Learning To See: Making Value Flow …From End to End

John Shook
April 2012
What is “LEAN”?  

MIT International Motor Vehicle Program  
– Toyota Production System as “LEAN Production”  
  ▪ Flow production from Ford  
  ▪ PDSA from Deming  
  ▪ Toyota’s JIT system dynamics and supply chain design  
  ▪ Toyota’s engagement of people to build in quality and solve problems for continuous kaizen  
  ▪ Management System  
    ○ A highly developed socio-technical system  
      • With focus on system and people development
Lean Thinking, Lean Practice, Lean Value Streams

A simple definition:
Develop people, process, and systems to meet customer need while consuming the fewest possible resources.
Automobiles: A Century of Value Stream Challenges

- Reliable, affordable personal mobility
  - Ford Model T and Highland Park
- Transportation fashion
  - GM: a car for every wallet
- Transportation fashion and affordability
  - Toyota flow with variety
- Globalization
  - Diffusion of TPS and TMS
- Environmental sustainability
  - The next frontier – Toyota with a slight lead…
The Problem of Production

• What’s most difficult often isn’t *making* the product.

• It’s organizing all the parts and materials that go into it.
The Problem of Production

In the case of cars:

• 20-30,000 parts must come together at exactly the right time once per minute.

• Almost all parts are engineered specifically for each model of car.

• Most cars are unique.
End-to-End Flow
The Ford Model T Value Stream
A Value Stream as One Giant Conveyor

The first moving assembly. The magneto line, Highland Park, 1913
Ford Production at the River Rouge
Giant Conveyors for “Ore to Assembly”
15 million sq. ft.
100,000 workers
100 miles of railroad track
15 miles of roads

120 miles of conveyors.
6000 suppliers
The Rouge 1932 – Choked by Complexity
MASS PRODUCTION

Stamping

Body

Paint

Assembly

Sub-Assy

= Storage

= Push

Supplier

Supplier

Supplier

Suppliers

“B”
MASS PRODUCTION with Diverse Customers

- Stamping
- Body
- Paint
- Assembly
- Sub-Assy

Symbols:
- Storage
- Push

Suppliers and Sub-Assy connections are indicated in the diagram.
The Problem of Production - Cars

1,280 SPECIFICATION SETS

76,745 VEHICLES (50%)

6.2%

9,544 SPECIFICATION SETS

51 - 50-31 30-11 10-4 2-3

1 VEHICLE / 1 SPECIFICATION

ONE TYPICAL MONTH’S TOTAL SPECIFICATION SETS: 19,349
LEAN PRODUCTION

Customer Requirements

Pr. Control

LEVELING

Stamping

Body

Paint

Assembly

Suppliers

= "Supermarkets"

= Pull

(sequenced)
Built-In Quality

Cost

Ability to find root cause

High

Low

In-Process  Next Process  Final Inspection  Customer

Location of Defect Detection
One Piece Flow

To produce an order of ten products that is processed through three steps, batch & queue versus one piece flow.

Lead Time: 30 ++ minutes for total order

CONTINUOUS FLOW “MAKE ONE, MOVE ONE”

Lead Time: 12 minutes for total order
People Development

Capability development in solving problems and making improvements
Short Lead Time

– Get each process to produce only what the next process needs when it needs it.
– Orchestrate (control, manage, regulate) operations to get ever closer to this ideal, ever shortening the lead time.

“All we’re trying to do is shorten the time line…”
Taiichi Ohno
Value Stream Improvement and Process-step Improvement

The Three Value Streams:

- Order to Delivery
- Concept to Launch
- Lifecycle Maintenance

Value Stream Improvement and Process-step Improvement

VALUE STREAM

PROCESS

Stamping

PROCESS

Welding

PROCESS

Assembly Cell

Finished Product

Raw Material
Overproduction: The Worst Form of Waste!
つくりすぎが最も悪いムダ!

I need 30 units of A and 10 units of B!

Customer

Warehouse

Kaizen Express
Total System Efficiency
Lean Transformation
Some Lessons Learned

Techniques ➔ System ➔ Thinking

• Selecting the tools we like is not enough

• The tools comprise a system

• A way of thinking underlies the tools and the system

Learn the thinking through doing
Lean Thinking

Womack and Jones:

• Specify value from the standpoint of the customer.

• Identify the value stream for each product/family – from concept to launch & order to delivery – and remove the wasted steps (the muda).

• Make value flow.

• At the pull of the customer.

• Strive continually for perfection.
What is Value Stream Mapping?

– A tool to display flow of material and information of a business process through all the steps (value creating and not) as it moves from beginning to end.

– A process to align a team around a target condition, a Future State, for that value stream and plan to achieve it.
Future State Questions

VALUE STREAM VISION
• What is the Takt Time?
  (How do you understand customer demand?)
• Where can you flow?
• Where should you pull?
• At what single point in the production chain do you trigger production?
• How much work do you trigger and take away?
• How do you level the production mix?

PROCESS KAIZEN to Support the Value Stream Vision
• What process improvements are necessary?
  (reliability, quick changeover, etc.)
Takt Time

Matches Pace of Production with Pace of Sales

Takt Time = \frac{\text{Operating Time per Shift}}{\text{Production Requirement per Shift}}

\frac{450 \text{ minutes}}{460 \text{ pieces}} = 59 \text{ sec}
Set the Pacemaker Process

selecting the “Pacemaker Process”

- process 1
- process 2
- process 3
- process 4

- SUPERMARKET
- SCHEDULE
- SCHEDULE *
- FIFO

customer

FLOW

FLOW
Rules:

- Following processes go to preceding processes and withdraw the amount needed when they need it.
- Preceding processes replenish exactly what is taken away.
Pull System

Assumptions:

- Production schedules will always change
- Production will never go according to schedule, anyway
What is Your EPEX?

Every Part Every Week

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td>400A</td>
<td>100A, 300B</td>
<td>200B, 200C</td>
<td>400C</td>
<td>200C, 200A</td>
</tr>
</tbody>
</table>

Every Part Every Day

<table>
<thead>
<tr>
<th>Monday:</th>
</tr>
</thead>
<tbody>
<tr>
<td>140 A, 100 B, 160 C</td>
</tr>
</tbody>
</table>

Every Part Every X (EPEX)

<table>
<thead>
<tr>
<th>Monday</th>
<th>Every Part Every X (EPEX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 A</td>
<td>20 A</td>
</tr>
<tr>
<td>20B</td>
<td>20 A</td>
</tr>
<tr>
<td>10 C</td>
<td>20 C</td>
</tr>
</tbody>
</table>

How do you want to run your operations? Why?
Frequent Movement of Small Quantities

1. Pick up next kanban
2. Drop kanban at process
3. Pick up one finished packout quantity
4. Move finished parts to supermarket or shipping

(repeat cycle every pitch)
Takt Time = 58
Future State Questions

**VALUE STREAM VISION**
- What is the Takt Time? (How do you understand customer demand?)
- Where can you flow?
- Where should you pull?
- At what single point in the production chain do you trigger production?
- How much work do you trigger and take away?
- How do you level the production mix?

**PROCESS KAIZEN to Support the Value Stream Vision**
- What process improvements are necessary? (reliability, quick changeover, etc.)
Lean Transformation
Some Lessons Learned

Techniques ➔ System ➔ Thinking

• Selecting the tools we like is not enough

• The tools comprise a system

• A way of thinking underlies the tools and the system

→ Learn the thinking through doing
Fujio Cho of Toyota:

“Production Control”

“When you try to apply TPS, the first thing you have to do is to “even out” or level the production flow. And that is the responsibility primarily of production control.”
Role of Production Control

1. Interface between customer requirements and company capability.
2. Must satisfy both sales and manufacturing.
3. Must be very strong.
The challenge of any business: Matching capability with demand

MUDA (Excess)
- Know your demand
- Know your true capability (capacity)
- Create flexibility to get them to match

MURI (Overburden)

MURA (Instability)
System Design to Control the 3 M’s

**MUDA** = Waste

**MURI** = Overburden

**MURA** = Variation, fluctuation

1. Design the system with sufficient capacity to fulfill customer requirements without overburdening people, equipment, or methods.
System Design to Control the 3 M’s

**MUDA** = Waste

**MURI** = Overburden

**MURA** = Variation, fluctuation

1. Design the system with sufficient capacity to fulfill customer requirements without overburdening people, equipment, or methods.
2. Reduce controllable variation/fluctuation to a bare minimum.
MUDA = Waste

MURI = Overburden

MURA = Variation, fluctuation

1. Design the system with sufficient capacity to fulfill customer requirements without overburdening people, equipment, or methods.
2. Reduce variation/fluctuation to a bare minimum.
3. Eliminate sources of waste!
“Variability will be buffered by some combination of inventory, capacity and time.”

- Hopp and Spearman, *Factory Physics*

→ This is true for any kind of capacity, not just factory equipment, e.g. people in product development.
What is a system?

• “A network of interdependent components that work together to try to accomplish the aim of the system.”

- W.E. Deming
What is a system?

• A process (or network of processes) with inputs, outputs and a feedback loop that enables adaptation. That’s what an Material & Information Flow system is.

• Value Stream Mapping, used fully and properly, does much more than simply identify waste to eliminate. VSM is a tool & process to design lean value creating systems.
A simple definition:
Develop people, process, and systems to meet customer need while consuming the fewest possible resources.