Lean Operations

16

PowerPoint presentation to accompany
Heizer, Render, Munson / Global Edition
Operations Management, Twelfth Edition
Principles of Operations Management, Tenth Edition

PowerPoint slides by Jeff Heyl

Outline

- **Global Company Profile:** Toyota Motor Corporation
- Lean Operations
- Lean and Just-in-Time
- Lean and the Toyota Production System
- Lean Organizations
- Lean in Services

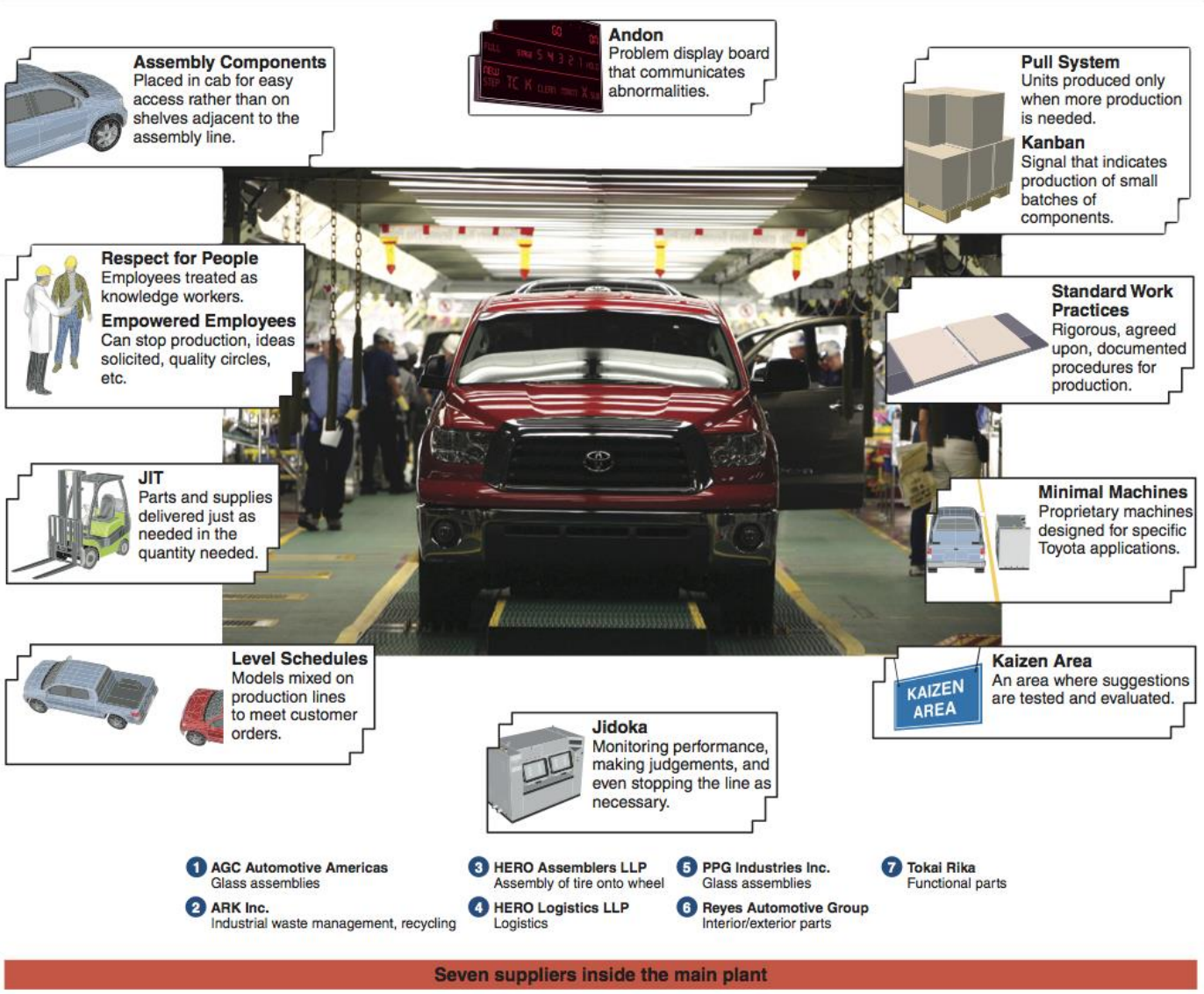
Toyota Motor Corporation

- One of the largest vehicle manufacturers 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



Learning Objectives

When you complete this chapter you should be able to:

16.1 ***Define*** Lean operations

16.2 ***Define*** the seven wastes and the 5Ss

16.3 ***Identify*** the concerns of suppliers when moving to supplier partnerships

16.4 ***Determine*** optimal setup time

Learning Objectives

When you complete this chapter you should be able to:

16.5 ***Define*** kanban

16.6 ***Identify*** six attributes of Lean organizations

16.7 ***Explain*** how “Lean Concept” applies to services

Lean Operations

- **Lean operations** supply the customer with exactly what the customer wants when the customer wants it, without waste, through continuous improvement
- Driven by “pulling” customer orders

Lean Operations

- **Just-in-time (JIT)** focuses on continuous forced problem solving
- **Toyota Production System (TPS)** emphasizes continuous improvement, respect for people, and standard work practices in an assembly-line environment

Lean Operations

- Encompasses both JIT and TPS
- Sustains competitive advantage and increases return to stakeholders
- Three fundamental issues
  - Eliminate waste
  - Remove variability
  - Improve throughput

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*

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
- ***Simplify/straighten*** – methods analysis to
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Two additional Ss

- *Safety* – built in good practices
- *Support/maintena*nce – reduce variability and unplanned downtime

Remove Variability

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

Sources of Variability

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

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  specificati

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

Improve Throughput

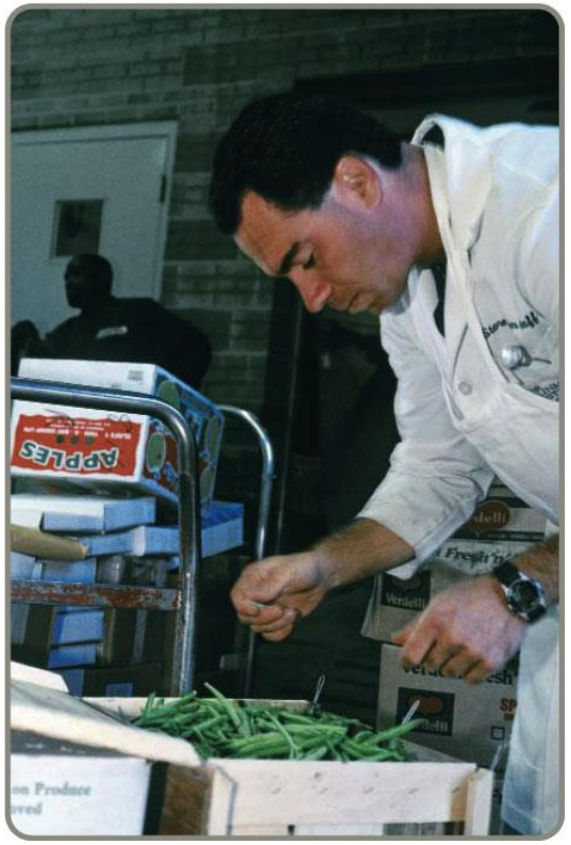
- The rate at which units move through a process
- The time between the arrival of raw materials and the shipping of the finished order is called **manufacturing cycle time**
- A **pull system** increases throughput

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

Lean and Just-In-Time

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



Supplier Partnerships

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

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

Lean Layout

- Reduce waste due to movement

TABLE 16.1
LEAN 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 (*poka-yoke* functions can help)
- 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

Lean Inventory

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

TABLE 16.2

LEAN 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

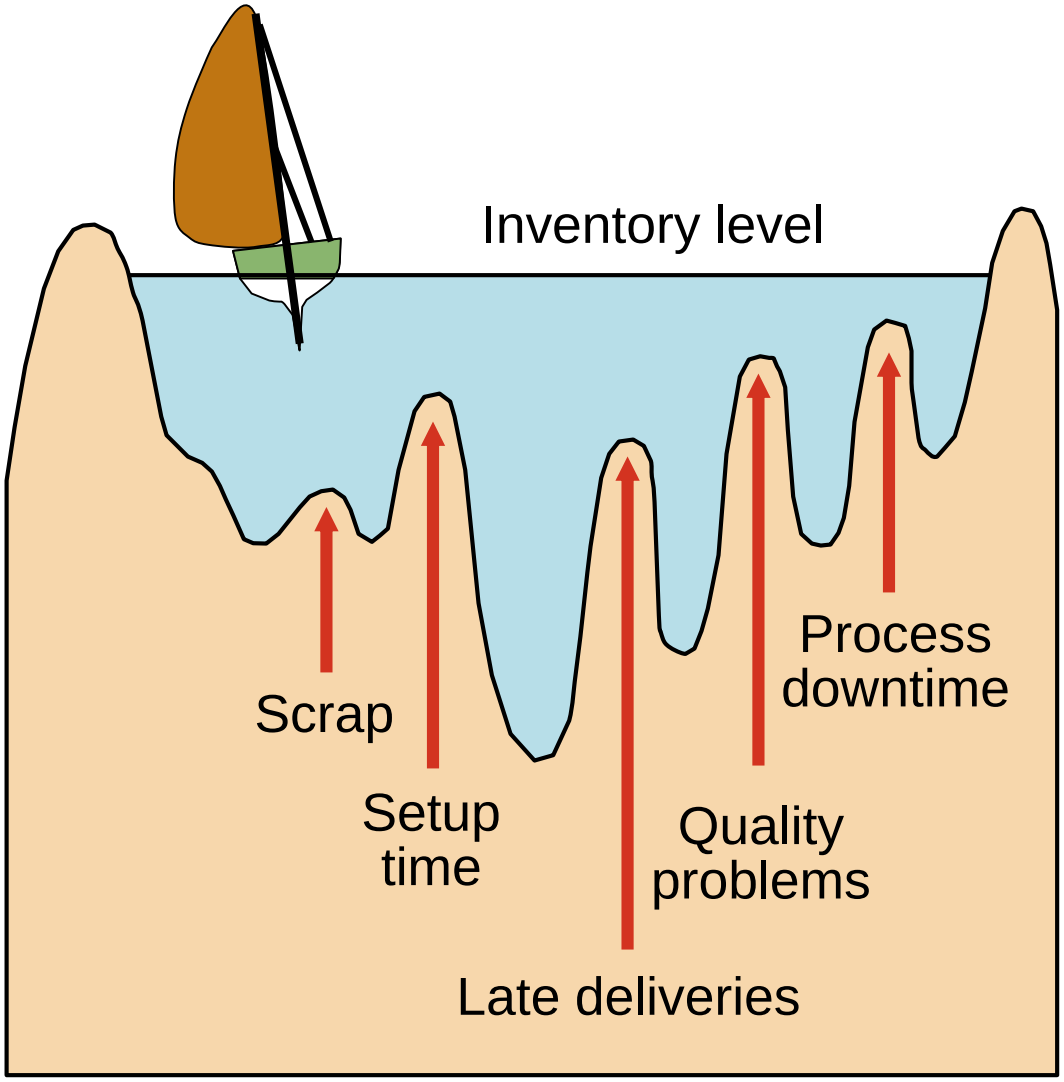


Figure 16.3

Reduce Variability

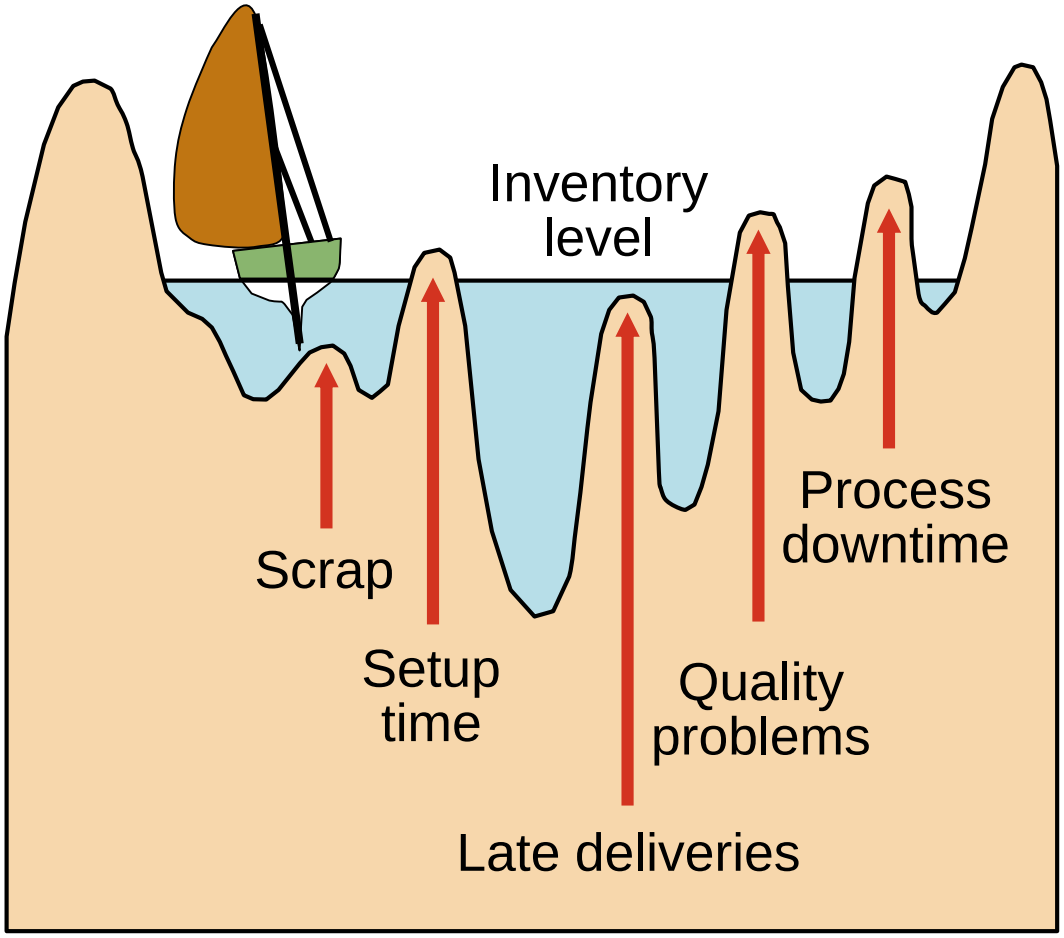


Figure 16.3

Reduce Variability

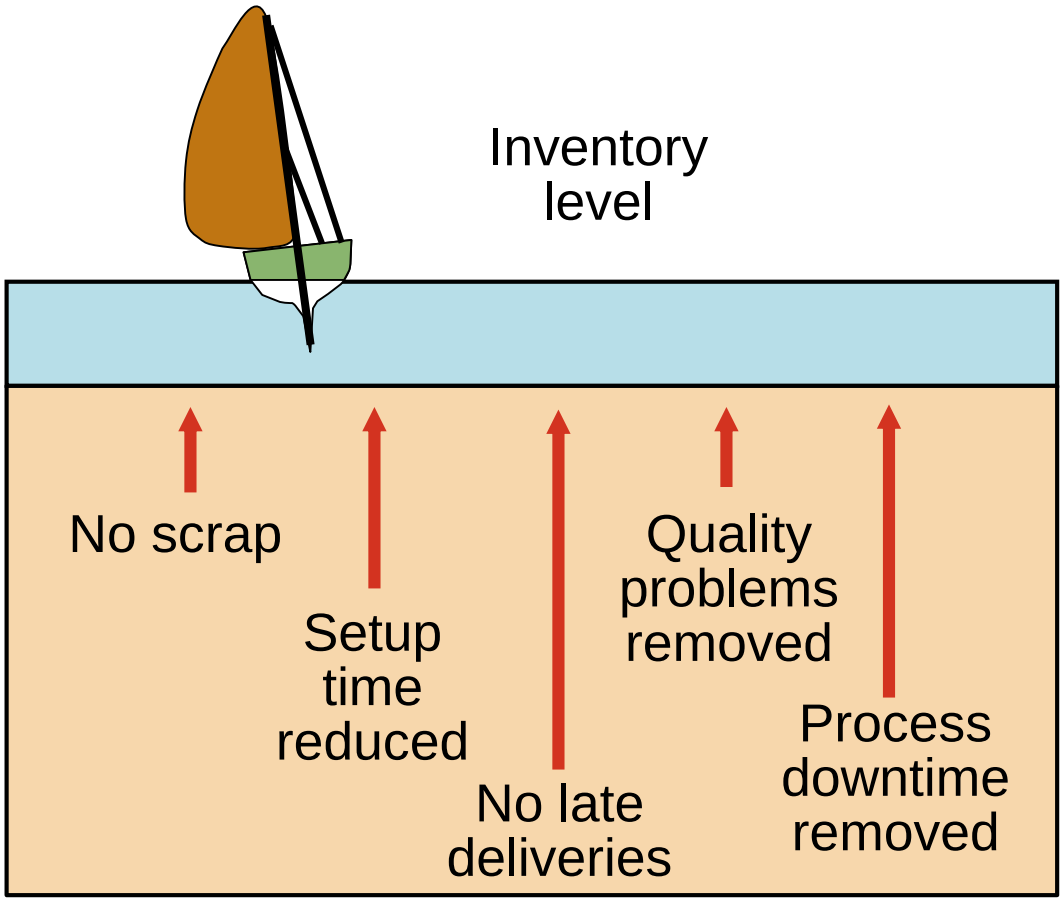


Figure 16.3

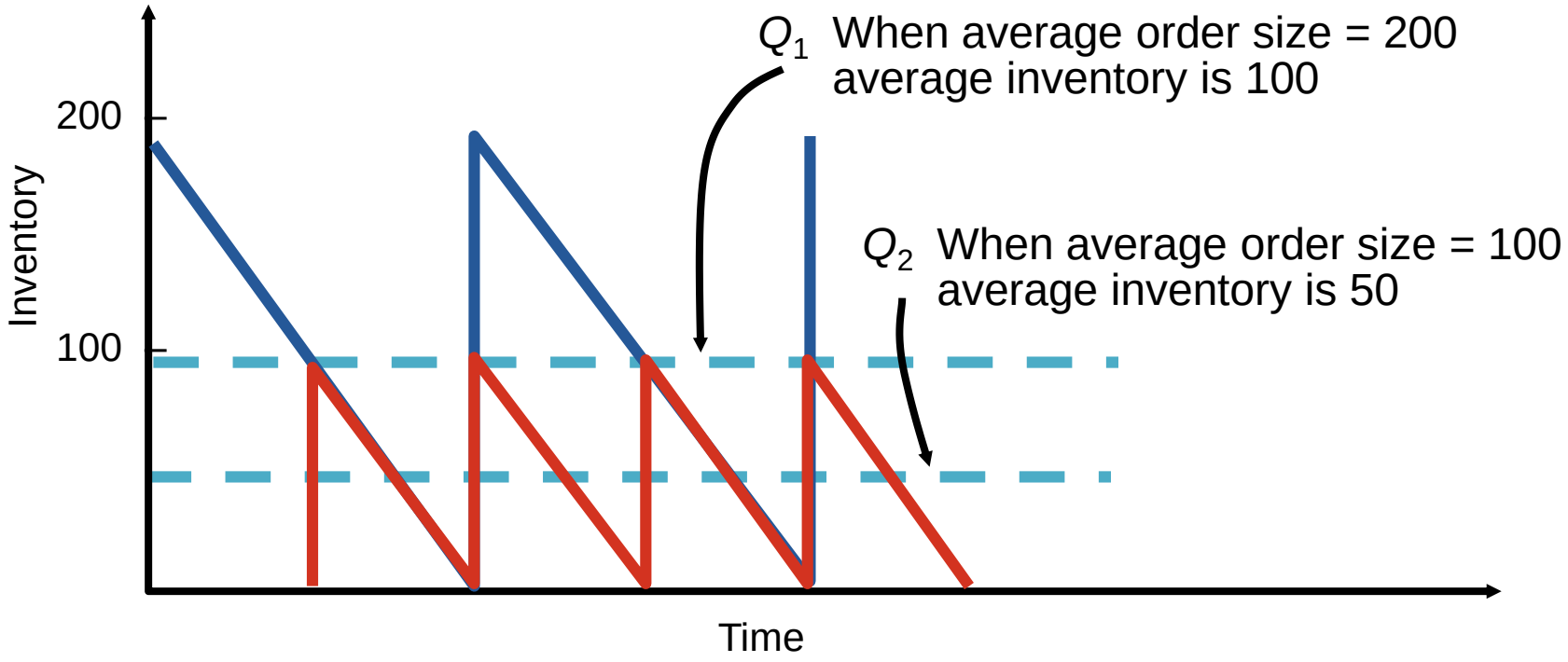
Reduce Inventory

- 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

Figure 16.4



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

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

Setup Time 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_p = EOQ desired = 400
H = Holding cost = \$20 per unit
S = Setup cost (to be determined)

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

$$S = \frac{(Q_p^2)(H)(1-d/p)}{2D} = \frac{(400)^2(20)(1-1{,}600/4{,}000)}{2(400{,}000)} = \$2.40$$

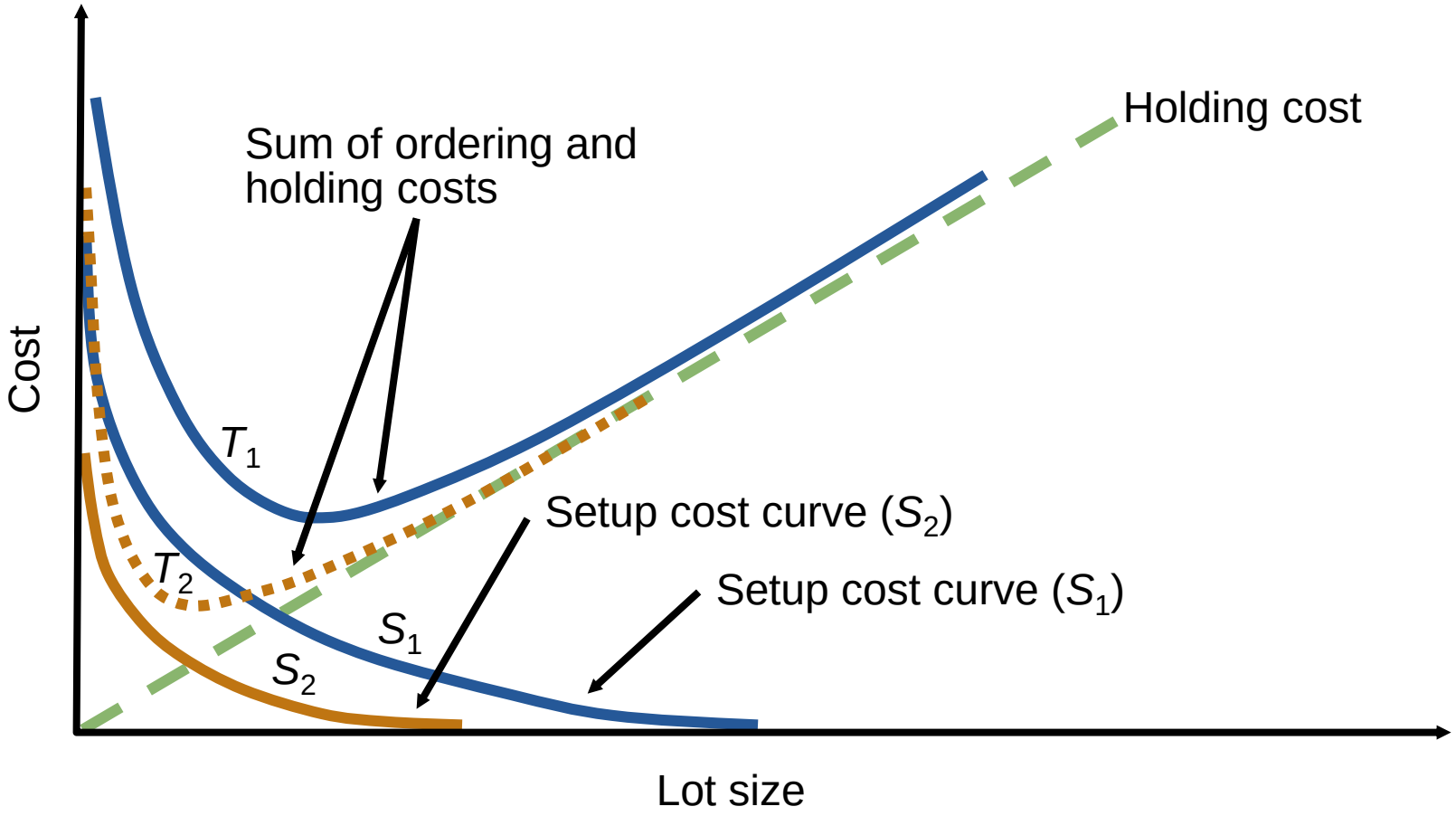
Setup time = \$2.40/(\$30/hour) = 0.08 hr = 4.8 minutes

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

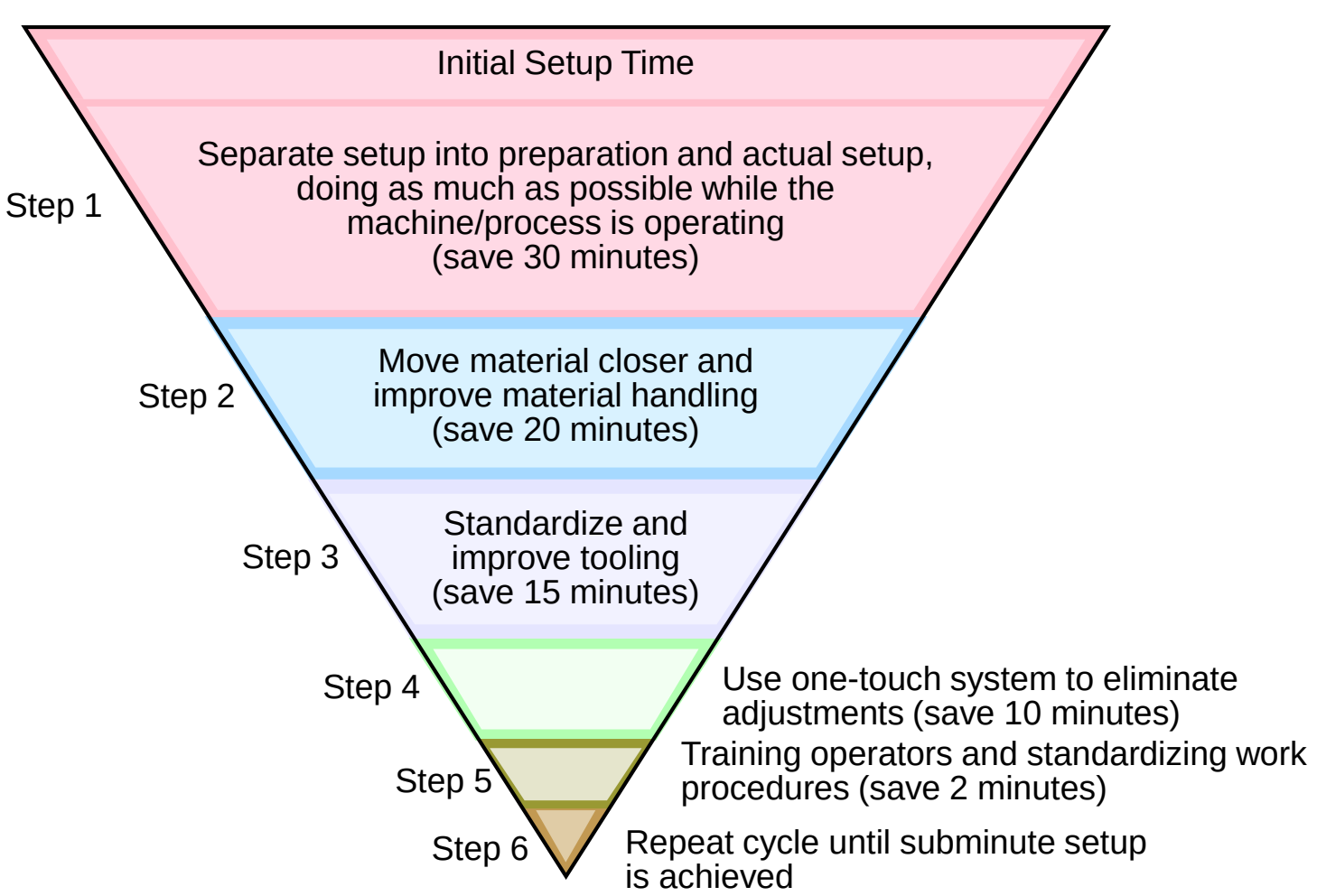
Lower Setup Costs

Figure 16.5



Reduce Setup Costs

Figure 16.6



Lean 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

Lean Scheduling

- Better scheduling improves performance

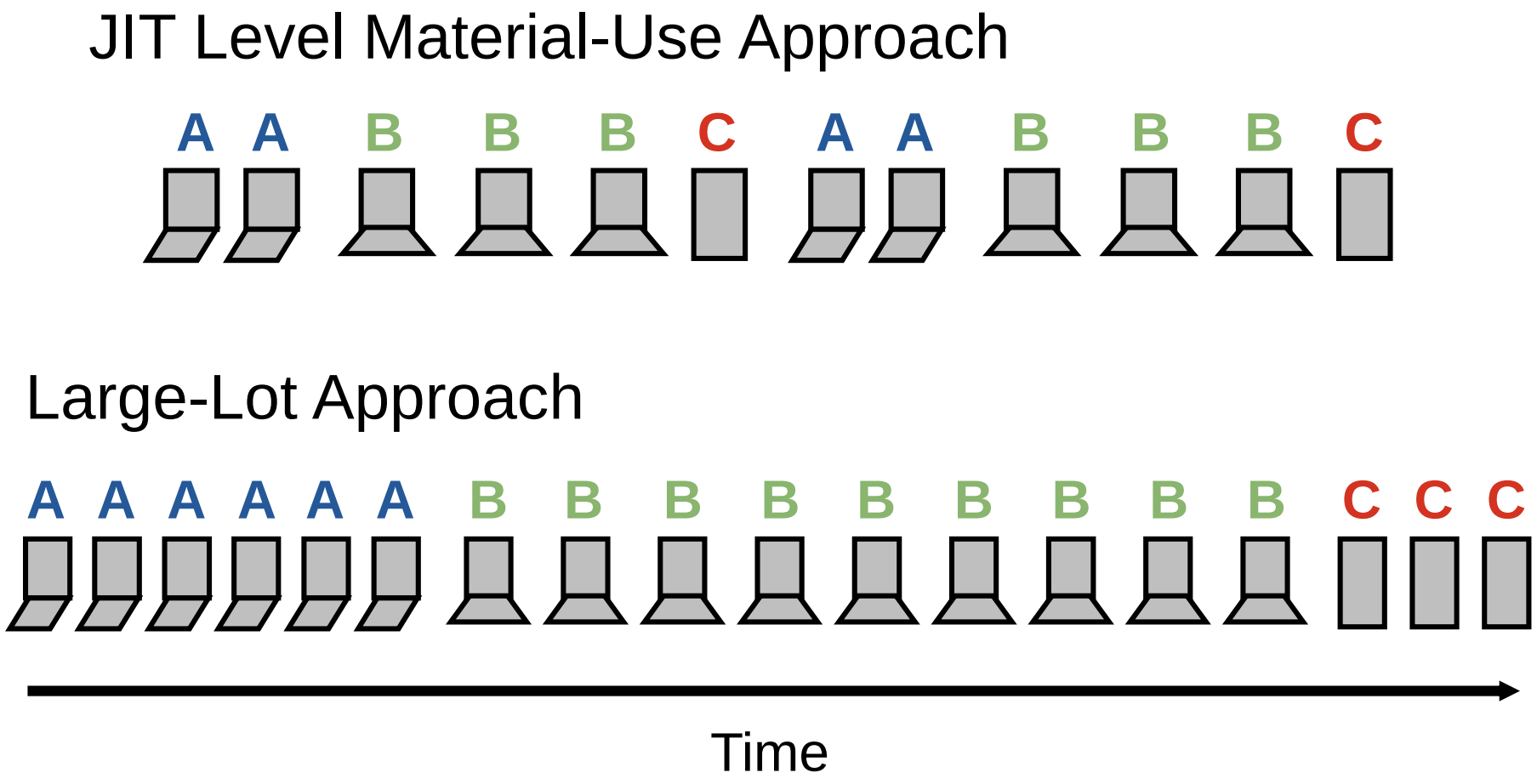
TABLE 16.3
LEAN SCHEDULING TACTICS
Make level schedules
Use kanbans
Communicate schedules to suppliers
Freeze part of the schedule
Perform to schedule
Seek one-piece-make and one-piece-move
Eliminate waste
Produce in small lots
Make each operation produce a perfect part

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

Scheduling Small Lots

Figure 16.7



Lean Quality

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

Lean Quality Tactics

TABLE 16.4
LEAN QUALITY TACTICS
Use statistical process control
Empower employees
Build fail-safe methods (poka-yoke, checklists, etc.)
Expose poor quality with small lots
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

https://global.toyota/en/company/vision-and-philosophy/production-system/

Toyota Production System

- Processes and standard work practice
  - Work shall be completely specified as to content, sequence, timing, and outcome
  - Internal and external customer-supplier connections are direct
  - Material and service flows must be simple and directly linked to the people or machinery involved
  - Process improvement must be made in accordance with the scientific method at the lowest possible level of the organization

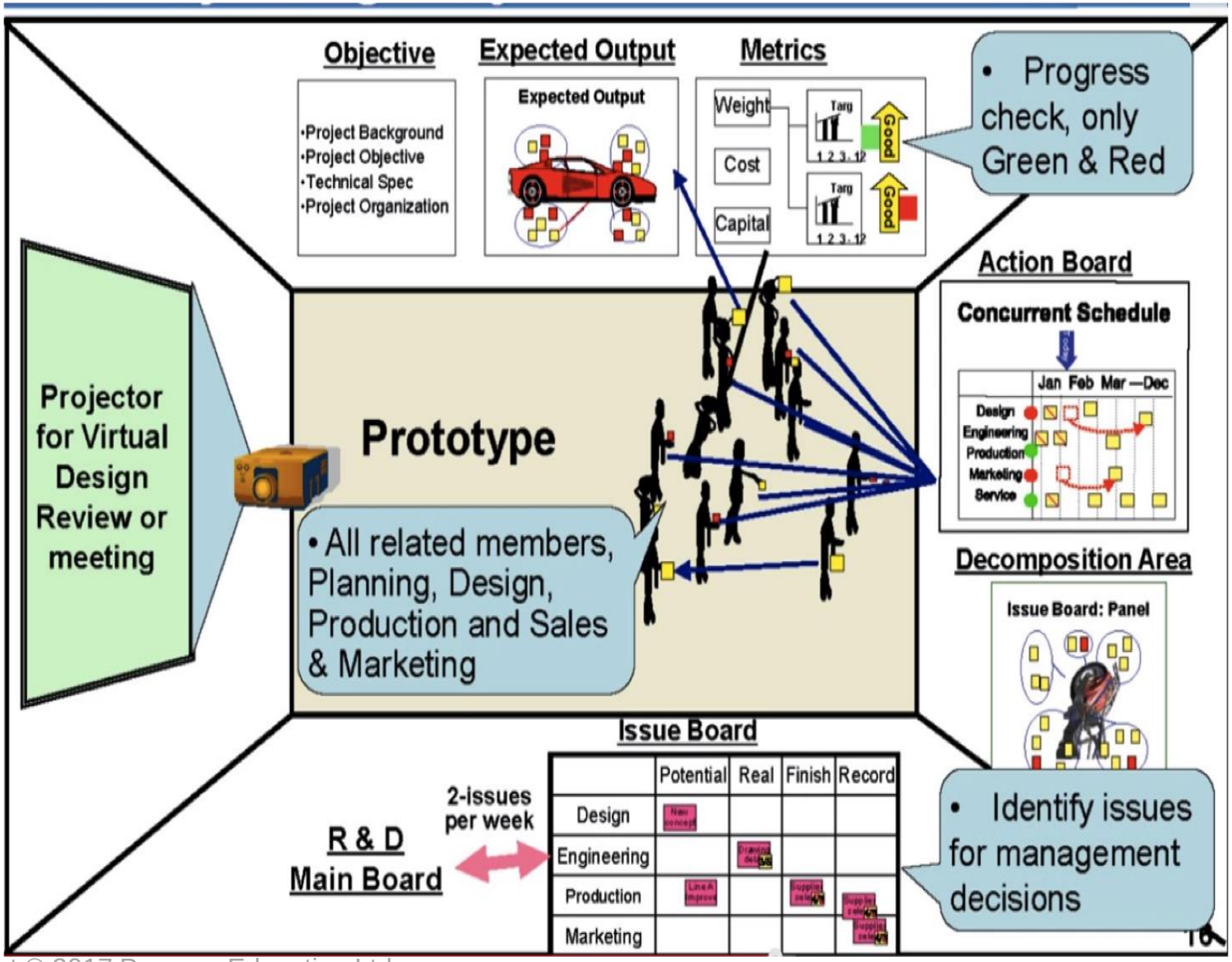
Toyota Production System

- Processes and standard work practice
  - Stopping production because of a defect is called *jidoka*
  - Dual focus
    - Education and training of employees
    - Responsiveness of the system to problems
  - Result is continuous improvement

Obeya (Extra)

- During the product and process development, all individuals involved in managerial planning meet in a “Big Room" to speed communication and decision-making. This is intended to reduce "departmental thinking" and improve on methods like email and social networking. The Obeya can be understood as a team spirit improvement tool at an administrative level.
- An Obeya will contain visually engaging charts and graphs depicting such information as program timing, milestones and progress-to-date and countermeasures to existing technical or scheduling issues.
- At Toyota, vehicle development is possible in significantly less than 20 months; by comparison, the average for other car makers is 36 months.

Obeya (Extra)



Toyota Production System

Further information:

- https://global.toyota/en/company/vision-and-philosophy/production-system/
- http://artoflean.com/wp-content/uploads/2019/01/Basic_TPS_Handbook.pdf

Lean Organizations

- Understanding the customer and their expectations
- Functional areas communicate and collaborate to make sure customer expectations are met
- Implement the tools of Lean throughout the organization

Building a Lean Organization

- Transitioning to a Lean system can be difficult
- Build a culture of continual improvement
- Open communication
- Demonstrated respect for people
- **Gemba walks** to see work being performed

Building a Lean Organization

- Lean systems tend to have the following attributes
  - *Respect and develop employees*
  - *Empower employees*
  - *Develop worker flexibility*
  - *Develop collaborative partnerships with suppliers*
  - *Eliminate waste by performing only value-added activities*

Lean in Services

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