Student Self-administered case study

Lean enterprise Boeing 737 manufacturing Lean Production System

Case duration (Min): 45-60

Operations Management (OPs)

Lean enterprise

Worldwide

Case summary:

Assembling a 737 is a complex job. Factory employees must take 367,000 parts, an equal number of bolts, rivets and other fasteners and 36 miles (58 kilometres) of electrical wire then put them all together to form an airplane. Production methods have evolved enormously since the first 737 was made in 1966. The main difference is that instead of the aircraft being assembled in one spot (static production bays - traditional manufacture) they are now on a moving assembly line similar to that used in car production. Since the late 1990's the company has continuously improved production, becoming a lean enterprise. This case can be used to show what a lean enterprise may look like.

Learning objectives:

Explain the key principles of lean operating systems.
Describe the basic lean tools and approaches.
Explain how lean principles are used in manufacturing.
Describe the concepts and philosophy of just-in-time operating systems.

Case problem:

How to make production processes more efficient.

Company

Aerospace/Defense Products & Services

Boeing

www.boeing.com

Boeing is the largest global aircraft manufacturer by revenue, orders and deliveries, and the second largest aerospace and defence contractor in the world.

Pre class activities...

1	Read the production history at http://www.b737.org.uk/production.htm	20-30

First, if you are taking a taught management course then consult with your tutor and ensure that the case has not been scheduled into a teaching class or tutorial. If it has not:
1. Play/ read the media associated with the case. You may need to access the Internet and enter a URL to locate any video clips.
2. Attempt the Case study questions.
Consider attempting the case study as a group exercise; you could form a study group with fellow students.
3. Check the suggested answers - remember these are suggestions only and there are often many possible answers.
Discuss questions and answers with other students.
4. If you feel your answer(s) were weak then consider reading the relevant suggested readings again (also see the case study suggested references).

Title/ Media type	URL/ Media description
Boeing 737 manufacturing.	http://www.yourtechtv.com/viewVideo.php?video_id=561&title=Boeing_737_manufacturing
Film	Whilst there is no narration for this film clip - the viewer gains a fascinating insight into a moving assembly line. The film clip shows how Boeing has adopted principles of lean manufacture.

NOTES:

Case study questions...

	Action	Pre/During/After class
1	**WHAT DO THE TERMS 'LEAN' AND 'JUST-IN-TIME' MEAN?** Define key terms, identify the key principles of lean operations and discuss (at a high level) the differences between traditional and lean approaches to lean manufacturing.	During
2	**LEAN PRODUCTION/ THE APPLICATION OF LEAN MANUFACTURING TECHNIQUES :** Now watch the film clip and identify as many examples of lean/JIT thinking as you can. Assembling a 737 is a complex job. Factory employees must take 367,000 parts, an equal number of bolts, rivets and other fasteners, 36 miles (58 kilometres) of electrical wire and then put them all together to form an airplane. Why does Boeing have the shortest final-assembly time of any large commercial jet organisation ?	During
3	**PRODUCTION METHODS :** PRODUCTION METHODS have evolved enormously since the first 737 was made in 1966. The main difference is that instead of the aircraft being assembled in one spot (static production bays) they are now on a moving assembly line similar to that used in car production. What are the strengths and weaknesses of the two approaches?	During
4	**CONTINUOUS IMPROVEMENT :** Why is continuous improvement necessary at Boeing?	During
5	**BOEING'S 9 STEPS :** BOEINGS 9 steps (tactics) used in final assembly: in addition to initiatives already discussed, Boeing made use of value stream mapping – investigate this tactic further.	During

Answers...

GLOBALIZATION OF PRODUCTION

Trend in manufacturing industries, in particular, of shifting operations to countries where conditions and environment are more advantageous for the firm than they are in its current location; usually involving cost reductions.

JUST-IN-TIME PRODUCTION

A method of operating production facilities in such a way that production only takes place when customers place an order

LEAN PRODUCTION

A term commonly used to refer to just-in-time production.

LEAN PRODUCTION

an approach which combines machine-pacing, work standardization, just-in-time materials flow, continuous improvement, problem-solving teams and powerful supervision.

PRODUCTION

The stage after the new system is installed and the conversion is complete; during this time the system is reviewed by users and technical specialists to determine how well it has met its original goals.

PRODUCTION LINE

A type of manufacturing process used to produce a narrow range of standard items with identical or highly similar designs.

PRODUCTION PROCESS

the way that businesses create products and services

PRODUCTION RUN

completion of all tasks is associated with a production order

Question/ Answer

1 **WHAT DO THE TERMS 'LEAN' AND 'JUST-IN-TIME' MEAN?**

Define key terms, identify the key principles of lean operations and discuss (at a high level) the differences between traditional and lean approaches to lean manufacturing.

Lean enterprise - refers to approaches that focus on the elimination of waste in all forms, and smooth, efficient flow of materials and information throughout the value chain to obtain faster customer response, higher quality, and lower costs.
Lean thinking - the application of just in time principles to non-manufacturing organizations.
Lean production -an approach which combines machine-pacing, work standardization, just-in-time materials flow, continuous improvement, problem-solving teams and powerful supervision; a term commonly used to refer to just-in-time production.
Just-in-time production - a method of operating production facilities in such a way that production only takes place when customers place an order.
Key principles/ philosophy: eliminate waste (Waste according to the JIT perspective - any activity that does not add value to the goods or service in the eyes of the consumer), faster ops, more dependable, producing higher quality at lower cost. Producing goods exactly when they are needed (i.e. reduced inventory), no customer waiting; involving everyone, continuous improvement
Traditional: process stage ☐ inventory (buffer) ☐ process stage ☐ inventory (buffer) ☐ process stage (each stage can work uninterrupted i.e. stages are insulated from one another)
Lean/JIT: ☐ process stage☐ process stage☐ process stage☐ process stage (if one stage stops, the following stages notice immediately) problems do not get ignored/ everyone tackles them – no inventory.

PRODUCTION TEAM

a stable number of individuals in a relationship involving shared and recognized production goals, with work status defined through a system of social roles and behavioural norms supported by a set of incentives and sanctions.

ASSEMBLY LINE

A product layout dedicated to combining the components of a good or service that has been created previously

LEAN ENTERPRISE

Refers to approaches that focus on the elimination of waste in all forms, and smooth, efficient flow of materials and information throughout the value chain to obtain faster customer response, higher quality, and lower costs

LEAN THINKING

The application of just in time principles to nonmanufacturing organizations

JUST-IN-TIME

An approach in which processes are linked together in an extended chain to ensure that good quality components are delivered to the user just-in-time for them to be used.

JUST-IN-TIME (JIT)

a method of planning and control and an operations philosophy that aims to meet demand instantaneously with perfect quality and no waste.

CONTINUOUS FLOW PROCESS

a type of manufacturing process that closely resembles a production line process

2 LEAN PRODUCTION/ The application of LEAN MANUFACTURING TECHNIQUES :

Now watch the film clip and identify as many examples of lean/JIT thinking as you can. Assembling a 737 is a complex job. Factory employees must take 367,000 parts, an equal number of bolts, rivets and other fasteners, 36 miles (58 kilometres) of electrical wire and then put them all together to form an airplane. Why does Boeing have the shortest final-assembly time of any large commercial jet organisation ?

1 Reduced set-up times (Set-up reduction -the process of reducing the time taken to changeover a process from one activity to the next) point-of-use staging of tool and parts kits - equipment staged near point of use (storage areas for replenishing). Bringing tools and parts to workers in "kits," so workers no longer have to go looking for what they need. Instead of workers bringing their own tools, the tools they need are delivered to the assembly stations in "kits," each tool in its place for a particular job, always in a blue plastic box. Parts come in grey boxes; hazardous materials come in green boxes. The result is the workers no longer spend much of their time looking for tools and parts; they just put things together.
2 Visual control systems – Andon, a light above a workstation that indicates its state, whether working, waiting for work, broken down, etc. , Andon lights may be used to stop the whole line when one station stops etc Developing visual cues that tell workers if there is a problem in their part of the line and where it is, so it can be swiftly fixed. Looking down the line, everyone can see eight large scoreboard-like panels, (staffed with helpers who can help solve problems if they arise) each one topped by a colour beacon that reflects the production status. When the line is running smoothly, all eight beacons are green. Each panel displays the name of up to 16 different teams, which specialize on specific parts of the aircraft. If a problem arises a worker hits a button, and the green light suddenly changes to yellow. The board lights up with the name of the group encountering the problem and its category. A team member goes to a nearby computer, open to the factory floor, and writes a description of the problem in more detail. They can call in an emergency team to solve the problem. If the problem is not solved in 30 minutes the light turns purple and the line, running at two inches an hour, stops until it is fixed. One goal is to develop more visual cues to make the production status more accessible for everyone working on the aircraft.
3 Layout – bays and lines marked on the floor, reduced distance to travel, easier to locate, routes obvious; The 737 moving production line has been divided into eight "flow day positions," which is three fewer than the 11 days it now takes to make a plane. The disconnect keeps workers thinking toward the goal of even-faster production rates.
4 Limited inventory (no waste)/ just-in-time delivery systems/ Kanban controls - Reducing inventory so there is less complication.
5 Standardized work processes – Instructions to do specific jobs, standardised work procedures for mechanics.
6 Continuous production flow - Keeping the aircraft moving past the workers and parts so that workers can focus on assembling instead of looking for things.
7 Action teams - Forming temporary week-long action teams any time there are problems, so those problems can be solved permanently/ involvement of everyone; Moving line workers, managers and engineers into close proximity in the same building, to improve and speed up communication. Creating more permanent teams to focus on parts of the airplane.
8 Feeder lines.
9 Work balancing (across two shifts).
10 Continuous improvement and break through process redesign.

3 PRODUCTION METHODS :

PRODUCTION METHODS have evolved enormously since the first 737 was made in 1966. The main difference is that instead of the aircraft being assembled in one spot (static production bays) they are now on a moving assembly line similar to that used in car production. What are the strengths and weaknesses of the two approaches?

Traditional one spot (static production bays): process stage ☐ inventory (buffer) ☐ process stage☐ inventory (buffer) ☐ process stage (each stage can work uninterrupted i.e. stages are insulated from one another) – higher capacity utilisation but wasteful, large inventories; other problems included parts and tools not always where they were needed; production status not always visible.
Lean/JIT: ☐ process stage☐ process stage☐ process stage☐ process stage (if one stage stops, the following ones notice immediately) problems do not get ignored/ everyone tackles them – no inventory. This has the effect of accelerating production, which not only reduces the order backlog and waiting times for customers but also reduces production costs. The line moves continuously at a rate of 2 inches per minute; stopping only for worker breaks, critical production issues or between shifts. Timelines painted on the floor help workers gauge the progress of manufacturing. Less waste/ inventory

CONTINUOUS IMPROVEMENT

an approach to operations improvement that assumes many, relatively small, incremental, improvements in performance, stress the momentum of improvement rather than the rate of improvement; also known as kaizen, often contrasted with breakthrough improvement.

INVENTORY

Those stocks or items used to support produc-tion (raw materials and work-in-process items), supporting activities (maintenance, repair, and operating supplies) and customer service (finished goods and spare parts).

ACTION TEAM

a team that executes brief performances which are repeated under new conditions. Its members are technically specialized, and the team has a high need to co-ordinate its output with that of other work units.

KAIZEN

Focuses on small, gradual, and frequent improvements over the long term with minimum financial investment and with participation by everyone in the organization

CYCLE TIME

the time it takes a product to go from beginning to end of a production process; i.e., the time it is work-in-process

WORK-IN-PROCESS INVENTORY

Consists of partially finished products in various stages of completion that are waiting further processing

WASTE ACCORDING TO THE JIT PERSPECTIVE

Any activity that does not add value to the good or service in the eyes of the consumer.

4 CONTINUOUS IMPROVEMENT :

Why is continuous improvement necessary at Boeing?

Continuous improvement - an approach to operations improvement that assumes many, relatively small, incremental, improvements in performance, stresses the momentum of improvement rather than the rate of improvement; also known as kaizen, often contrasted with breakthrough improvement.
Cycle time - the time it takes a product to go from beginning to end of a production process; i.e., the time it is work-in-process
Kaizen - Focuses on small, gradual, and frequent improvements over the long term, with minimum financial investment and with participation by everyone in the organization.
Competitive pressures (winning market share from rival Airbus for example) constantly drive continuous improvement. In 2005 they cut the time to move a Boeing 737 through the factory to 11 days (5,500 airplane unit hours of work), half the time required only five years previously. The future target is 6 days (4,000 airplane unit hours of work). In Dec 2005 a second production line was opened to increase the production rate to 31 aircraft a month. By 2007 there was a three year waiting list for new 737s, and an order backlog of over 1,600 aircraft. A third production line is under construction.
Kaizen was introduced in the 1990's to identify alternative ways of doing things. This reduced cycle times, inventory, lead times, costs.

5 BOEING'S 9 steps :

BOEINGS 9 steps (tactics) used in final assembly: in addition to initiatives already discussed, Boeing made use of value stream mapping – investigate this tactic further.

SET-UP REDUCTION

the process of reducing the time taken to changeover a process from one activity to the next; also called single minute exchange of dies (SMED) after its origins in the metal pressing industry.

ANDON

a light above a workstation that indicates its state, whether working, waiting for work, broken down, etc. , Andon lights may be used to stop the whole line when one station stops.

KANBAN

Japanese term for card or signal; it is a simple controlling device that is used to authorize the release of materials in pull control systems such as those used in JIT.

KANBAN

A flag or a piece of paper that contains all relevant information for an order: part number, description, process area used, time of delivery, quantity available, quantity delivered, production quantity, and so on

ASSEMBLY LINE BALANCING

A technique to group tasks among workstations so that each workstation has—in the ideal case—the same amount of work

Case study references

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Collier, D. and Evans, J. (2009) 'OM', Ed. 1. Cengage Learning.

Evans, J. and Collier, D. (2007) 'Operations Management Integrated Goods & Services Approach, International Edition', Ed. 2. South Western.