Lean Production

- Doing more with less inventory, fewer workers, less space
- Just-in-time (JIT)
  - A philosophy and an integrated management system first adopted by the Toyota Production System
  - Minimizing inventory and smoothing the flow of material to arrive just as it is needed
  - “JIT” and “Lean Production” are used interchangeably
- The goal is to eliminate all kinds of Muda
  - waste, anything other than that which adds value to the product or service
Waste in Operations

1. Overproduction (producing items we cannot immediately use or sell)
2. Waiting (for parts, machines, and downstream operations)
3. Transporting (moving items needlessly)

Waste in Operations (cont.)

1. Processing unnecessary steps that do not add value
2. Inventory (storing, revolving, counting, insuring, taking up space & money)

Waste in Operations (cont.)

1. Movement (involved for tools, parts, instruction, approval)
2. Defects (defects and errors)
3. Talent (underutilization of worker knowledge and skills)
Lean Production

Basic Elements

1. Flexible resources
2. Cellular layouts
3. Pull production system
4. Kanban production control
5. Small lot production
6. Quick setups
7. Uniform production levels
8. Quality at the source
9. Total productive maintenance
10. Supplier networks

Lean Element 1
Flexible Resources

- Multifunctional workers
  - perform more than one job
- General-purpose machines
  - perform several basic functions
- Cycle time and takt time
  - Cycle time is the time required for the worker to complete one pass through the operations assigned
  - Takt time is the pace at which production takes place to match customer demand

Lean Element 2
Cellular Layouts

- Using cellular layout in stead of process layout to reduce transportation, waiting time, inventory, and improve product flow
- Cycle time is adjusted to match takt time by changing worker paths
Cellular Layout

Cells with Worker Routes

Worker Routes Lengthen as Volume Decreases

Lean Element 3

Pull System

- Material is pulled through the production system when needed
- Reversal of traditional push system where material is pushed according to a schedule

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Lean Element 4

Kanbans

- Cards which indicate standard quantity of production
- Used to signal or authorize the production and movement of goods and to maintain discipline of pull production

Sample Kanban

Types of Kanban

- Production kanban
  - authorizes production of goods
- Withdrawal kanban
  - authorizes movement of goods
- Kanban square
  - a marked area designated to hold items
- Signal kanban
  - a triangular kanban used to signal production at the previous workstation
- Material kanban
  - used to order material in advance of a process
- Supplier kanban
  - rotates between the factory and suppliers
A Dual Kanban System

Lean Element 5
Small Lots

- Require less space and capital investment
- Move processes closer together
- Make quality problems easier to detect
- Make processes more dependent on each other
- Reduce inventory

Inventory Hides Problems
Less Inventory Exposes Problems

- Lengthy setups
- Poor quality
- Machine breakdowns
- Inefficient layout
- Bad design
- Unreliable supplier

Lean Element 6
Quick Setups

- Internal setup
  - Can be performed only when a process is stopped
- External setup
  - Can be performed in advance
- SMED Principles
  - Separate internal setup from external setup
  - Convert internal setup to external setup
  - Streamline all aspects of setup
  - Perform setup activities in parallel or eliminate them entirely

Lean Element 7
Uniform Production Levels

- Result from smoothing production requirements
- Reduce variability with more accurate forecasts
- Smooth demand across planning horizon
- Mixed-model assembly steadies component production
Mixed-Model Sequencing

Lean Element 8
Quality at the Source

- Do it right the first time
  - Visual control: makes problems visible
  - Poka-yokes: prevent defects from occurring
  - Kaizen: continuous improvement; “change for the good of all”
  - Jidoka: authority to stop the production line
  - Andons: call lights that signal quality problems
  - Under-capacity scheduling: leaves time for planning, problem solving, and maintenance

Lean Element 9
Total Productive Maintenance

- Preventive maintenance
  - Proactive approach that uses periodic inspection & maintenance to keep machines operating
- Total Productive Maintenance (TPM) combines preventive maintenance and total quality concepts
Reliable suppliers are critical to lean production:
- Supplier selection
  - Small number of suppliers; single sourcing
  - Long-term contracts
  - Synchronized production
  - Geographical proximity
  - Small but frequent deliveries
  - Frequent information sharing

Benefits of Lean Production:
- Reduced inventory
- Improved quality
- Lower costs
- Reduced space requirements
- Shorter lead time
- Increased productivity
- Greater flexibility
- Better relations with suppliers

Drawbacks of Lean Production:
- Lean production isn’t for everyone and is difficult to implement for
  - products with high variability in demand
  - large variety of low-volume products
  - custom—engineered products
  - high volume repetitive items
- Risks with unexpected changes in supply and demand
Lean Services

- Basic elements of lean production apply equally to services
- Most prevalent applications
  - lean retailing
  - lean banking
  - lean health care

Leaning the Supply Chain

- "pulling" a smooth flow of material through a series of suppliers to support frequent replenishment orders and changes in customer demand
- Firms need to share information and coordinate demand forecasts, production planning, and inventory replenishment with suppliers and supplier’s suppliers throughout supply chain

Lean Six Sigma

- Lean and Six Sigma are natural partners for process improvement
  - Lean
    - Eliminates waste and creates flow
    - More continuous improvement
  - Six Sigma
    - Reduces variability and enhances process capabilities
    - Requires breakthrough improvements