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

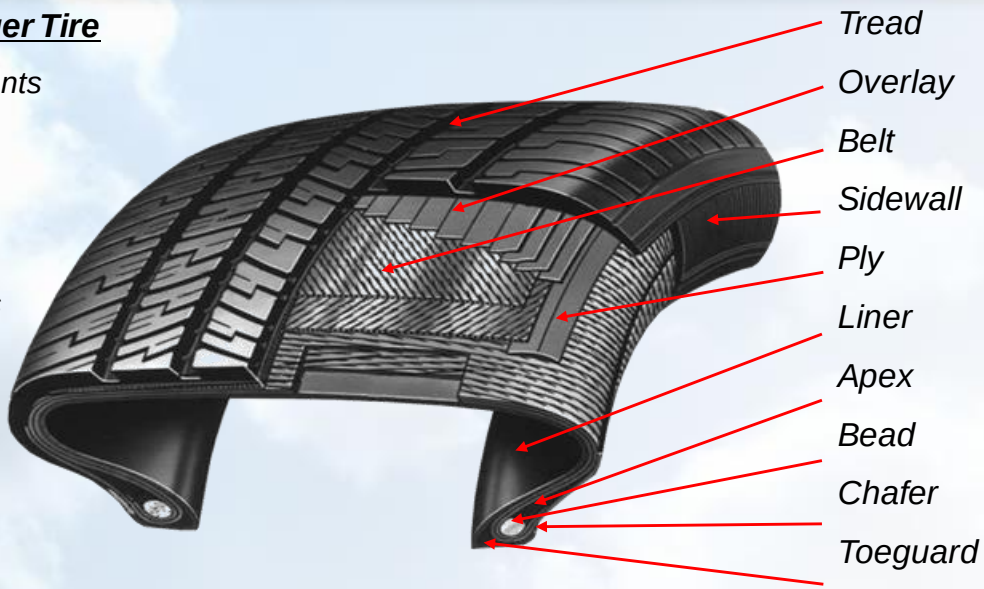
- Goodyear Specialty = Tires and Tire Materials
- Global company – 42 manufacturing facilities in 22 countries
- Third largest tire company - $20 Billion annual sales
- 3 Innovation Centers – Akron-Ohio, Luxembourg and Hanau/Germany – 2,500 professionals

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

The (Missing) Link Between Lean and Innovation

"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

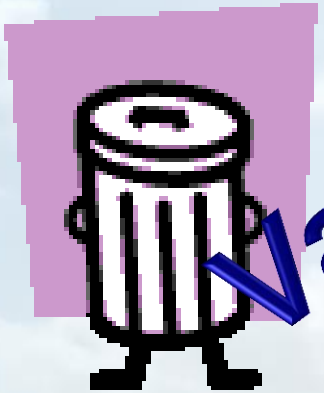
- Learn and understand the principles
- Understand the process - train the people ***in*** the process to improve the process
- Correctly apply the principles to the complete value stream to achieve visible results

"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..."

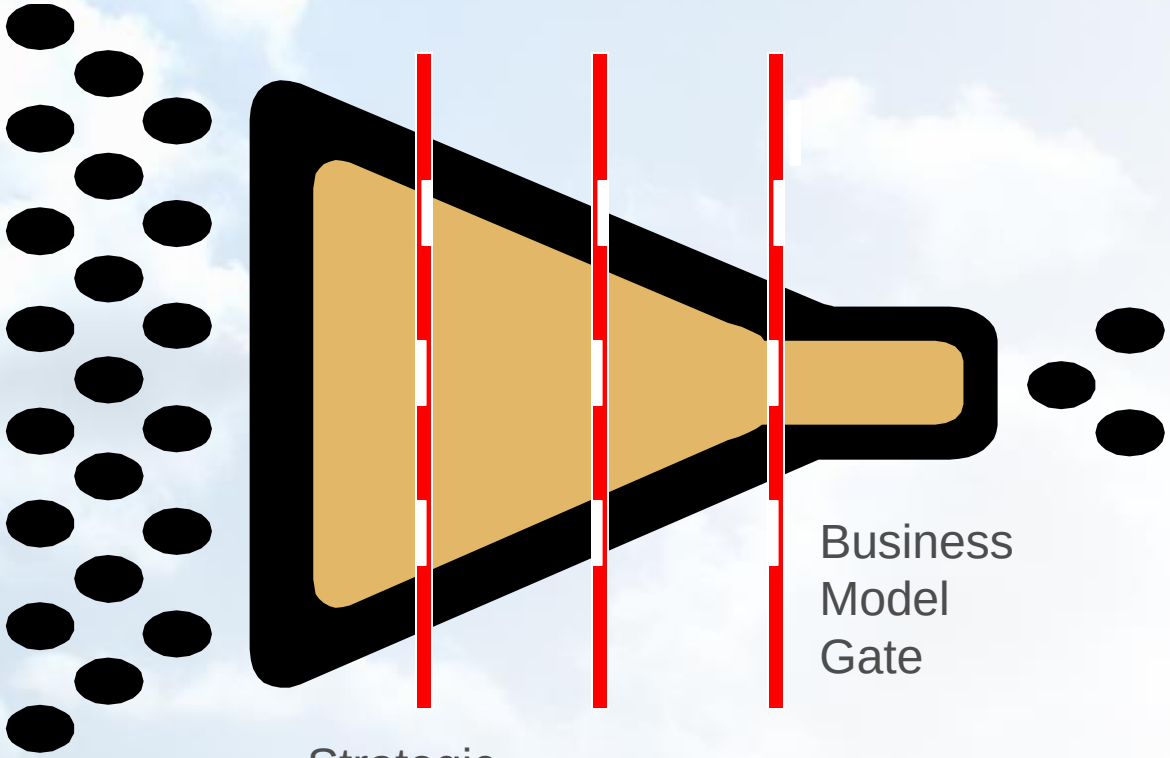
Speed



Value and Waste

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

Generic Product Innovation



"Reality"

Goodyear Innovation Department – 80's: No process!

30 Years Later
Goodyear Innovation Process

Product Leadership Strategy

ICP: Innovation Creation Process (Global)

TCP : Technology Creation Process (Global)

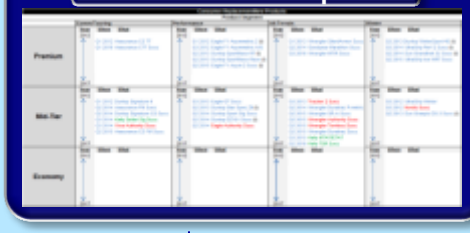
Gate A → Phase B Concept Scoping → Gate B → Phase C Proof of Concept → Gate C → Phase D Detailed Assessment → Gate D

Transition Phase

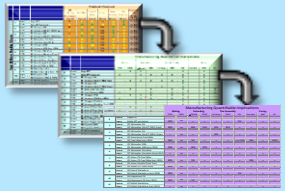
PCP : Product Creation Process (Regional)

Stage 1 Product Concept Screening → Gate 1 → Stage 2 Business Evaluation → Gate 2 → Stage 3 Product/ Process Devel → Gate 3 → Stage 4 Industrial -ization → Gate 4 → Stage 5 SOP/ Launch → Gate 5 → Stage 6 Product Monitoring → Gate 6

PCP Roadmap

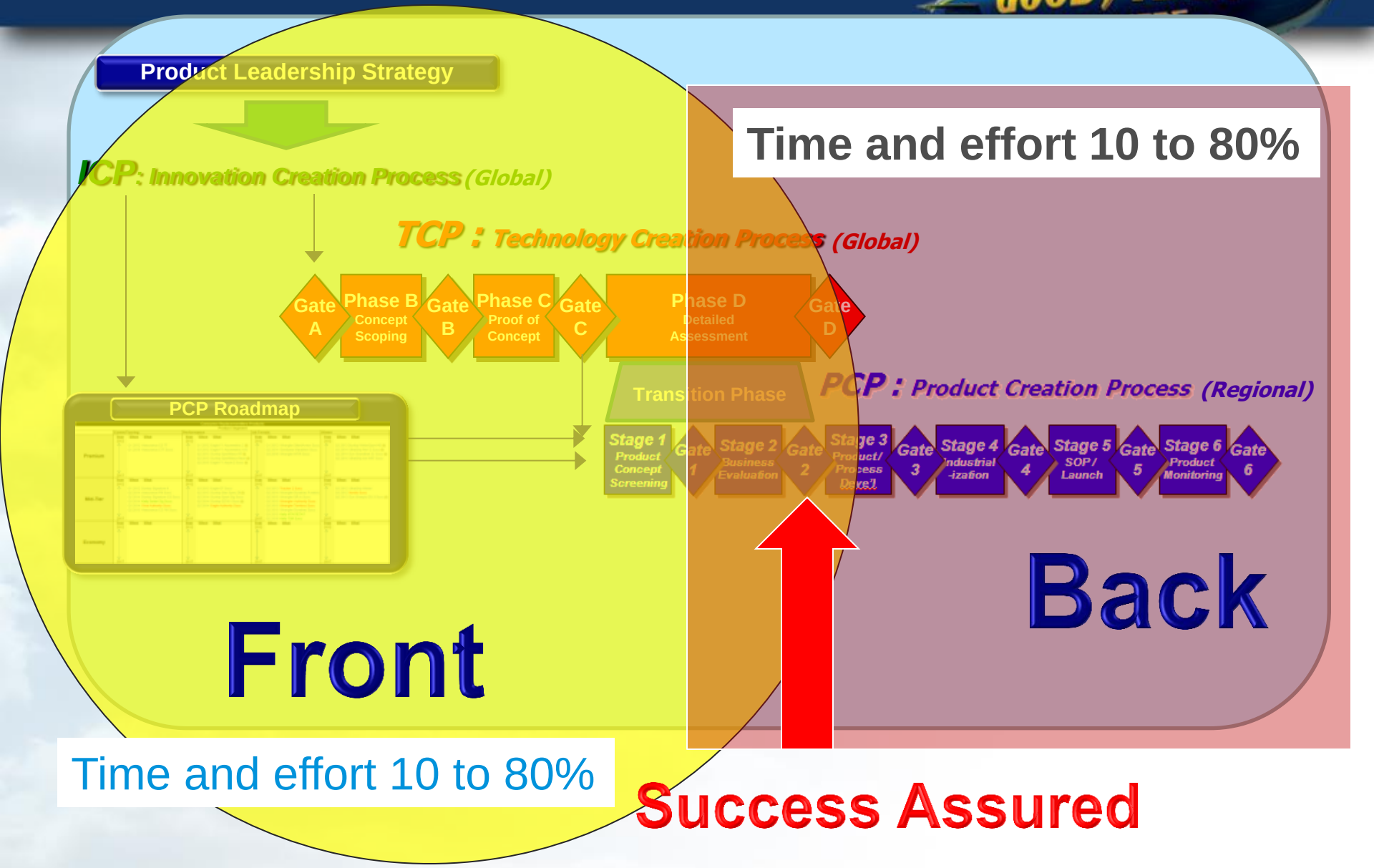


Corporate R vs Cc

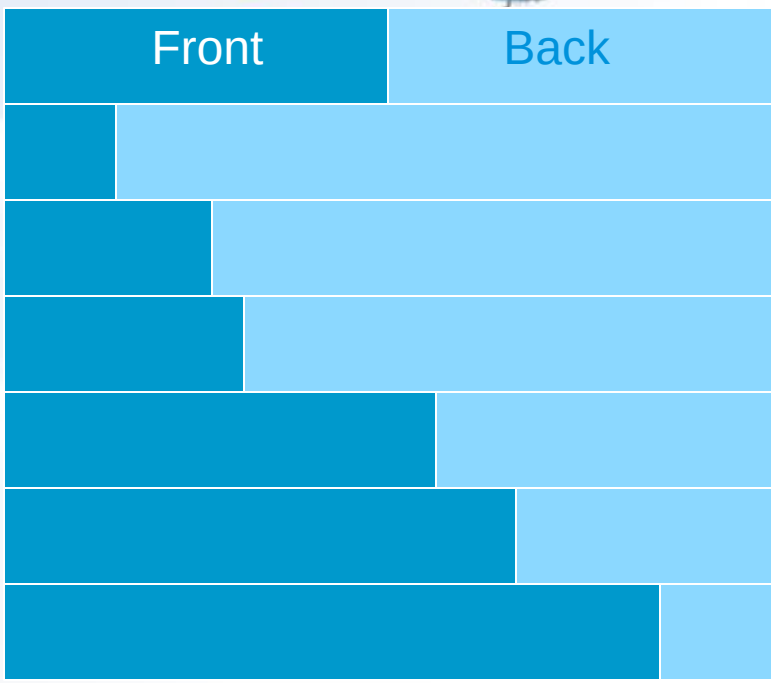


MARKET-BACK LINKAGE
BUSINESS GOVERNANCE WITH FOCUS ON PROFITABLE VALUE STREAMS

Product Innovation Process

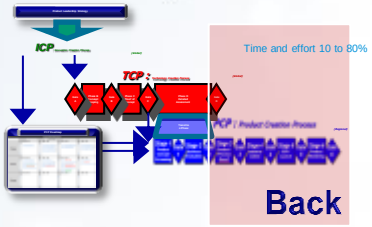


Front – Back Comparison (Relative)



Work on the biggest chunk first (Pareto)

What is important in the BACK part

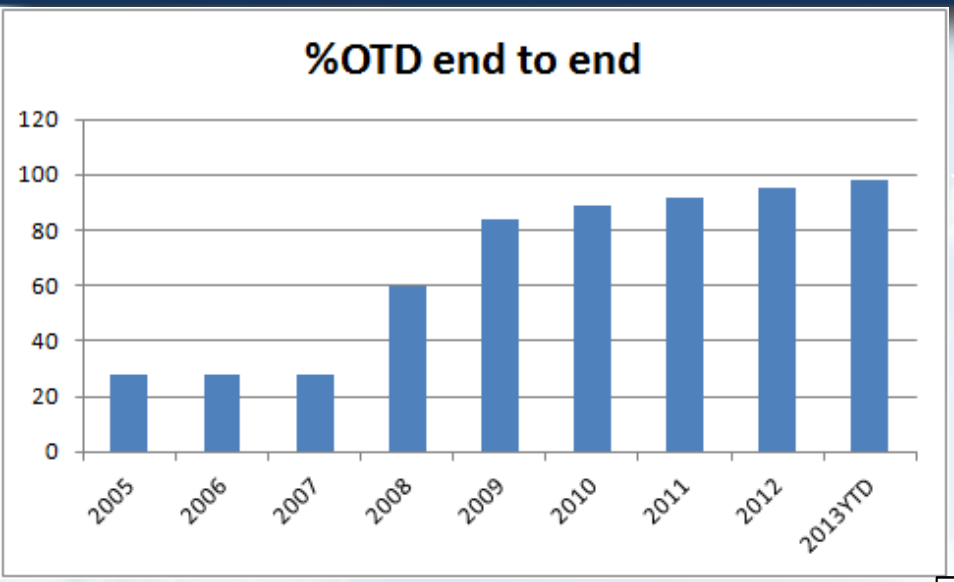


- Predictable outcome and delivery
- FAST, efficient and AGILE

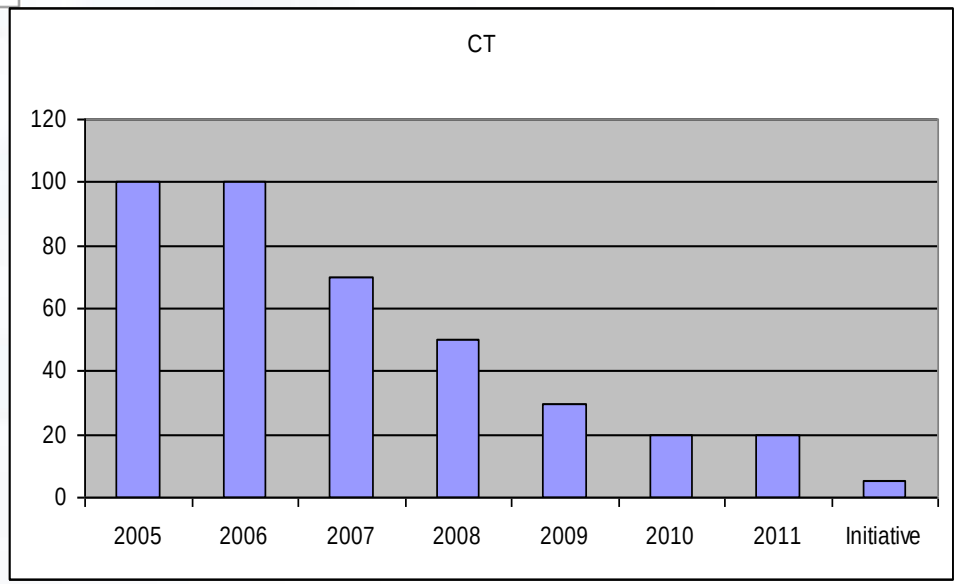
Validated Lean Principles:

- 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 ….

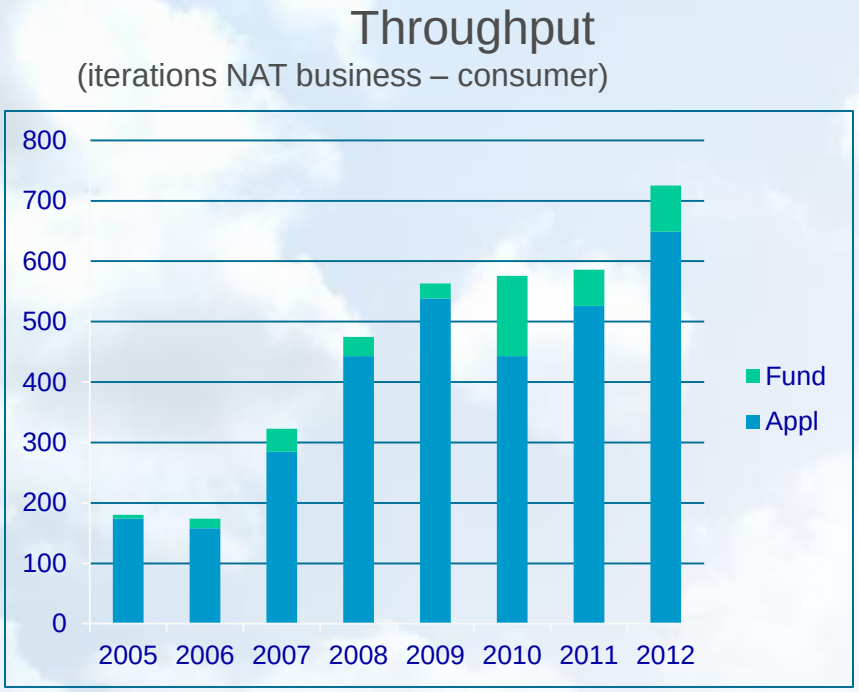
Validation Results - Goodyear



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



Validation of the “Hidden Factory”



Lean gave Goodyear back the front end back … and also increased the value added work

The "fuzzy" Front End

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

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

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

A **Generate a product that the customer actually buys**

FAST to assure first mover advantages
Make a profit
Motivated resources

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

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

Incoming Ideas		Screened Ideas	Economic Consequences
Good Ideas	Accepted	Good Labeled Good	None
	Incorrect Rejection	Bad Labeled Good	Waste i… required next che…
	Incorrect Acceptance	Good Labeled Bad	None if surplus
Bad Ideas	Rejected	Bad Labeled Bad	None

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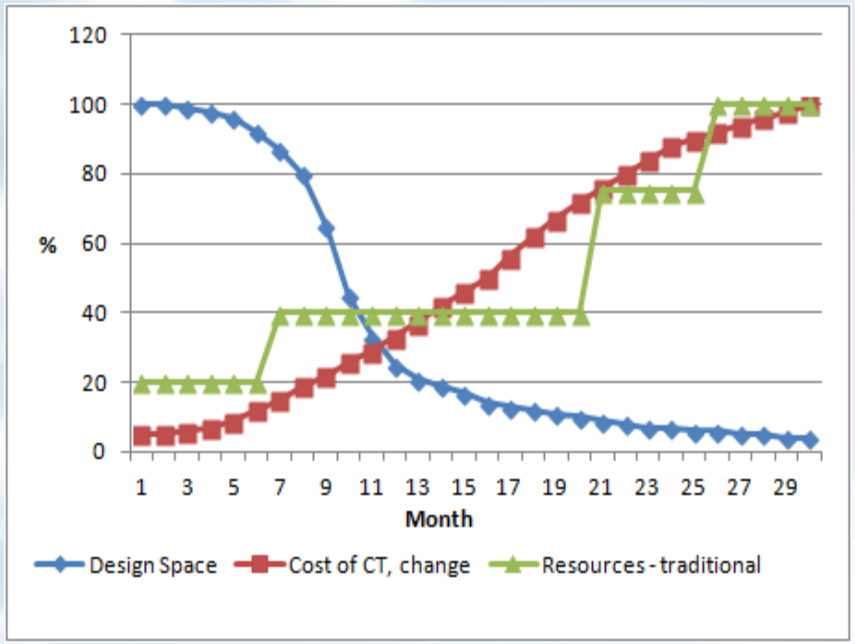
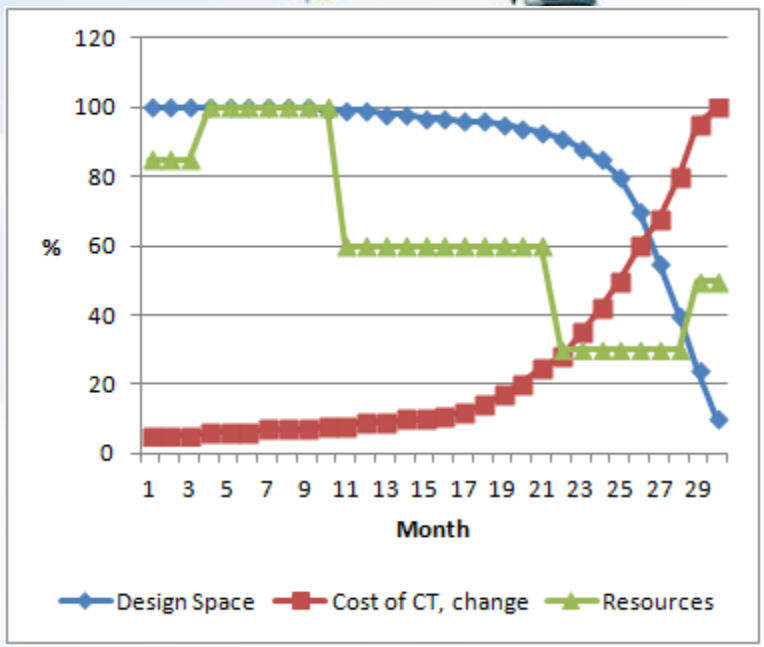
Keep the Design Space Open



Traditional

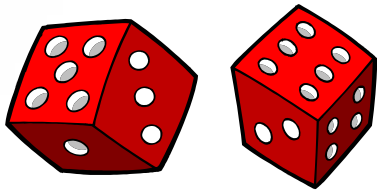


Lean

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

Set Based Thinking

There is never one single solution



SPEED

B

Generate a product that the customer actually buys

FAST to assure first mover advantages

Make a profit

Motivated resources

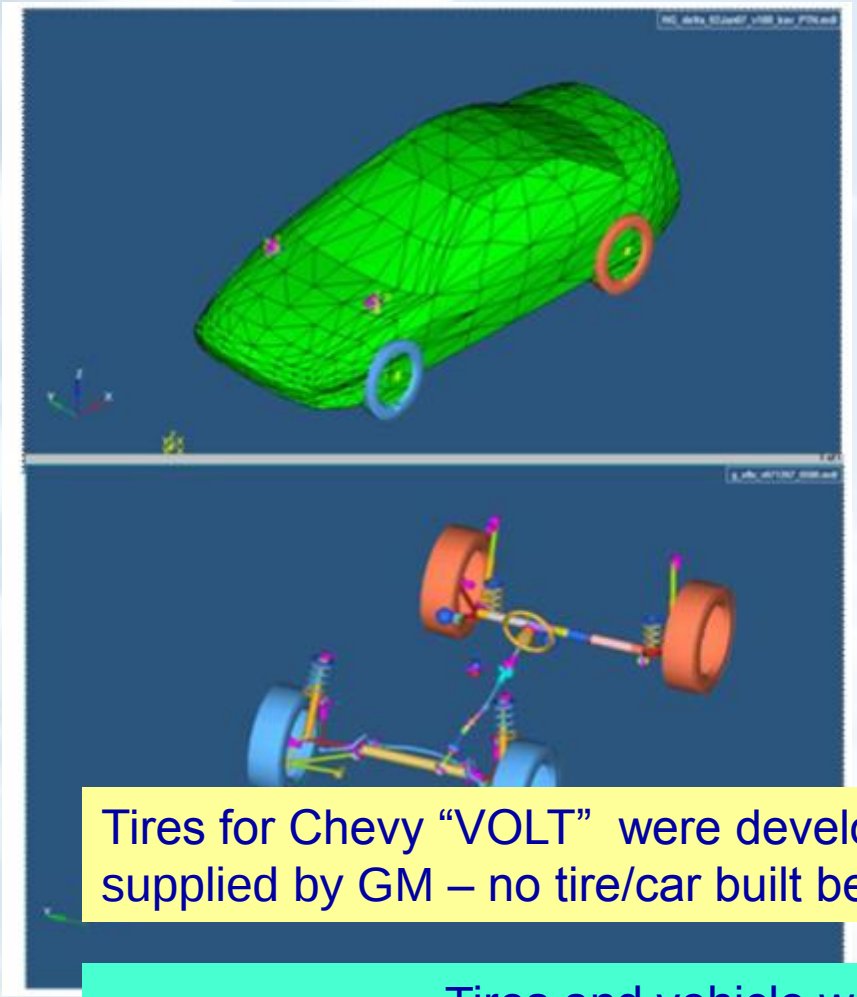
- QUICKLY evaluate prototypes (with the customer)
  - Rapid learning cycles
  - Quick prototypes and very fast testing
  - Quality results

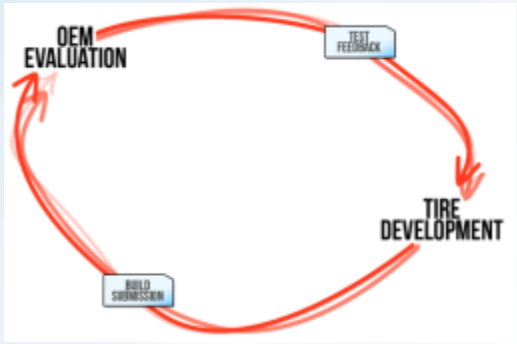
ALL the way back to lean ……..

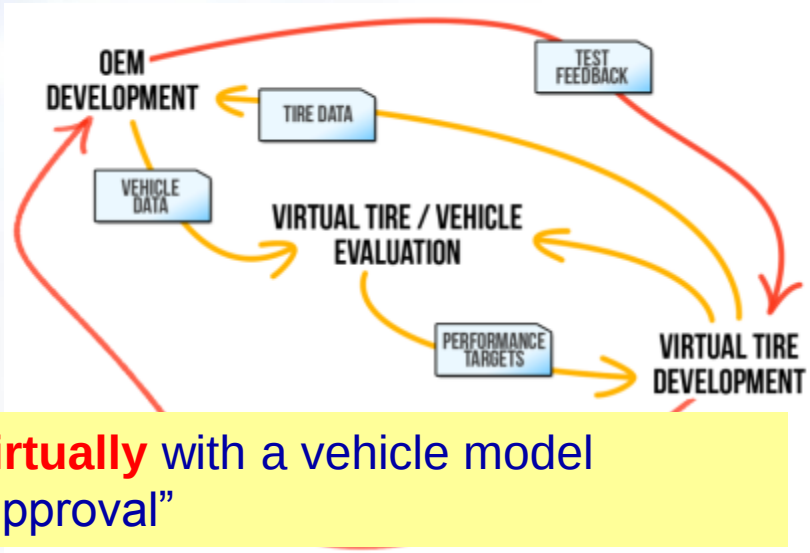
Lean Principles for SPEED

- 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

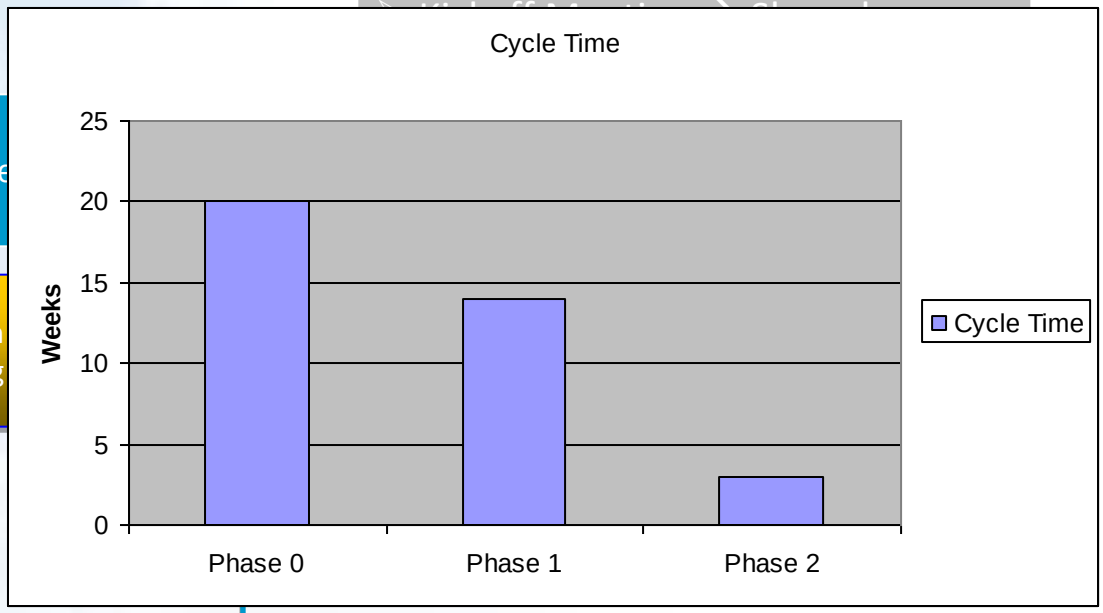
Modeling and Knowledge Reuse

- 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

ITERATION KICKOFF MEETING

- Single Piece Flow → Focus Resources and Eliminate Wait Times



Prepare Design

Prepare Mold Eng.

Prepare Construction Modeling

Prepare Materials Development

Prepare Tire Build Tire Build

Prepare Tire Testing

Lean is very popular with

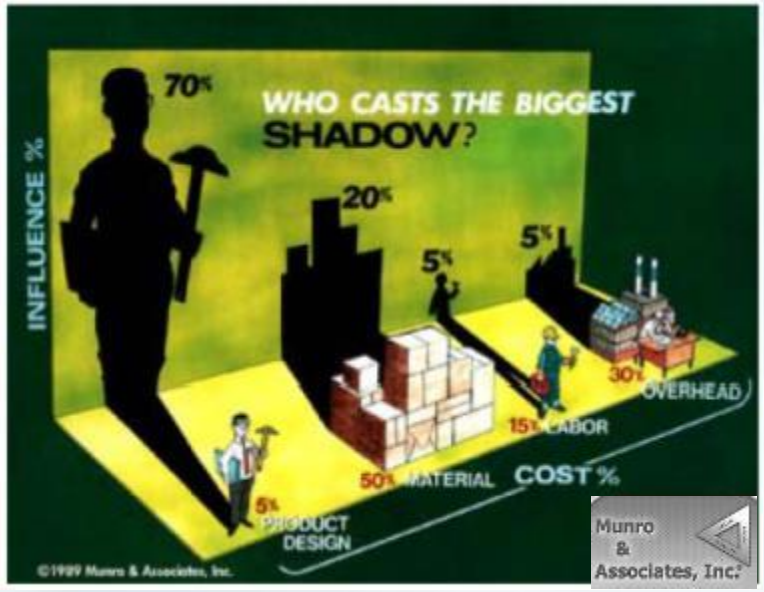
- Rapid learning
- Testing min feasible products
- Consumer testing
- Pharmaceutical testing
- Etc. …

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



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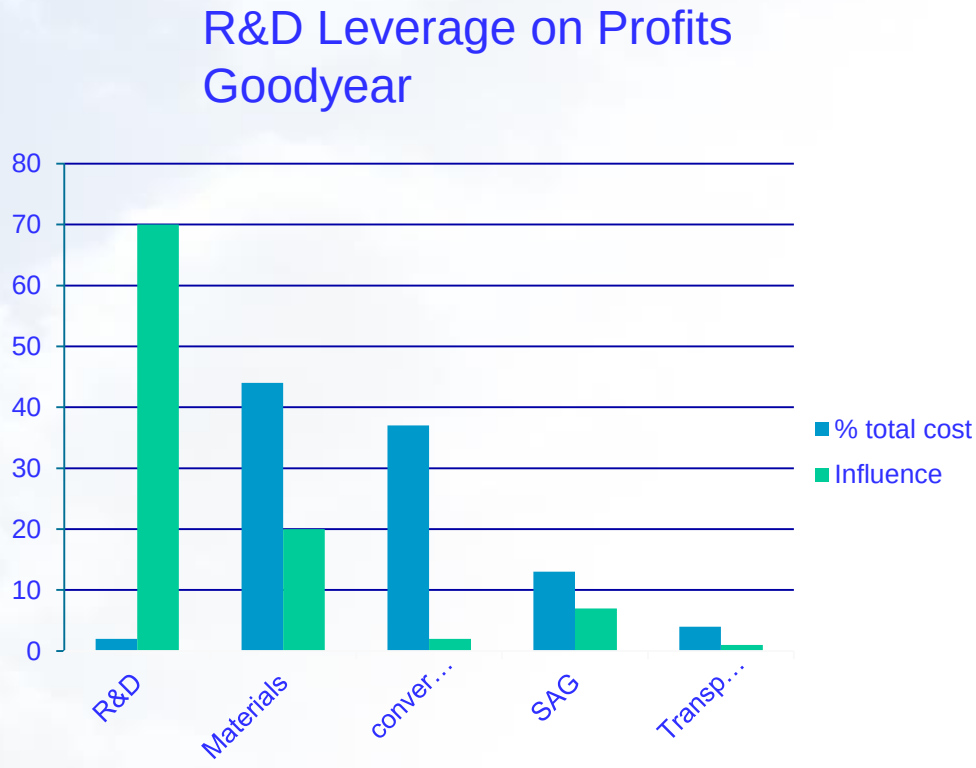


Make a profit

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

C Make a profit

Motivated resources

- 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

D 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 Learning Cycles

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

auto motor sport TEST Goodyear Eagle Vector+

THE PRODUCT OF YEAR

CONSTRUCTION EQUIPMENT

eurotuner

NorTech

ROAD&TRACK

Consumer Reports

Newport's Heavy Duty Trucking

GUTE FAHRT

WINNER evo TYRE TEST 2007 Eagle F1 Asymmetric

Newport's roadSTAR

Popular Mechanics

Auto Bild Vorbildlich Testsieger Goodyear Vector 4Seasons Platz 1

R&D 100

Automotive News PACE AWARD

Auto ZEITUNG

ADAC motorwelt 10/08 GOODYEAR Ultra Grip 6 BESONDERS EMPFEHLENSWERT

Auto Bild UltraGrip 7+ GUT sportscars

CIO 100 2008 Award Winner

CAR AND DRIVER

evo THE THRILL OF DRIVING

sport auto URTEIL Goodyear Eagle F1 Asymmetric

Inside Business

POWERCAR SEHR EMPFEHLENSWERT

ADAC motorwelt 10/2008 Goodyear Vector 4Seasons empfehlenswert 19 Winterreifen im Test

auto motor sport TESTURTEIL EMPFEHLENSWERT

CONSUMERS BEST BUY DIGEST

NEW YORK

TUULILASI

INDUSTRIAL DESIGN EXCELLENCE AWARDS

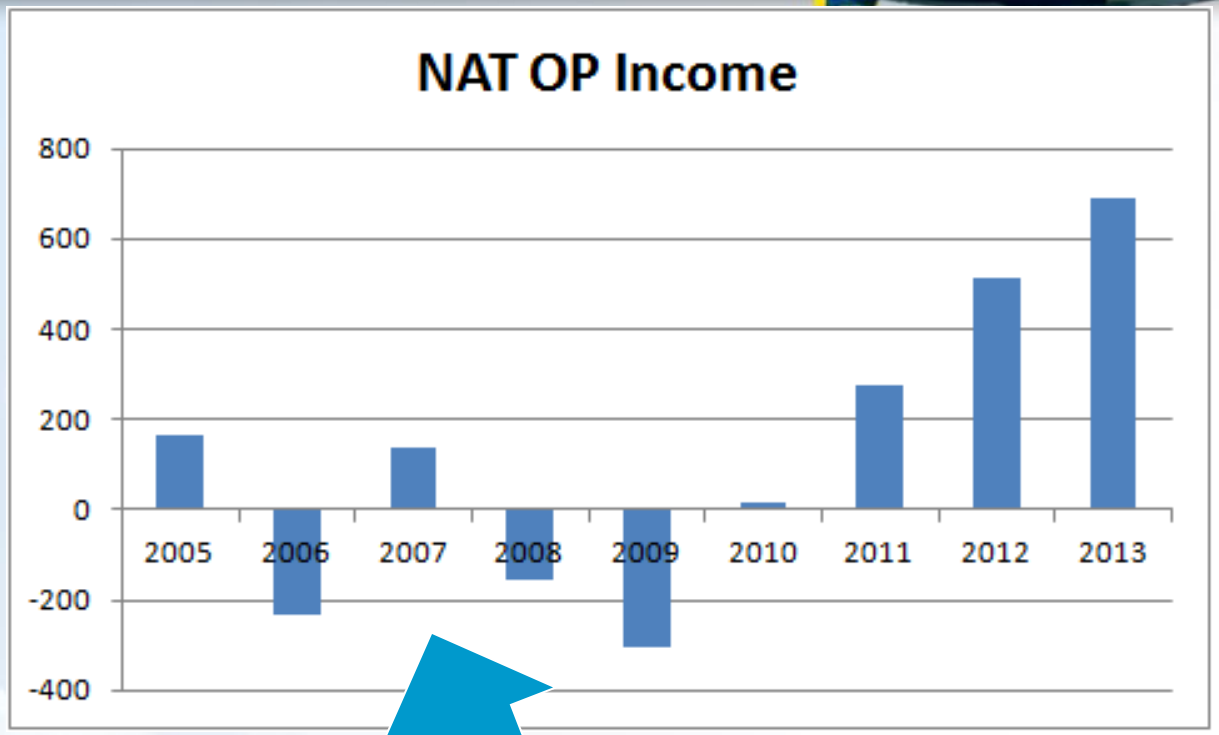
AUTOCAR THE ORIGINAL CAR WEEKLY

TIRE RACK .com

wheels

POPULAR SCIENCE

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

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

-- Mario Andretti

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