Successful Innovation Based on Principles of Lean Product Development

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Goodyear Marketplace

Tires are an integral element of all Vehicle Systems
Business Overview

- Goodyear Specialty = Tires and Tire Materials
- Global company – 42 manufacturing facilities in 22 countries
- Third largest tire company - $20 Billion annual sales
- 3 Innovation Centers – Akron-Ohio, Luxembourg and Hanau/Germany – 2,500 professionals

Focus on high (technical) end of the business – high value products and innovation
Tire Development

Typical Passenger Tire
- 15 - 18 Components
- 12 Compounds
- 2 Fabrics
- 2 Steels
- 60 Raw Materials

At Goodyear we release about 1,500 new (innovative, high value added) SKU’s every year around the world

- Competitive marketplace and diverse customers lead to short product cycles and much complexity in a highly regulated industry
- High variability in application, testing, manufacturing processes …
- Combination of high complexity and high variability created a worthy challenge for a lean product development process
Myth

Lean is detrimental to creativity and innovation!

Active banana – result of 5S in PD – misunderstanding of lean principles
Lean brought from manufacturing or Toyota is considered too rigid by innovators
Restrictive standard work / product or process standards / imposing standards for control
Using creativity to “beat the system” not always welcome
Counterproductive Metrics (functional productivity)
Free thinkers do not like processes ..
Discovery is non repetitive

INNOVATORS ARE DIFFERENT
Good Variability

- No such thing as good variability in six sigma!
- “bad variability” in a product development process:
  - Unreliable test results.
  - Experiments that were done before or that are not needed
  - Discarded knowledge

Acceptable Variability in a PD process:
- Unsuccessful experiments that generate learning
- Large amount of experiments to explore new space
- Sufficient amount of experiments to reduce the risk

“Zeal” of finding waste cannot eliminate good variability
Myth

Lean is detrimental to creativity and innovation!

Myth(buster)

If the lean product development principles are understood and applied correctly, lean can turbo-charge the innovation creation process.
“I have long felt that a great weakness of the lean movement is that we tend to take customer value as a given, asking how we can provide more value as we currently define it, at lower cost with higher quality and more rapid response to changing demand. This is fine as far as it goes. But what if the customer wants something fundamentally different from what our organizations are now providing?”

Jim Womack, *Gemba Walks*  
LEI - v1 2011
Paradox

- The innovation paradox: creating new opportunities and achieving operational excellence
- The lean paradox: you can have the quality, the delivery the speed and the low cost at the same time...and maybe innovation and creativity
Principle Based Lean Process

- Learn and understand the principles
- Understand the process - train the people in the process to improve the process
- Correctly apply the principles to the complete value stream to achieve visible results

“How-To’s” to follow for Product Innovation
Definition of “LEAN”

“We look at the time line, from the moment the customer gives us an order to the point where we collect the cash...”

Value and Waste

...And we are reducing the time line by reducing the non-value-adding wastes.

- Taiichi Ohno
Generic Product Innovation

Strategic Question Gate

Value Proposition Gate

Business Model Gate
Goodyear Innovation Department – 80’s: No process!
Product Innovation Process

TCP: Technology Creation Process (Global)

Phase A: Gate B
Phase B: Concept Scoping
Phase C: Proof of Concept
Phase D: Detailed Assessment
Gate A
Gate B
Gate C
Gate D

ICP: Innovation Creation Process (Global)

Product Leadership Strategy

PCP Roadmap

Time and effort 10 to 80%

Success Assured

Time and effort 10 to 80%

Back
Front – Back Comparison (Relative)

Mature Consumer
Automotive
Goodyear
Commercial
High – Tech commercial
Web, .com

Time/Resources

0% 100%

Work on the biggest chunk first (Pareto)
What is important in the BACK part

- Predictable outcome and delivery
- FAST, efficient and AGILE

Validated Lean Principles:
- Concurrent Engineering
- Late Start
- WIP control
- Visual plan to 80% of capacity
- Standard Work (Based on Knowledge)
- Quick/no prototyping/testing
- Pull process
- Flexible resources
- Matrix org – PM – operations
- Etc ….
Validation Results - Goodyear

Target is 90% - Target of 100% hurt “project risk taking” and innovation

Graph: %OTD end to end

Graph: CT
Lean gave Goodyear back the front end back … and also increased the value added work
Key “challenges” of front end process

A. Generate a product that the customer actually buys

B. FAST to assure first mover advantages

C. Make a profit

D. Motivated innovators

- Jim Euchner – Director Goodyear Innovation
- Paul Zaffiro – P&G Innovation

How LEAN can help
Value for the Customer

“I had committed the biggest waste of all: building a product that our customers refused to use. That was really depressing.”

-Eric Ries, The Lean Startup

Managing of the incoming work
Keep the design space open
Go to gemba to find out about the customer

A Generate a product that the customer actually buys
FAST to assure first mover advantages
Make a profit
Motivated resources
Managing Incoming Work

- This problem is unique to PD (no issue in manufacturing/services)
- Focus on value for the customer - not a natural engineering skill
- Have a process – including STOPPING projects
- Quickly sort out many options (KM and Modeling, fast test cycles, computer modeling…)
- Focus on knowledge gaps
- Tolerance (budget) for failure
- Managing WIP

Most companies use or must use the same process for both front and back part of the innovation process.
What is worse ...?

Front End Processing Errors

<table>
<thead>
<tr>
<th>Incoming Ideas</th>
<th>Screened Ideas</th>
<th>Economic Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good Ideas</td>
<td>Accepted</td>
<td>Good Labeled Good</td>
</tr>
<tr>
<td></td>
<td>Incorrect Rejection</td>
<td>Bad Labeled Good</td>
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Keep the Design Space Open

- Test with the customer
- Manage risk better
- Better decisions by keeping options open
- Allows for "Set Based - (A3) thinking"

Traditional vs. Lean:

- Design Space
- Cost of CT, change
- Resources - traditional
- Resources

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Set Based Thinking

There is never one single solution
SPEED

QUICKLY evaluate prototypes (with the customer)
- Rapid learning cycles
- Quick prototypes and very fast testing
- Quality results

Generate a product that the customer actually buys FAST to assure first mover advantages
Make a profit
Motivated resources

ALL the way back to lean .............
Lean Principles for SPEED

- Modeling and Knowledge Management
- Concurrent Engineering
- Late Start
- WIP control
- Visual plan to 80% of capacity – enough buffers on engineer’s time
- Standard Work (Based on Knowledge)
- Quick/no prototyping/testing
- Pull process
- Flexible resources
- Matrix org – PM – operations
- Etc ….
Modeling the Tire on the Vehicle

Tires for Chevy “VOLT” were developed **virtually** with a vehicle model supplied by GM – no tire/car built before “approval”

Tires and vehicle were developed concurrently
Modeling and Knowledge Reuse

- Use knowledge to build good computer modeling or “predictive” tools
- Test to validate/improve the models
- Interpolations and extrapolations
- Set based and DOE’s
Concurrent Engineering

- Single Piece Flow ➔ Focus Resources and Eliminate Wait Times

- Kickoff Meetings ➔ Celebrate

- Single Piece Flow ➔ Focus Resources and Eliminate Wait Times

- Kickoff Meetings ➔ Celebrate

- Cycle Time

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Phase 0</th>
<th>Phase 1</th>
<th>Phase 2</th>
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<tbody>
<tr>
<td></td>
<td>20</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

- Prepare
- Design
- Design
- Prepare
- Mold Eng.
- Mold Eng.
- Prepare
- Teamwork / Parallel Engineering
- Downstream Activities are Planned / Scheduled
- Kickoff Meeting ➔ Shared Information / Up-front Preparation
- Concurrent Engineering
- Materials Development
- Teamwork / Parallel Engineering
- Downstream Activities are Planned / Scheduled
- Cycle Time
- Prepare
- Tire Build
- Tire Build
- Prepare
- Tire Testing
- Tire Testing
- Prepare
- Tire Build
- Tire Build
- Prepare
- Tire Testing
- Tire Testing
Lean is very popular with

– Rapid learning
– Testing min feasible products
– Consumer testing
– Pharmaceutical testing
– Etc. …
WHY lean in R&D?

- Generate a product that the customer actually buys
- FAST to assure first mover advantages

C – Make a profit

- Motivated resources

R&D Leverage on Profits
Goodyear

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The job of product development is to generate **profitable value streams** (and reusable knowledge)

Collaboration throughout the complete value chain with line of sight to corporate goal (profit)

Understanding of “profit” in all functions

* Requires Customer Value
Motivated Resources

Generate a product that the customer actually buys FAST to assure first mover advantages
Make a profit
Motivated resources

Worst nightmares for inventors:

– Idea does not get funded or defunded – NEED PROCESS!
– Lack of resources on an approved project – SCHEDULE ACCORDING TO 80% of Capacity
– Everything moves too slow – Lean and flow
Front End learning cycles scheduled through the same channels than back end learning cycles in factories and prototype shop
OTD is over 95% although degree of difficulty much higher
Validation for Lean in the Front End

- Agile software development
- Goodyear process
PRODUCT AWARDS
Goodyear Financial Results

- Reduced Volume
- .. Flat R&D budget

Investment in LEAN PD
Summary

- This myth has been **BUSTED**
- The lean paradox: you can have the quality, the delivery the speed and the low cost **and** the innovative products **at the same time**
- Follow Principle Based Lean = Learn the principles and use those who know the process to apply them correctly
Thanks

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If everything seems under control, you're just not going fast enough.

-- Mario Andretti