The Lean Journey at the Boeing Company

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Lean Enterprise Office
Boeing Commercial Airplanes
The Road Taken to a Lean Enterprise

- Building the B-17 in World War II
- Quality or Productivity Circles
- World Class Competitiveness
- Just in Time (JIT) and Accelerated Improvement Workshops (AIWs)
- 9 Tactics, an integrated strategy
- The Boeing Production System
The B-17 Flying Fortress

► First prototype from design to flight in less than 12 months
► NEED! As many as we could build, right now
► FRESH EYES! Half the workforce were women, new to manufacturing
► NO ROOM in the factory
The B-17 Flying Fortress

Many methods that we now call Lean were developed

PRODUCTION SOARED TO 15 PLANES PER DAY!
Fast Forward to the 1980’s

- After the war, sense of urgency ended. Waste crept back in

- Continuous Quality Improvement (CQI) was embraced in Commercial Airplanes and in Boeing Aerospace

- Dr. Edwards Deming visit, 3000 managers studied *Out of the Crisis*
Fast Forward to the 1980’s

- Dr. Joseph Juran visit
- Quality Circles, Productivity Circles
- Employee Involvement Program at 757 program
- Quality Improvement Center in Commercial
  formed 1986
Beginning of the 90’s, Beginning of Lean

- CQI Associates and CQI Specialists programs formed, disbanded
- Statistical Process Control (SPC)
- Variability Reduction (VR) on military side in response to end of “cost-plus” contracts
- Hardware Variability Control (HVC) on commercial airplanes side
Japan Study Tour and World Class Competitiveness

- Managers benchmarked eight Japanese companies
- Trip preparation included 45 classroom hours and 5 books
- Each company was “World-Class” in something
- Boeing hired DeltaPoint consultants to help develop World Class Competitiveness training
- Training for all 100,000 employees in Boeing, taught by the managers
Lean Tools Begin to Be Implemented

- **5S** – Sort, Simplify, Sweep, Standardize, Self-Discipline
- Other Lean tools, such as Just In Time (JIT) seen as competing initiatives
- Propulsion Systems Division (PSD) implemented full-blown Lean strategy
- PSD hired BoozAllen consultants to develop Lean manufacturing assessment
Shingijutsu Consultants

- Boeing participated in Wiremold / Pratt & Whitney Lean workshops, and met Shingijutsu consultants
- Senseis Iwata and Nakao were protégés of Taiichi Ohno, father of the Toyota Production System, and founders of Shingijutsu consultants.
- 1995 first Shingijutsu Japan Kaizen tour
- Managers traveled to Japan to study Toyota Production System, hosted by Shingijutsu
Visits peaked in 1998-1999, as Boeing became familiar with the Toyota Production System. Visits decreased as Boeing matured.
Shingijutsu-led Events

- From 1995 to 1998, the focus was on conducting Accelerated Improvement Workshops (AIWs)
- In the first two months of 1997, Boeing conducted 100 AIWs
- Shingijutsu began showing Boeing other Lean tools
  - Production preparation process (3Ps)
  - Distribution kaizens
  - Heijunka
As Boeing matured, the number of weeks of consultants’ use decreased, but will probably never drop to zero.
Turn of the Century (2000)

- Commercial Airplanes starts Six Sigma with General Electric Aircraft Engines
- BCA Lean Enterprise Office incorporates Six Sigma and Value Stream Analysis
- Non-manufacturing processes begin to become focus of Lean
Turn of the Century (2000)

- Boeing enterprise-wide Lean push
- Common Lean and Six Sigma training
- Enterprise-wide Lean leadership (Process Action Team)
- Coffee game at Boeing Leadership Center for executive training
Development of 9 Tactics
Roadmap to Achieve Continuous Flow

1. Understand how value flows
2. Balance the line
3. Standardize work procedures
4. Put visual controls in place
5. Put everything at point of use
6. Establish feeder lines
7. Radically re-design products and processes
8. Convert to a pulse line
9. Convert to a moving line.
Moving Lines

- Automobile production technique applied to airplanes
- 717 Final Assembly pulsed in November 2000, moved in September 2001
- 737 Final Assembly moved in April 2001
- 757 Final Assembly moved in August 2002
- Major subassemblies have moving lines
- F/A-22 wing assembly
737 Moving Line
Focus Outside the Four Walls

- If customers succeed, they’ll buy more
- IDS Lean Office consults with military bases
- BCA Lean Office teaches Lean to airlines
- BCA Field Service works joint Six Sigma projects with airline customers
- If suppliers succeed, Boeing benefits
- Mexmil, potential Toyoda-Boshuku relationship
Evolution of the Boeing Production System House

* Boeing customized the Toyota Production System house into the Boeing Production System (BPS) house.

* This visual aid showed the entire company how the various pieces of Lean all fit together.
Evolution of the Boeing Production System House - 2000

It had a fulcrum and the nine internal blocks as a guide to developing toward a “Pull System” of production.
Evolution of the Boeing Production System House - 2003

Base expanded to emphasize 5S as the foundation of the BPS house. New in Autonomation pillar: Do not accept, produce or pass on defects
Evolution of the Boeing Production System House - 2005

Re-emphasized the elimination of waste in the foundation
Timeline of the Lean Journey at Boeing

1978
- Fab Division Productivity Circles

1980
- Productivity Circles
- 757 Productivity Program

1984
- Dr. Joseph Juran (Boeing Aerospace)
- BAC QIC formed

1986
- BCAG Total Quality Process
- Managing Quality Seminar
- Conway Seminars
- Dr. Edwards Deming (Wichita)

1988
- Japan Study Missions
- CQI as the Management System

1990-1991
- Japan Study Missions
- CQI as the Management System

1992
- World Class Competitiveness Training
- 5S
- Management by Policy/Cross Functional Mgt/Daily Mgt
- Process Management/Work Management
- Boeing Arnprior JIT Initiative

1993
- Fabrication Division JIT Pilot
- Rapid JIT Implementation Workshops
- PSD JIT Pilot

1994
- Accelerated Improvement Workshops (AIW)
Timeline of the Lean Journey at Boeing

1995
- Manufacturing Leadership Summit
- North Amer. MBU Trip
- Womack Visit
- Boeing Wichita JIT Startup
- First Shingijutsu Japan Kaizen Seminar

1996
- Lean Manufacturing Assessment (LMA)
- Shingijutsu kaizen training in Japan
- Lean Manufacturing Office created from QIC
- BCA Lean Kickoff

1997
- A&M Lean Kickoff

1998
- DeltaIV Develops Lean Plan
- S&C Lean Kickoff

1999
- 717, 737 F/A Moving Lines
- VSA, Six Sigma and LEO groups merged

2000
- 717 Pulsed Line
- 9 Tactics
- Began Six Sigma

2001
- LMAs implemented across 26 IDS sites

2002
- 757 Moving Line

2003
- Shingo Prize awarded to Mesa and St. Charles sites
Results from Boeing’s Defense Side

➔ Mesa, Arizona Apache helicopter program
➔ Build hours 67% down, cycle time 69% down, defects 90% down
➔ Site awarded 2004-5 Shingo Prize
➔ St. Charles, Missouri Joint Direct Attack Munitions program
➔ Increased inventory turns from 3 to 78
➔ Site awarded 2004-5 Shingo Prize
Results from Commercial Fabrication

→ Commercial Airplanes parts plants reduced inventory by $1 billion in 1999

→ Spokane, Washington floor panel manufacturing plant

→ Manufacturing cycle time down 60%, floor space 50%
Results from Commercial Final Assembly

- Renton, Washington 737 program

- Factory cycle time down 46%, stores inventory down 59%, work-in-progress inventory down 55%, and factory footprint down 21%.

- Five years ago, flow time in Final Assembly was 22 days. It is now 11 days, with a goal of 8 days.
Lessons from the Road

- Success at Lean is largely due to the personalities of the leaders.
- Zealots put themselves at risk professionally.
- Leaders that will engage in Lean themselves must be positioned in the right places.
- Even if you think you have institutionalized something, if leadership backs off its support, the workforce backs off.
Lessons from the Road

- Measuring activity pushes people to learn and do Lean
- Make point improvements. Connect them into flow improvements. Connect those into system improvements.
- External eyes (consultants) are necessary
- Internal and external pressures are essential
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