



Chapter 8 – Just-in-Time and Lean Systems

Fundamentals of Operations Management

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Learning Objectives

- Explain the core beliefs of the JIT philosophy
- Describe the meaning of waste in JIT
- Explain the differences between “push” and “pull” systems
- Explain the key elements of JIT manufacturing



Learning Objectives con't

- Explain the elements of TQM and their role in JIT
- Describe the role of people in JIT and why respect for people is so important
- Understand impact of JIT on service and manufacturing
- Understand functional impact of JIT on all areas



Just-in-Time

- JIT philosophy means getting the right quantity of goods at the right place and the right time
- JIT exceeds the concept of inventory reduction; it is an all-encompassing philosophy geared to eliminate waste, anything that does not add value
- A broad JIT view – or *lean production/lean systems* - is one that encompasses the entire organization



Philosophy of Just-in-Time

- JIT originated in Japan at Toyota Motor Co, fueled by a need to survive the devastation post WWII
- JIT gained worldwide prominence in the 1970s
- Often termed “Lean Production” or “Lean Systems”
- Broad view that entire organization has the same goal - to serve customers



The Philosophy of JIT con't

- JIT is built on simplicity - simpler is better
- Continuous improvement – often using kaizen blitz
- Visibility – all waste must be visible to be identified and eliminated
- Flexibility - to adapt to changes in environment

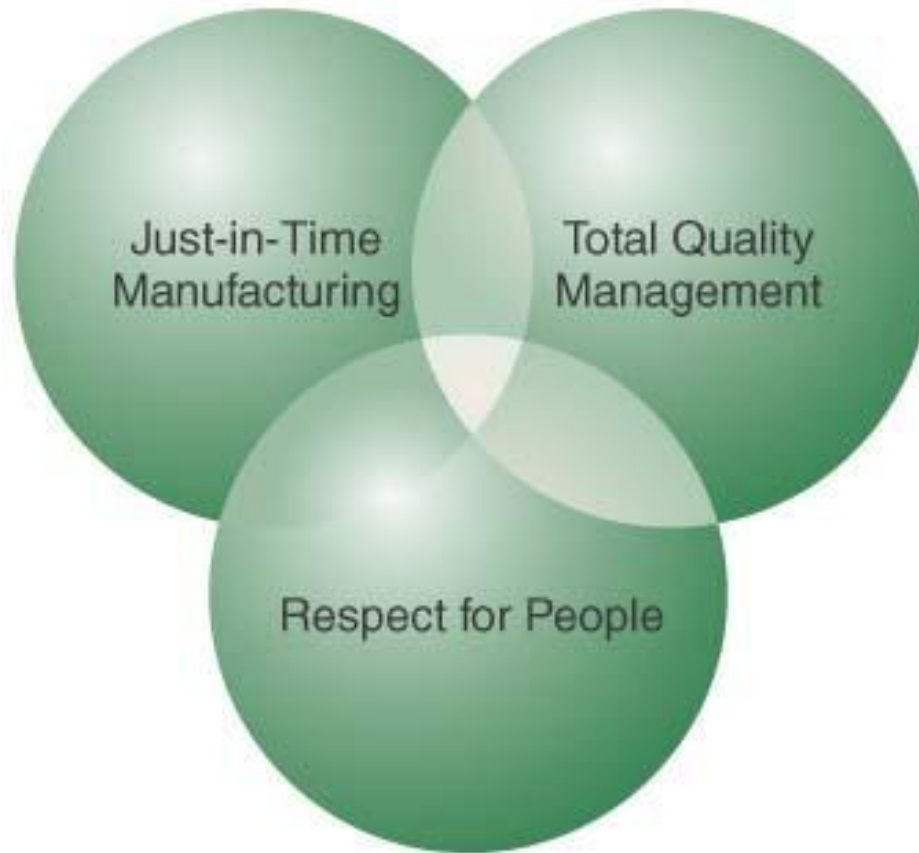


Seven Wastes

1. Waste of Overproduction
2. Waste of Waiting
3. Waste of Transportation
4. Waste of Stock
5. Waste of Motion
6. Waste of Processing
7. Waste of making defective products



Three Elements of JIT





Three Elements of JIT con't

- *JIT manufacturing* focuses on production system to achieve value-added manufacturing
- *TQM* is an integrated effort designed to improve quality performance at every level
- *Respect for people* rests on the philosophy that human resources are an essential part of JIT philosophy

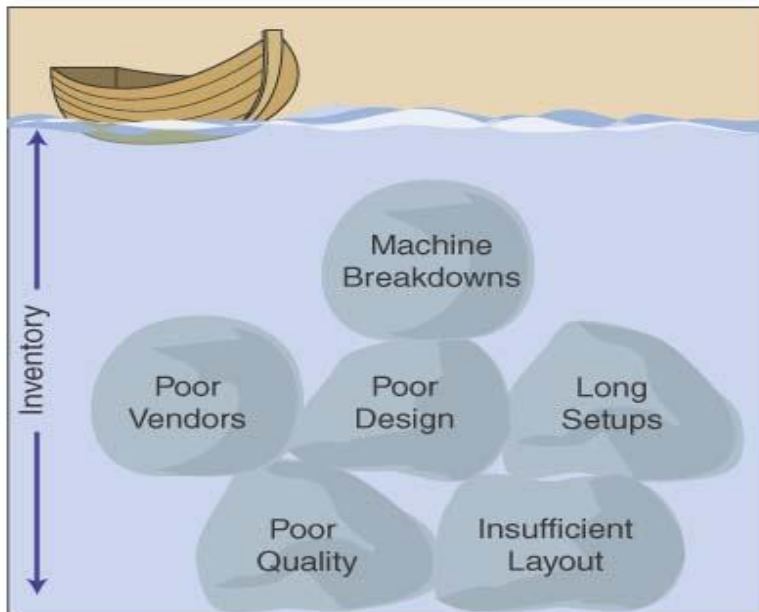


Elements of JIT Manufacturing

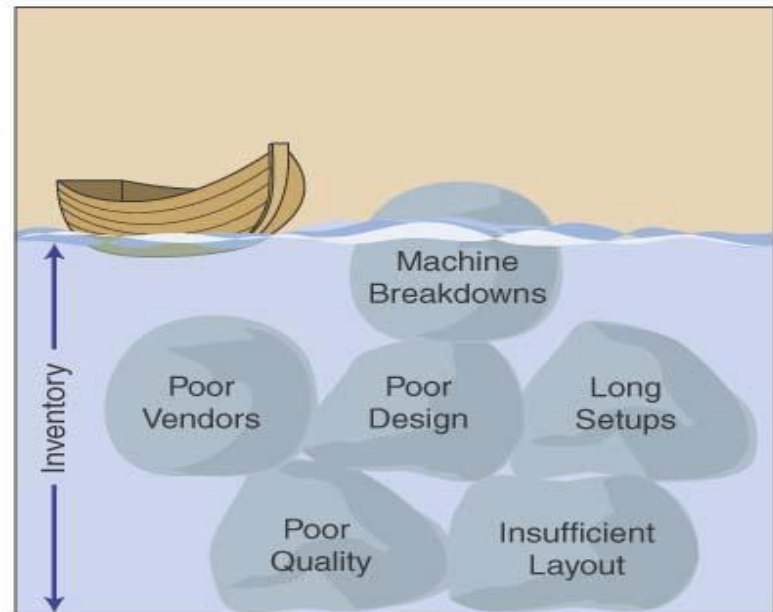
- JIT Manufacturing is a philosophy of *value-added* manufacturing
- Achieved by focusing on these elements:
 - Inventory reduction - exposes problems
 - Kanbans & pull production systems
 - Small lots & quick setups
 - Uniform plant loading
 - Flexible resources
 - Efficient facility layouts

Role of Inventory Reduction

- Inventory = Lead Time (less is better)
- Inventory hides problems

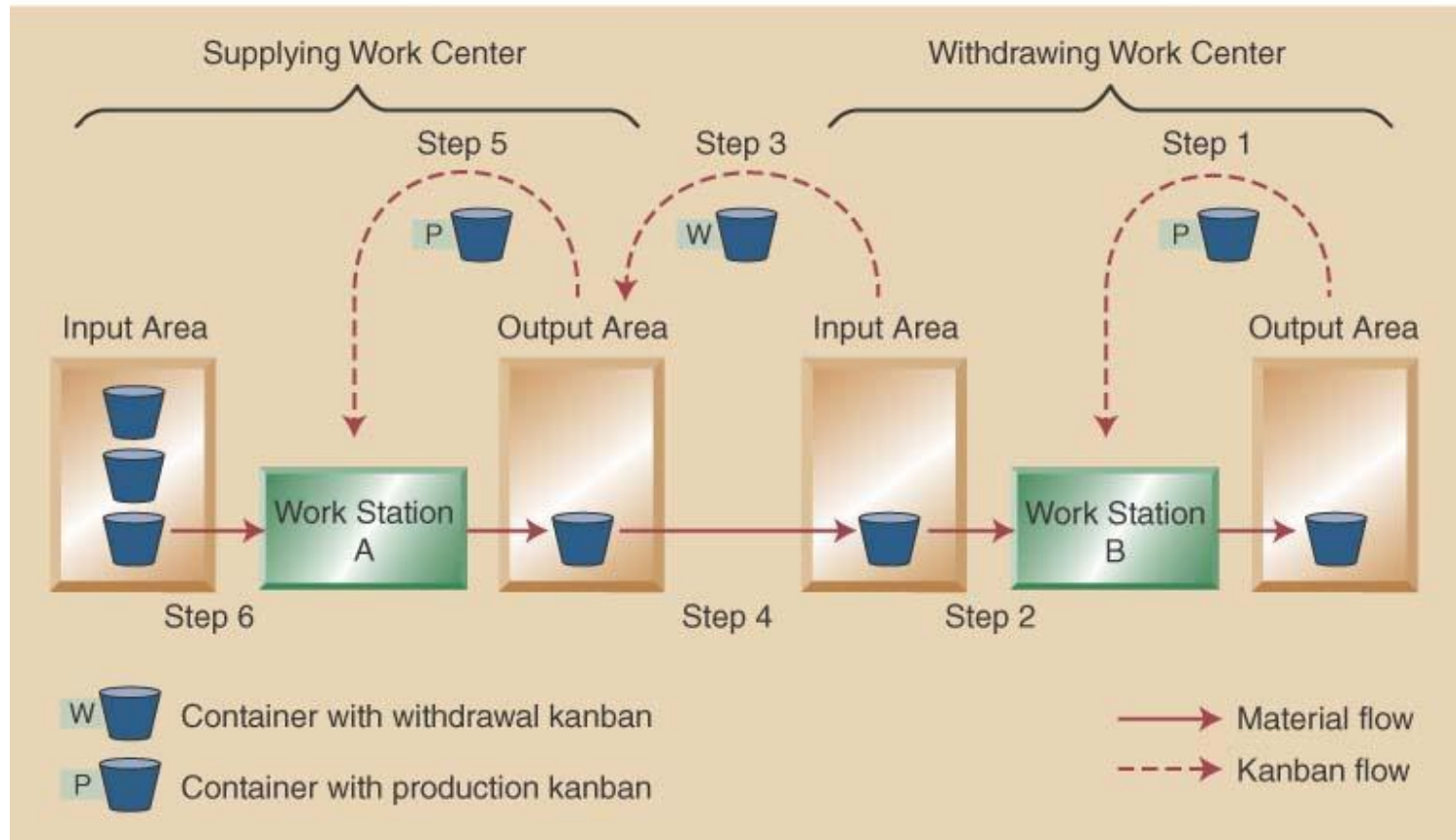


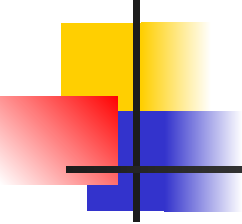
(a) Inventory Hides Problems



(b) Reducing Inventory Exposes Problems

JIT Manufacturing: The Pull System





Computing the Number of Kanbans: an aspirin manufacturer has converted to JIT manufacturing using kanban containers. They must determine the number of containers at the bottle filling operation which fills at a rate of 200 per hour. Each container holds 25 bottles, it takes 30 minutes to receive more bottles, safety stock is 10% of demand during LT.

Solution :

D = 200 bottles per hour

T = 30 minutes = .5 hour

C = 25 bottles per container

S = 0.10(demand)(T) = 0.10(200)(.5) = 10 bottles

$$N = \frac{DT + S}{C} = \frac{(200)(.5) + 10}{25} = 4.4 \text{ kanban containers}$$

Question : round up or down?



Number of Kanbans Required

$$N = \frac{DT + S}{C}$$

N = number of containers

D = demand rate at the withdraw station

T = lead time from supply station

C = container size

S = safety stock

Variations on Kanban Production



- Kanban boxes – space on factory floor for storing supplies
- Flags – used to indicate when supplies need to be ordered
- Supplier kanbans – brings filled containers to point of usage in factory/picks up empty containers



Small Lot Sizes & Quick Setups

- Small lots mean less average inventory and shorten manufacturing lead time
- Small lots with shorter setup times increase flexibility to respond to demand changes
- Strive for single digit setups- < 10 minutes
- Setup reduction process is well-documented
 - **External tasks-** do as much preparation while present job is still running
 - **Internal tasks-** simplify, eliminate, shorten steps involved with location, clamping, & adjustments
- Ultimate goal is single unit lot sizes



Uniform Plant Loading

- A “level” schedule is developed so that the same mix of products is made every day in small quantities
- Leveling the schedule can have big impact along whole supply chain

Weekly Production Required				
A		10 units		
B		20 units		
C		5 units		
D		5 units		
E		10 units		
Traditional Production Plan				
Monday	Tuesday	Wednesday	Thursday	Friday
AAAAA	BBBBB	BBBBB	DDDDD	EEEEE
AAAAA	BBBBB	BBBBB	CCCCC	EEEEE
JIT Plan with Level Scheduling				
Monday	Tuesday	Wednesday	Thursday	Friday
AABBBB	AABBBB	AABBBB	AABBBB	AABBBB
CDEE	CDEE	CDEE	CDEE	CDEE



Flexible Resources

- **Moveable, general purpose equipment:**
 - Portable equipment with plug in power/air
 - Drills, lathes, printer-fax-copiers, etc.
 - Capable of being setup to do many different things with minimal setup time
- **Multifunctional workers:**
 - Workers assume considerable responsibility
 - Cross-trained to perform several different duties
 - Trained to also be problem solvers



Effective Facility Layouts

- Workstations in close physical proximity to reduce transport & movement
- Streamlined flow of material
- Often use:
 - **Cellular Manufacturing** (instead of process focus)
 - **U-shaped lines:** (allows material handler to quickly drop off materials & pick up finished work)



Respect for People: The Role of Employees

- Associates gather performance data
- Team approaches used for problem-solving
- Decisions made from bottom-up
- Everyone is responsible for preventive maintenance



Basics of '5Ss' Practice

- Structure/Organisation (Seiri)
 - Discard unwanted items
 - Organise occasionally used items in storage
 - Place the vital items in convenient place
 - Aiming for 'one is best' policy (one-stop service)
- Systemize/Neatness (Seiso)
 - Clearly designated name and place
 - Functional placement of parts, tools, and materials
 - Quick and easy retrieval of parts and documents
 - Neat and easy to read notice boards



Basics of '5Ss' Practice

- Sanitize/Cleaning (Seiton)
 - Assigning specific cleaning responsibilities to specific people
 - Adopting simple methods for cleaning and inspection
 - Regular and thorough cleaning activities
- Standardize (Seiketsu)
 - Certification of inspections using labels and tags
 - 'Danger' warning marks and signs
 - Color coding files, pipes and containers
 - Directional markings on pipes and gangways (walkways)



Basics of '5Ss' Practice

- Self-Discipline (Shitsuke)
 - Follow all the safety rules at work (eg wearing helmets, gloves, and shoes)
 - Execute individual responsibilities
 - Communicate effectively
 - Practice dealing with emergencies
 - Understand, check and follow '5S' practices



JIT Layout

- Layout means how the raw materials are travelled before making finished goods and services
- JIT layout reduces waste in operation
- Tactics for JIT Layout:
 - Reduced distance or compact layout (U-shape layout, focus factory, group technology, etc.)
 - High Flexibility in manufacturing cells
 - Impact on Employees
 - Reduce the space and inventory



JIT Inventory

- JIT inventory is the minimum inventory necessary to keep a system running
- Exact amount of good arrives at the moment it is needed at the designated place
- Tactics for JIT Inventory
 - Reduce or eliminate setup times (single digit setup time)
 - Reduce lot size
 - Reduce lead times
 - Reduce variability
 - Reduce setup costs



JIT Scheduling

- Scheduling establishes the timing of use of equipment, facility and human activity in operation system.
- JIT scheduling involves smaller batches of products produced more frequently
- Uses Kanban Production Control System
 - Kanban is a simple, visual sign that is used to control the movement of materials between work centers.
 - Two main types of kanban: Production Kanban and Withdrawl Kanban
 - Production Kanban: signals the need to produce more parts
 - Withdrawl Kanban: signals the need to withdraw parts from one work center and deliver them to next work center



JIT Quality (TQM)

- Integrate quality into all processes
 - Focus on continuous improvement - Kaizen
- Quality at the source - sequential inspection
 - **Jidoka** - authority to stop line
 - **Poka-yoke** - **fail-safe** all processes
- Preventive maintenance - scheduled
- Some other requirements:
 - Use of statistical process control
 - Empower employees
 - Expose poor quality with small lot JIT
 - Provide immediate feedback



Respect for People

The Role of Employees:

- Genuine and meaningful respect for associates
- Willingness to develop cross-functional skills
- Bottom-round management – consensus management by committees or teams
- Quality circles – small volunteer teams that solve quality problems



Respect for People

Lifetime Employment:

- Everyone feels secure/is empowered
- Everyone is responsible for quality:
understand both internal and external
customer needs



Lean Operations

- Lean production system is an emerging trend
- Method to build lean system:
 - Use JIT techniques to eliminate virtually all inventories
 - Build system that help employees to produce perfect parts
 - Reduce space requirements
 - Educate suppliers
 - Eliminate non-value adding activities



Respect for People

The Role of Management:

- Responsible for culture of mutual trust
- Serve as coaches & facilitators
 - Responsible for developing workers
 - Provide multi-functional training
 - Facilitate teamwork
- Support culture with appropriate incentive system including non-monetary



Respect for People

Supplier Relationships

- Single-source suppliers
 - Can supply entire family of parts
- Build long-term relationships with small number of suppliers
 - Fewer contracts
 - Cost and information sharing
 - Work together to certify processes



Benefits of JIT

- Reduction in inventories
- Improved quality
- Reduced space requirements
- Shorter lead times
- Lower production costs
- Increased productivity
- Increased machine utilization
- Greater flexibility



Implementing JIT

- Starts with a company shared vision of where it is and where it wants to go
- Management needs to create the right atmosphere
- Implementation needs a designated “Champion”



Implementing JIT – con't

- Implement the sequence of seven steps:
 1. Make quality improvements
 2. Reorganize workplace
 3. Reduce setup times
 4. Reduce lot sizes & lead times
 5. Implement layout changes
 6. Switch to **pull** production
 7. Develop relationship with suppliers



JIT in Services

Many JIT concepts also apply to Service companies

- Improved quality such as timeliness, service consistency, and courtesy
- Uniform facility loading to provide better service responsiveness
- Use of multifunction workers
- Reduction in cycle time
- Minimizing setup times and parallel processing
- Workplace organization



TQM con't

- Preventative Maintenance:
 - Regular inspections and maintenance to keep machines operational
 - Costly, yes but less expensive than unexpected machine breakage.
 - Workers perform maintenance as part of their regular work
 - Care of equipment and well-trained workers are very important.



JIT & Lean Systems: How it all Fits Together

JIT: an overriding philosophy that affects all other business decisions

- Quality Improvements (chs 5 & 6)
- Partnering with suppliers (ch 4)
- Changing job designs (ch 11)
- Facility layout (ch 10)
- Changes in production process (ch 3)
- Changes in inventory (ch 12)



JIT Across the Organization

- JIT eliminates organizational barriers and improves communications
 - Accounting changes or relies on activity-based costing
 - Marketing by interfacing with the customers
 - Finance approves and evaluates financial investments
 - Information systems create the network of information necessary for JIT to function



Chapter 7 Highlights

- JIT is a philosophy that was developed by the Toyota Motor Company in the mid-1970s. It has become the standard for many industries by focusing on simplicity, eliminating waste, taking a broad view of operations, visibility, and flexibility. Three key elements of this philosophy are JIT manufacturing, total quality management, and respect for people.
- JIT views waste as anything that does not add value.



Chapter 7 Highlights

- Traditional manufacturing systems use “push” production; JIT uses “pull” production. Push systems anticipate future demand and produce in advance in order to have products in place when demand occurs. Pull systems work backwards. The last workstation in the production line requests the precise amounts of materials required.



Chapter 7 Highlights con't

- JIT manufacturing is a coordinated production system that enables the right quantities of parts to arrive when/where they are needed. Key elements of JIT manufacturing are the pull system and kanban production, small lot sizes and quick setups, uniform plant loading, flexible resources, and streamlined layout.



Chapter 7 Highlights con't

- TQM creates an organizational culture that defines quality as seen by the customer. The concepts of continuous improvement and quality at the source are integral to allowing for continual growth and the goal of identifying the causes of quality problems.



Chapter 7 Highlights con't

- JIT considers people to be the organization's most important resource.
- JIT is equally applicable in service organizations, particularly with the push toward time-based competition and the need to cut costs.
- JIT success is dependent on interfunctional coordination and effort.



The End

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