

Lean Manufacturing

Chris Barry

IBEX 2004

Session 602

3:30 PM Wednesday, October 27, 2004.

Overview

- Goals
- History
- The Seven Wastes
- Standard Lean Tools
- Group Technology
- Quality
- CAD/CAM
- Robust Design
- Resources

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What Is Lean:

- *“Lean Manufacturing is a strategy with a set of tools for eliminating waste and reducing non-value-added time. The focus is on reducing time throughout the entire business process: including time-to-market, order processing time, production time, delivery time, billing time and service time.”*

National Shipbuilding Research Program
Project 2000930

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Shorten Production Flow By Eliminating Waste: A Total System - Lean Thinking

- Reduce Work In Process
- Operational Stability
- Achieve One Piece Flow
- Pull Work Through Processes
- Just In Time
- Built In Quality

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Typical Lean Results: *Show Me The Money*

- 75% Inventory Reduction
- 90% Lead Time Reduction
- >100% Productivity Improvement
- < 500 PPM Defects
- Improved Morale
- Reduced Accidents

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History: Toyota Production System

- Henry Ford - Basic Concepts Of Lean
 - 1926: “*Today And Tomorrow*” - Flow Production
 - Vast Market, Rouge River Plant, Post WWII Mass Production - Lean Concepts **Lost**
- Toyota, Deming, Taiichi Ohno
 - Smaller Japanese Market, Less Capital, Wider Product Range - Required Different Approach
 - “Low Volume/High Mix” - With Quality
- Japanese Ship Building: Elmer Hann
 - Using Many Lean Concepts Well Before Toyota

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Benchmarking

*“If You Don’t Know Where You Want To Go,
It Doesn’t Matter Which Way You Choose”*

The Cheshire Cat

- Standard Shipbuilding Measure:
Manhours / Compensated Int’l Gross Ton
- $GRT = (0.2 + 0.02 * \text{Log } V) V$
With $V = \text{True Enclosed Volume (m}^3\text{)}$
- Compensation Factor Based On Size, Type
Small Ships, Ferries: 5; Warships: 10-12
- Odense Lindo: 8 MH/CGRT, IHI: 12, Munson 15,
US Comm’l Yard: 45-60, Korea: 20-40,
China: 100 - 150, Yacht Builder: **300 !**

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The Seven Wastes

- Overproduction: Producing Prior To Need
- Inventory: Due To Overproduction
- Transport: Due To Overproduction & Outsourcing
- Movement: Taking Care Of The Inventory
- Waiting On Work: Wrong Parts, Wrong Place
- Overprocessing: Parts Not Well Specified
- Defects: Rework, Warrantee Claims,
Products Consumers Don’t Want To Buy

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Standard Lean Tools

- *Kaizen* - Continuous Improvement
- Level, One Piece Flow
- *Kanban* - “Signal Card” - Moves Work
- *Poke Yoka* - “Foolproof Assembly”
- *Takt* Time - Uniform Beat Of Production
- Group Technology - Classifying Parts Logically
- “5S” - Good Housekeeping - **And More**
- The Visual Workplace
- Quality Tools: TQM, ISO 9001, Baldrige, Six σ
- Ergonomics Applied To Tasks

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Kaizen - Continuous Small Improvements

“For who hath despised the day of small things?”

Zechariah 4:10

- Observe Work (Video, Measure, etc.)
- Document Processes - Statistical Control
- Involve Workers - Create Teams
- Continuous Cycle Of Improvement:
 - **Plan** - Identify Opportunities, Analyze Process Develop Optimal Solution
 - **Do** - Try It: Experiment, Early, Frequently
 - **Study** - Did It Work ?
 - **Act** - Standardize The Solution

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Kanban

- Minimizes Excess Interim Product
- Minimizes Waiting On Work
- Minimizes Scheduling Effort
- Work Is “Pulled”
By Downstream Demand
- “CON BON”:
Card Out Notice, Build On Notice
- For Mass Production:
Return Card - Produce Another Identical Part
- Different Techniques Required For Boats



IHI Kure Shipyard

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Kanban In Shipyards

- Returned Card Triggers Next Task In Fixed List
- Returned Card Coded By Ship, Module, Block
Triggers Off Multiple Lists
- Cards Set On Priority Board
- Doesn't Have To Be Cards At All
- ***Kanban Requires Palletizing***
- ***Kanban Requires Takt Time***
- ***Kanban Requires Group Technology***
 - To Properly Assign Resources

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Takt Time

- Takt Means Essentially “Beat”
- Work Packages All Require The Same Time (May Require Different Levels Of Manning)
- Keeps Work In Synch
- Facilitates Flow
- Facilitates Measuring Flow, Detecting Problems
- Eliminates Work Waiting On People, People Waiting On Work
- Allows Kanban

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Poke Yoka

- Features Of Product Or Task Design That Minimize Mistakes, Make Work Easier
- Think Phillips Head Screw
- Parts Designed With Assembly Aids
 - Tabs Built In To Steel Parts To Hold Them
 - FRP Parts With Alignment Features
- Jigging And Assembly Aids
- Proper / Convenient Tool Storage
 - Hang Tools From Overhead

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Group Technology

- Code Parts By Similarities
 - In Function (To Reduce Part Count)
 - In Process (To Assign Resources)
 - By Location (For Advanced Outfitting)
- Develop Work Cells By Part Family
 - In Shipyards, Work Cells Are People Teams
 - Cell Moves - Product May Not
- Traditionally Requires Coding Systems
 - Alternatives Are Resource Matrices

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“5S”

- *Seiri* - Organization - Sorting
- *Seiton* -Neatness - Straighten
- *Seiso* - Cleaning - Shine
- *Seiketsu* - Standardize
- *Shitsuke* - Discipline - Sustain
- More Than Just Good Housekeeping
- 5S Is Often The First Step To Lean
 - 5S Requires Teams, Employee Involvement, Process Surveys And Documentation

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The Visual Workplace

- Andon - Trouble Signals
- Status Boards
- Marked Locations For Tools, Storage, Work In Process



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IHI Kure Shipyard

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Quality Tools

- **Cost Of Quality Can Be 30% of Sales**
- What Is Quality?
- Robust Design
- Total Quality Management
- ISO 9001 / Malcolm Baldrige
- Six Sigma
 - Cut Defects To Six Standard Deviations
 - 3.4 Defects Per Million
 - Taguchi Experiments With Processes

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Quality

- Conventional - Conformance To Specification
- Deming - Minimize Variation
- Taguchi - Total Loss To Society
Loss Function - Loss Even If In Spec
- **WOW** Quality
“*Miryo Kuteki Hinshitsu*”
Qualities That Fascinate, Bewitch, Delight
 - That “Vision Thing”
 - What Make You So Special?

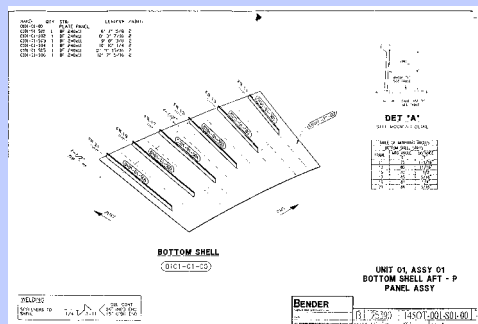
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CAD / CAM - Product Models

- Reduced Variation
- Resource Matrices
- Automated Pick & Place
- Improved Stock Management
- One Piece Flow
- Generate Kanban Off Part Tree
- Work Sketches Enable Palletization



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Robust Design

- 80% Of Cost, Quality, Originate In Design
- Poke Yoka Designed In
- Margins For Weight, Strength
- Designed To Standards
- Designed For Manufacture
- Ergonomics In Design -
For Production As Well As Use
- Designed With Your Plant In Mind
- Designed To Minimize Tolerances

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ISO 9001 / Malcolm Baldrige

- Total System Of Quality Management
- Documented Processes
 - **DON'T**
“Make a Honking Big Binder
Then Treat It Like A Dead Raccoon” *Dilbert*
- A Key To Continuous Improvement
- Filling In The White Spaces In The Org Chart
- “Why Are We Doing That?”
- Malcolm Baldrige Awards From NIST
 - Small Business - 300 Hours Of Help For \$500

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Management Leadership

Everything I Ever Needed To Know I Learned in Kindergarten
Robert Fulgrim

- Play Together
 - Everybody Participates
- Be Nice To Each Other
 - “Goodmouthing”
- Listen
- Be Honest
 - Lack Of Integrity In Management Destroys
- Share
 - Gainsharing

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Lean (TPS) Is A Total System: Of People

The real understanding of TPS is very difficult, and generally speaking people talk about one piece - kanban, andon, poka yoke. That in my opinion is one piece of TPS and is not the goal of TPS. Take the example of one piece manufacturing. If some problem occurs then you cannot produce goods through this system. If you just look at this segment of it, it is not a good way to produce things. So in one piece manufacturing, if something goes wrong you stop production, so we really have to think how to stop having that same problem twice and you have to really think and think. This is the part that is the real truth of TPS production. SO team members have to think, and through thinking team members grow and become better team members and people.

*Terujuki Minoura,
President and CEO, Toyota Manufacturing, North America
March 12, 2002*

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Resources

- www.sname.org
 - Marine Technology
 - Journal Of Ship Production
 - Ship Production Symposium
- NSRP: [www, USAShipbuilding.com](http://www.USAShipbuilding.com), www.nsnet.com
- Society Of Manufacturing Engineers, www.sme.org
- Deming, *Out Of The Crisis*
- Womack & Jones, *The Machine That Changed The World*
- Evans & Lindsay, *The Management and Control Of Quality*
- Suzuki, *The New Manufacturing Challenge*
- Besterfield, et al, *Total Quality Management*
- Roy, *A Primer On The Taguchi Method*
- Galsworth, *Visual Systems*

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