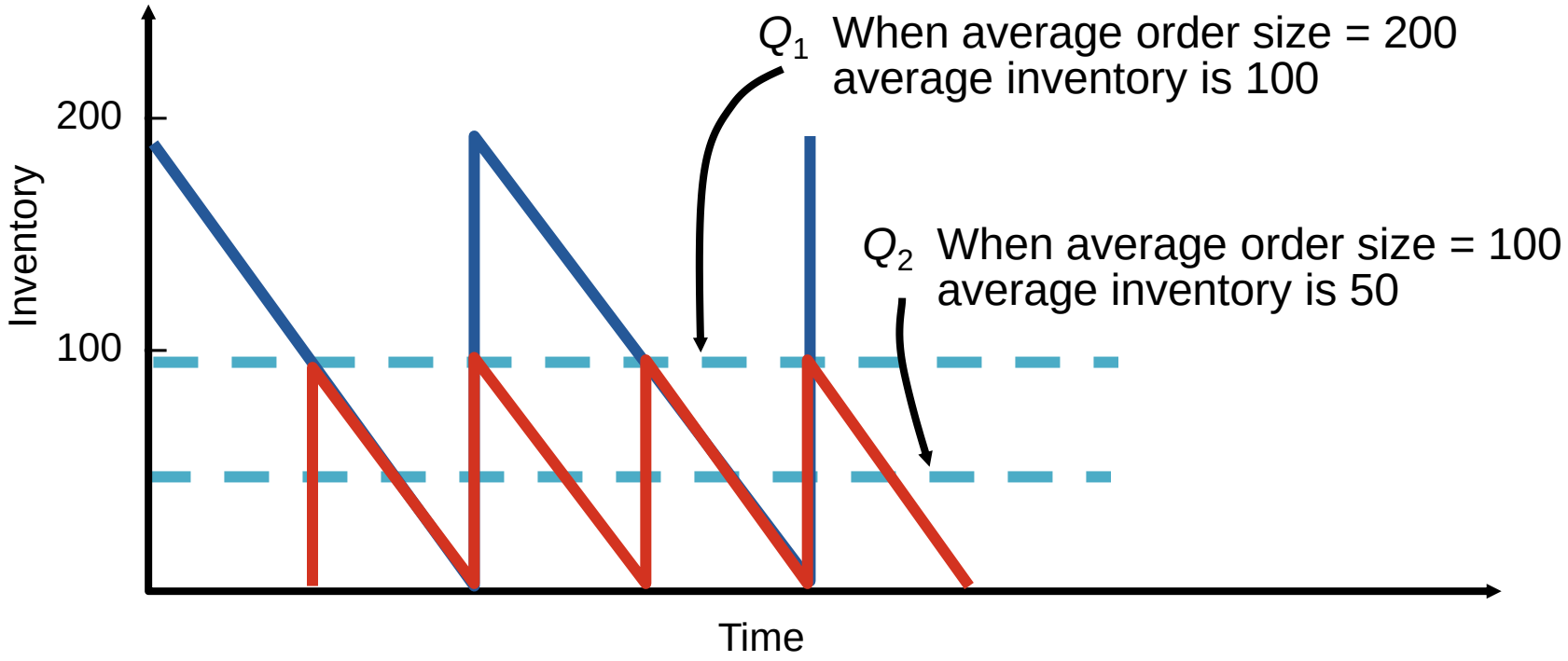
Reduce Variability



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

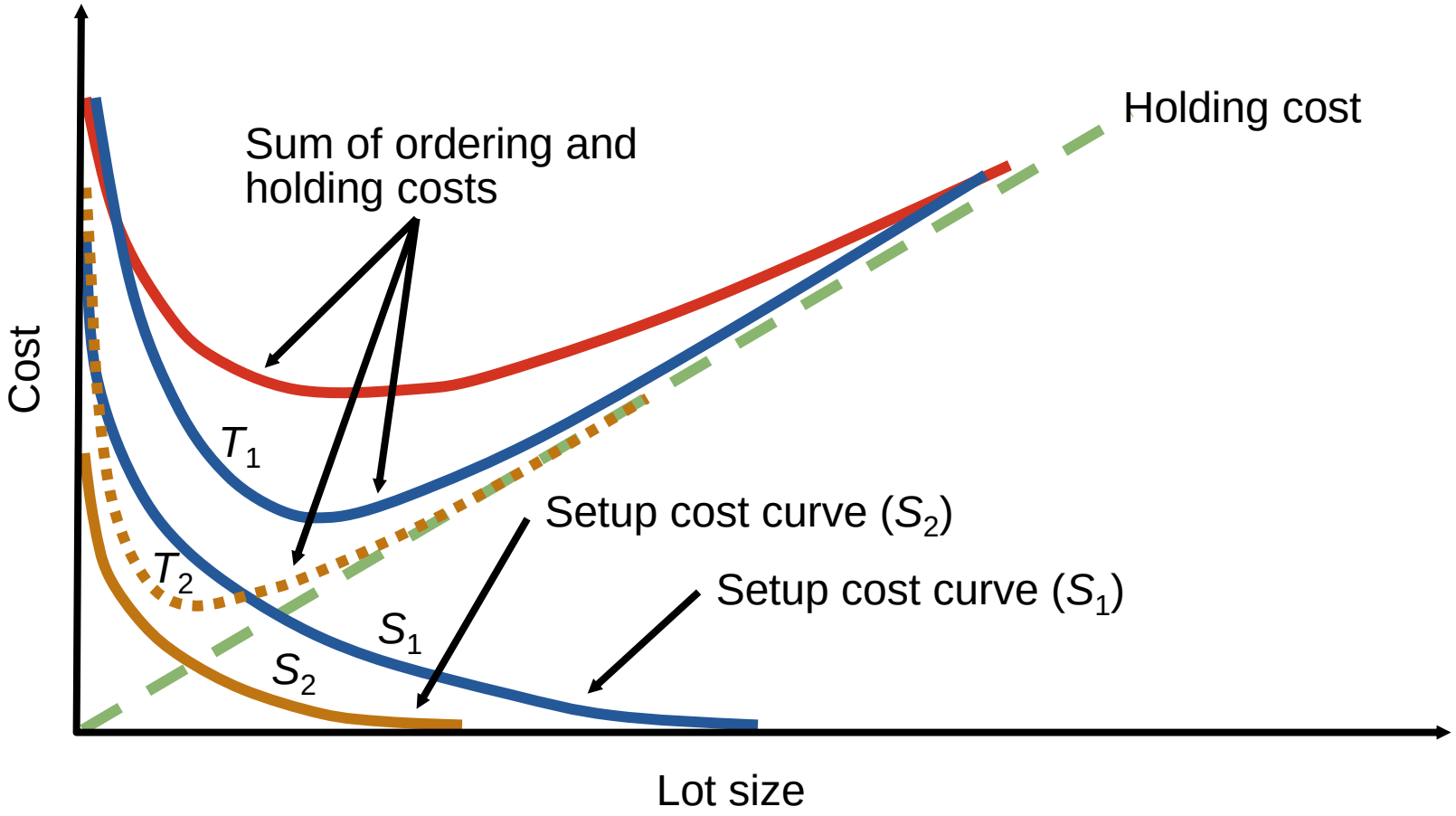
- Ideal situation is to have lot sizes of one pulled from one process to the next
- Often not feasible
- Can use EOQ analysis to calculate desired setup time
- Two key changes necessary
  - Improve material handling
  - Reduce setup time

$$Q_p^* = \sqrt{\frac{2DS}{H\left[1-(d/p)\right]}}$$

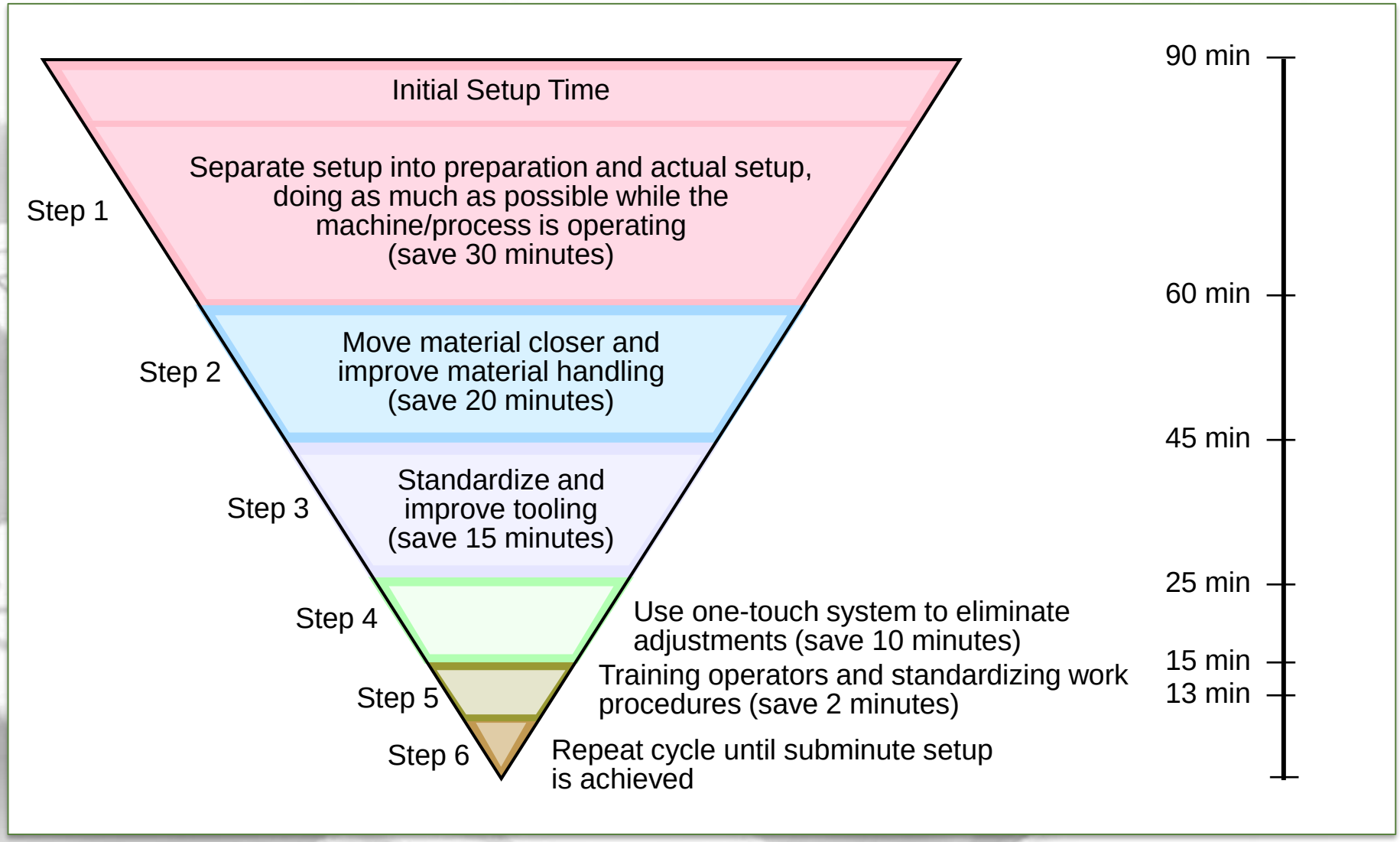
Reduce Setup Costs

- 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

Lower Setup Costs



Reduce Setup Costs



JIT Scheduling

- Schedules must be communicated inside and outside the organization
- Level schedules
  - Process frequent small batches
  - Freezing the schedule helps stability
- Kanban
  - Signals used in a pull system

JIT Scheduling

- Better scheduling improves performance

TABLE
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

Level Schedules

- Process frequent small batches rather than a few large batches
- Make and move small lots so the level schedule is economical
- Freezing the schedule closest to the due dates can improve performance

Kanban

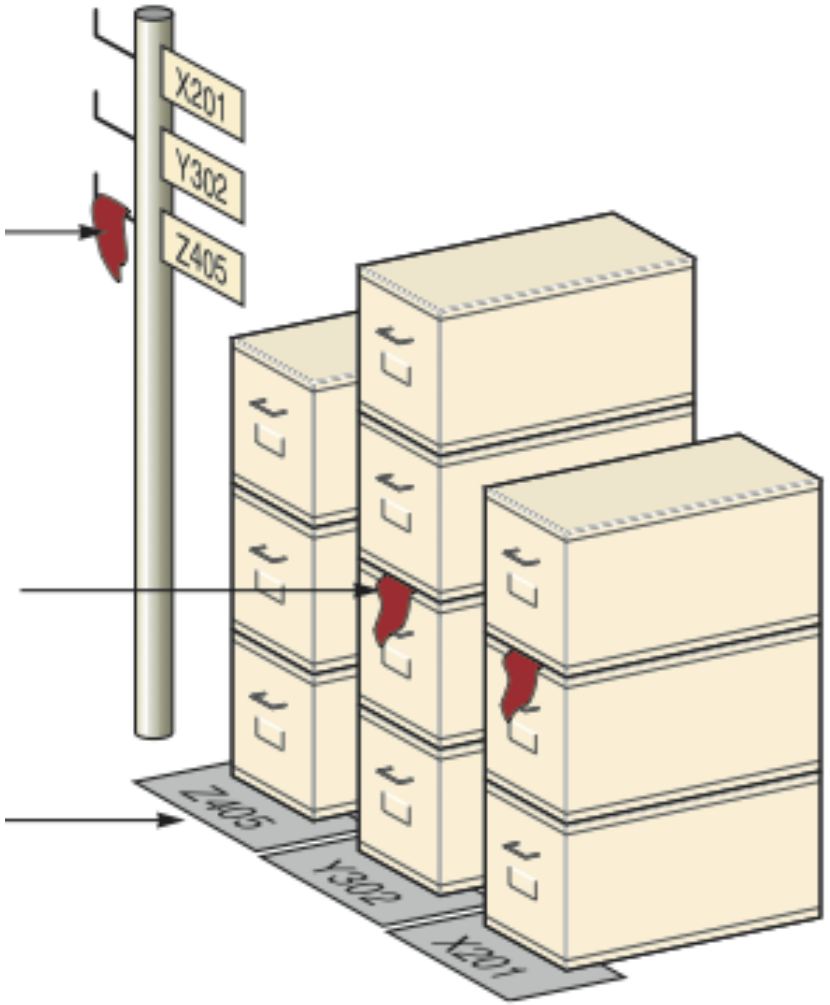
- **Kanban** is the Japanese word for card
- The card is an *authorization for the next container of material to be produced*
- A sequence of kanbans pulls material through the process
- Many different sorts of signals are used, but the system is still called a kanban

Kanban

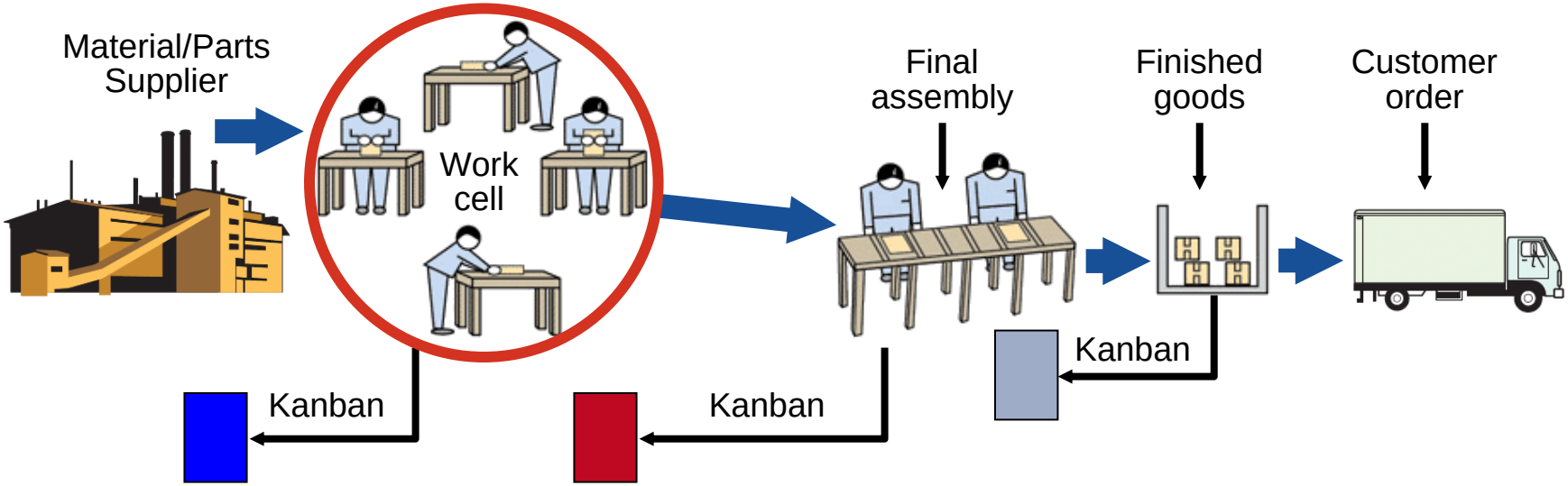
Signal marker hanging on post for part Z405 shows that production should start for that part. The post is located so that workers in normal locations can easily see it.

Signal marker on stack of boxes

Part numbers mark location of specific part



Kanban


Material/Parts Supplier
Work cell
Final assembly
Finished goods
Customer order
Kanban
Kanban
Kanban

More Kanban

- When the producer and user are not in visual contact, a card can be used; otherwise, a light or flag or empty spot on the floor may be adequate
- Usually each card controls a specific quantity or parts although multiple card systems may be used if there are several components or if the lot size is different from the move size

More Kanban

- Kanban cards provide a direct control and limit on the amount of work-in-process between cells
- If there is an intermediate storage area, a two-card system can be used with one card circulating between the user and storage area and the other between the storage area and the producing area

Advantages of Kanban

- Small containers require tight schedules, smooth operations, little variability
- Shortages create an immediate impact
- Places emphasis on meeting schedules, reducing lead time and setups, and economic material handling
- 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

JIT Quality Tactics

TABLE

JIT QUALITY TACTICS
Use statistical process control
Empower employees
Build fail-safe methods (poka-yoke, checklists, etc.)
Expose poor quality with small lot JIT
Provide immediate feedback

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

Lean Operations

- Broader than JIT in that it is externally focused on the customer
- Starts with understanding what the customer wants
- Optimize the entire process from the customer's perspective

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

- Lean systems tend to have the following attributes
  - Develop partnerships with suppliers
  - Educate suppliers
  - Eliminate all but value-added activities
  - Develop employees
  - Make jobs challenging
  - Build worker flexibility

Lean Sustainability

- Two sides of the same coin
- Maximize resource use and economic efficiency
- Focus on issues outside the immediate firm
- Driving out waste is the common ground

Lean Operations in Services

- The JIT techniques used in manufacturing are used in services
  - Suppliers
  - Layouts
  - Inventory
  - Scheduling


Terima Kasih
ngiyabonga
рахмат
danke
謝謝
spas
teşekkür ederim
Баярлалаа
mersi
kia ora
barka
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