Garment Production Management

Week 14

Just in Time and lean manufacturing

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Recap-previous week

- Introduction to scheduling and sequencing
- Scheduling strategies
- Scheduling techniques and methods
- Monitoring and control of production schedules

Lecture Learning Outcomes

1. Understanding JIT and lean concepts
2. Analyze JIT principles
3. Evaluate JIT inventory
4. Understand the lean principles
5. Understand JIT implementation

Session outline

- Just-in-Time (JIT)
- Lean Manufacturing concepts
- JIT inventory
- JIT implementation

Just in time (JIT)

- Originated at Toyota Production System (TPS) in the 1970s
- A production philosophy that produce and deliver:
  - Exactly what is needed
  - Exactly when it is needed
  - Exactly in the quantity needed
- Eliminate waste by reducing inventory and waiting time
- JIT is not just about inventory
- It is a discipline of timing and precision

Lean manufacturing

What is Lean Manufacturing?

- Lean = systematic elimination of waste (Muda) from all processes
- Broader than JIT– includes culture, process flow, quality, and people
- Maximize customer value while minimizing resources
- JIT is a key pillar of lean
- Lean also includes tools like 5S, Kaizen, and value stream mapping

Lean manufacturing

The 8 Wastes (Muda)

- Overproduction – Making more than needed
- Waiting – Idle time, people or machines
- Transportation – Unnecessary movement of goods
- Overprocessing – Doing more work than required
- Inventory – Excess raw materials, WIP, finished goods
- Motion – Unnecessary people movement
- Defects – Rework, scrap, inspection
- Non-Utilized Talent (or Skills) – Failing to use the knowledge, creativity, experience, or ideas of employees.

JIT directly attacks Inventory and Overproduction – the two most damaging wastes

JIT vs traditional manufacturing

Dimension	Traditional manufacturing	JIT manufacturing
Inventory	High (safety stock)	Minimal (near zero)
Batch sizes	Large	Small (ideally 1)
Lead times	Long	Short
Quality approach	Inspect after production	Build-in quality at source
Supplier relationship	Arms-length	Long-term partnerships

JIT is not an incremental improvement – it is a different operating model

Principles of JIT

- Pull system: Customer demand pulls production (no pushing)
- Continuous flow: Work moves without interruption
- Takt time: Production pace matches customer demand rate
- These three principles work together
- Without any one, JIT fails

Principles of JIT

Pull vs. push systems

Push (Traditional):

- Produce based on forecast
- Move goods forward regardless of downstream need

Pull (JIT):

- Produce only when downstream process requests it
- Controlled by Kanban signals
- *Think of a supermarket shelf.*
- *The shelf is restocked only when a customer takes an item – that is a pull system*

Takt time

- **Takt time** = Available production time / Customer demand
- Example: 480 minutes per day / 240 units = 2 minutes per unit
- Every process Takt time must produce one unit every 2 minutes
- Synchronizes the entire production line
- If any step takes longer than takt time, you have a bottleneck

Benefits of JIT and Lean

Benefits	Impact on business
Inventory reduction	50–90% lower carrying costs
Lead time reduction	Days → hours
Quality improvement	Defects reduced by 50%+
Space utilization	Floor space freed up (30%+)
Cash flow	Less working capital tied up

JIT inventory

- Inventory is considered waste, not an asset
- Stockless production (or as close as possible)
- Raw materials arrive exactly when needed; not before or after
- In traditional accounting, inventory is an asset
- In JIT, it hides problems
- Reducing inventory exposes issues so you can fix them

JIT inventory

The water and rocks analogy

- Inventory = water in a river
- Problems = rocks (defects, downtime, imbalance)
- Lower inventory (lower water) = rocks become visible
- When inventory is high, problems are hidden
- JIT lowers inventory deliberately to expose and then solve problems

Key JIT inventory metrics

Metric	Formula	Target
Inventory turns	COGS / Average inventory	>20x per year
Days of supply	(Inventory / COGS) × 365	<5 days
On-time delivery	Orders delivered on time / total orders	>98%
Supplier lead time	Order to receipt (days)	<1 day

You cannot manage what you do not measure. Start tracking these weekly

Kanban

Kanban – The visual pull signal

- Kanban (Japanese word meaning signboard): A card or signal that authorizes production or movement
- Two-bin system: When first bin is empty, return the card – that signals replenishment
- Digital Kanban now common (e-kanban)
- Kanban replaces purchase orders. It is simple, visual, and self-regulating

Types of Kanban

- Withdrawal Kanban: Authorizes moving parts to next process
- Production Kanban: Authorizes making more parts
- Supplier Kanban: Signals external supplier to deliver
- Emergency Kanban: For unexpected shortages (use carefully)

Most operations start with withdrawal and production Kanban between internal processes

Kanban cards

Calculating Number of Kanban Cards

- Number of Kanban = (Daily demand × Lead time × Safety factor) / Container quantity

Example:

- Daily demand = 100 units
- Lead time = 0.5 day
- Safety factor = 1.2
- Container = 10 units
- Kanban = (100 × 0.5 × 1.2) / 10 = 6 cards

This formula balances inventory with service level

Reduce lead time and you reduce Kanban cards

JIT

Small batch sizes (One-Piece Flow)

- Traditional: Large batches reduce changeover cost per unit
- JIT: Small batches (ideally batch size = 1)
- Requires single Minute Exchange of Die (SMED) (changeover under 10 minutes)
- Economic order quantity formula assumes fixed changeover cost
- JIT attacks that assumption by reducing changeover time to near zero

JIT

JIT with Suppliers: Key requirements

- Frequent deliveries: sometimes multiple times per day
- Nearby location: within 1–2 hours for many industries
- Dedicated trucks or milk runs
- Shared demand visibility (real-time data access)
- Long-term contracts

JIT cannot work with adversarial supplier relationships

You need partners, not vendors

JIT implementation

- **Assessment** – Where are we now?
- **Pilot** – One cell, one product line
- **Stabilize** – Eliminate variability
- **Scale** – Expand to value stream
- **Sustain** – Continuous improvement culture

- *Do not implement JIT across the entire factory in one month*
- *Start small, learn, and expand*

JIT implementation

Phase 1 – Assessment & readiness

- Calculate current inventory turns and days of supply
- Map value stream (current state)
- Identify top 3 waste categories
- Assess leadership commitment (critical)

- *If leadership still believes "inventory is insurance," JIT will fail*
- *Start with education*

JIT implementation

Phase 2 – Pilot selection criteria

- Choose a pilot area with:
  - High volume (see results quickly)
  - Repetitive process (easy to measure)
  - Committed team
  - Low risk to customer (not a sole-source critical part)

A good pilot builds confidence and creates a demonstration site for others

- *If leadership still believes "inventory is insurance," JIT will fail*
- *Start with education*

JIT implementation

Phase 3 – Stabilize the Process First

- JIT requires stable processes
- Before reducing inventory:
  - Reduce machine downtime (Total Productive Maintenance – TPM)
  - Standardize work
  - Reduce defects (Poka-yoke / mistake-proofing)
  - Reduce changeover time (SMED)
- Trying JIT on an unstable process is like building a house on sand
- Stabilize first

JIT implementation

The 5S Foundation for JIT

- Sort: Remove unneeded
- Set in order: A place for everything or visual organization
- Shine: Clean and inspect
- Standardize: Create rules or make 5S a habit
- Sustain: Discipline or regular audits

JIT critical success factors

- Top management commitment: Not just approval but active support
- Employee empowerment: Stop the line authority
- Supplier partnerships: Not adversarial bidding
- Visual management: anyone can see the status
- Continuous improvement (Kaizen) as a daily habit

Why JIT in garment industry?

- Traditional garment factories suffer from high inventory, long lead times, and large batch sizes
- Push production (cutting based on forecast) leads to overproduction – the worst waste
- Fabric stored in warehouses for weeks; cut pieces pile up between cutting and sewing
- Finished goods wait while fashion trends change, leading to markdowns or write-offs
- JIT and Lean flip push to pull: produce only what a customer has ordered

Why JIT in garment industry?

- Cut in small batches (1–2 dozen) instead of hundreds
- Reduce changeover time between styles to switch quickly without losing productivity
- Eliminate waiting by balancing flow from cutting to sewing to finishing
- Results are less cash tied up, faster response to demand, less rework, higher turns

JIT inventory in garment industry

- Fabric arrives daily from nearby suppliers – no bulk purchases months in advance
- Cut only what the sewing line needs for the next few hours
- Kanban (card or empty bin) signals cutting to produce exactly one more bundle
- Small batch size (1–2 dozen) means defects are caught immediately, not after hundreds of pieces
- Work-in-progress inventory drops dramatically; no piles between processes

JIT inventory in garment industry

- Suppliers deliver trims (zippers, buttons, threads) daily using a milk run truck
- Andon lights at each sewing station: worker pulls cord to stop line for quality or missing material
- Supervisor sees the light and responds immediately – problems are not hidden
- Inventory turns increase from 3–4x per year to 10–15x per year

Industry challenges in garment industry

- Long production lead times delay market response
- High defect rates in cutting and sewing processes
- Excessive waste types: overproduction, inventory, motion, waiting, defects
- Fast fashion demands 3–5 weeks from design to retail shelf
- Low productivity and high work-in-process (WIP) inventory across production lines

Key lean tools in garment industry

- Value Stream Mapping (VSM) to identify and eliminate non-value-added activities
- 5S workplace organization to reduce motion and searching waste
- Kanban / Just-in-Time (JIT) for pull-based production control
- Cellular manufacturing to improve workflow and reduce material handling
- Kaizen events for continuous, small-step process improvements

Measurable performance improvements

The case of lean in garment industry

- Production output increased after lean implementation
- Defect rate reduced in cutting operations
- Work-in-process inventory reduced
- Throughput time reduced
- Productivity increased

Real world case study results

Impact of lean implementation

- Ghana (ILO program): 159% increase in cutting capacity, 88% reduction in WIP retention
- Ethiopia: 48.5% WIP reduction, 80.3% throughput time reduction
- Egypt: 67% average productivity gain, $286,000 combined annual savings
- Sri Lanka: Digital Lean with IoT and e-Kanban overcame implementation barriers
- Bangladesh: Lean reduced rejection rates by 52% in export-oriented factories

Summary

What is Lean Manufacturing?

- Systematic elimination of waste (Muda) from all processes
- Maximize customer value while minimizing resources
- Broader philosophy that includes culture, flow, quality, and people

What is Just-in-Time (JIT)?

- Produce and deliver exactly what is needed, exactly when needed, in exact quantity
- Originated at Toyota as a key pillar of the Toyota Production System
- Focuses on timing, precision, and inventory reduction

Summary

The 7 Wastes (TIM WOOD)

- Transportation – Unnecessary movement of goods
- Inventory – Excess raw materials, WIP, finished goods
- Motion – Unnecessary people movement
- Waiting – Idle time for people or machines
- Overproduction – Making more than needed (the worst waste)
- Overprocessing – Doing more work than required
- Defects – Rework, scrap, inspection

Summary

Core JIT Principles

- Pull system (customer demand pulls production – no pushing)
- Continuous flow (work moves without interruption)
- Takt time (production pace matches customer demand rate)
- Small batch sizes (ideally one-piece flow)
- Kanban (visual signals that authorize production)

Summary

Key Enablers

- 5S (Sort, Set in order, Shine, Standardize, Sustain)
- SMED (fast changeover – under 10 minutes)
- Total Productive Maintenance (zero downtime)
- Poka-yoke (mistake-proofing)
- Supplier partnerships (frequent deliveries, nearby location)

Summary

Primary Benefits

- Inventory reduction (50–90% lower carrying costs)
- Lead time reduction (days to hours)
- Quality improvement (defects cut by 50%+)
- Space utilization (floor space freed 30%+)
- Improved cash flow (less working capital tied up)

References

1. **Ohno, T. (1988).** *Toyota production system: Beyond large-scale production*. Productivity Press.
   (The founder of JIT explains the original system—essential for any history or principles slide.)

2. **Womack, J. P., Jones, D. T., & Roos, D. (1990).** *The machine that changed the world*. Free Press.
   (Coined the term "Lean Production"—use for defining Lean vs. JIT.)

3. **Liker, J. K. (2004).** *The Toyota way: 14 management principles*. McGraw-Hill.
   (Source for the "House of Lean" diagram and the pillars of JIT & Jidoka.)

4. **Garcia, D. (2026).** Spread too thin: The impact of lean inventories. *Journal of Monetary Economics*.
   (Modern empirical evidence on JIT's vulnerability to supply shocks—perfect for a risks/disruptions slide.)

5. **Shah, R., & Ward, P. T. (2007).** Defining and developing measures of lean production. *Journal of Operations Management, 25*(4), 785-805.
   (Highly cited academic source for validated Lean measurement tools—use for implementation metrics.)

Thank You !

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