Lean Product Development and Ford’s Product Driven Revitalization

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Innovation – the heart of lean

• TPS (the genesis of lean) evolves, adapts and continually improves – it has human ingenuity and innovation at its very core

• JIT or Kanban are “counter measures” with an implicit expectation that a better method will be developed

• Lean at it’s heart is a powerful system of continuous innovation - successful in a variety of environments

• This is the essence of lean product development. It is a powerful and profound system to focus the creative power of people across the enterprise on delivering truly great products…and its not new
Event Sequence of LPPD Research

- Al Ward develops concept of “Set-based Recursive Design” @MIT (Late 1980s)
Research Results: High Performance Product Development at Toyota

Best Quality

- First place in seven of sixteen J.D. Powers categories for initial quality in 2001, nine in 2002, six in 2003, seven in 2004, and ten in 2005 (Total of 39 to 29 total for all of N.A. since 2001) Lexus capturing three of the four luxury categories as well as being rated as the highest quality brand in JD Powers) Industries lowest TGW/1000 and highest over all customer sat (80). The highest quality assembly plants worldwide and first place in five of ten categories of Consumer Reports Top Autos.

Sales and Profit

- AVG Profit/Rev: Toyota $7.5B / $135.7B vs. NA Avg. $(45)mil / $171.8B
Research Results: High Performance Product Development at Toyota

Speed to Market

- Product development lead times that were half of their competitors

Most Efficient Process

- Best in industry engineering efficiencies and fraction of the engineering changes than competitors. Designs that drive the worlds most efficient plants, T.P.S. and smoothest launches
We found that Toyota’s product development system is as powerful and profound as their manufacturing system...

...and may be even more important.
Framework for a Lean Product Development System

THE TOYOTA PRODUCT DEVELOPMENT SYSTEM

Integrating People, Process, and Technology

JAMES M. MORGAN
JEFFREY K. LIKER
Transforming An American Icon

"I was right – Ford’s problems weren’t as bad as Boeing’s. They were much, much worse"  
- Alan Mulally
Transforming An American Icon

It’s nearly impossible to describe...

- $8B profit (even with a European recession)
- 2-yr market share increase
- $17 stock price
- Stronger global supply base
- “ONE FORD”
- Hiring thousands
Product Led Revolution

“All in for product”

New global development process

Global development organization

Completely new product portfolio
The best people create the best products

So we develop people & products simultaneously
People

• Create a Chief Engineer System to Lead Development from Start to Finish
• Organize to Balance Functional Expertise and Cross-Functional Integration
• Develop Towering Technical Competence – Mastery in All Engineers and Create Leaders Who Are Technically Competent
• Fully Integrate the Enterprise Including Suppliers into the Product Development System
• Build in Learning and Passion for the Product
• Build a Culture to Drive Excellence and Relentless Continuous Improvement
The Chief Engineer

• Fundamental. . .but difficult to develop

• Groomed as super engineers and superb leaders with strategic assignments

• Responsibility without commensurate authority.

• Strong personalities. . .unreasonable and demanding – but focused

• The voice of the customer - intuition and technical understanding.

• Success depends on Functional organizations.
Organize around the value stream

Jim Morgan
Director Global Body Exterior, Safety & SBU Engineering

North America

Europe

FAPA

FSA

Body Structures

Exterior Systems

Stamping Program Mgt

Stamping

Business Office

Craftsmanship

Safety

TDM

Global Functional Skill Teams

Association for Manufacturing Excellence

Share • Learn • Grow
Skilled People

How do you transform a brand new college graduate into a Technically Mature, Highly Skilled and Efficient Employee?
Create Towering Technical Competence

Honor technical excellence and value creation

Developing Engineers as a Priority

• TMM
• ITDP
• Mentoring & targeted assignments
• Design reviews – for developing people and products
• Technical mastery

Strong Functional Organizations

• Foster deep technical knowledge – continually advance your product
• Provide an infrastructure for learning & continuous improvement
• Organize around the value stream
• Create a true competitive advantage
Technical Maturity Model @Ford

- Technical Maturity Models (TMM) around Critical Functions

- Skills required for Every Phase of PD mapped to the Function

- Mixture of Industry/Specialized Training/On-Job Experiences Defined to meet requirements of “Novice”, “User”, “Expert”

- System must teach Employees what they do not learn in school. “Body Structures 101”

- Mentoring role of Functional leaders
Design Reviews

• Great for developing **products and people**
• Cross-functional participation
• Rigorous, candid…and difficult
• Prep work part of learning
• Critical questions…Did you consider?…..How did you arrive at that?...What’s the data say?.....Have you thought of?....What are your benchmarks?
• Scientific Method: Go and see, develop a hypothesis, execute tests, analyze, action plan
• Bring it back to foundation documents – capture knowledge
Learning At The “GEMBA”

• “Go and See” what is really happening – grasp the situation for yourself
• Ask questions – deep understanding for all.
• Show Respect
• Coach and set clear expectations
• Come back and do it again – CADENCE. Make learning part of the process
Include The Extended Enterprise

“Fully integrate and align around delivering great products”

Ford Boosts Supplier Standing in Placing Among Top 3

By Doron Levin

May 10 (Bloomberg) -- Ford Motor Co., following its first annual profit since 2005, became the only non-Japanese auttor in a survey of suppliers.

Study Shows Ford Climbs to #3 Overall in 'Working Relations' With Suppliers; Honda and Toyota Still #1 and #2, but Slipping; GM Gaining

By James M. Amend

WARDSAUTO

‘One Ford’ Plan Making Auto Maker, Suppliers More Competitive

TRIARSE CITY, Mich -- Ford Motor Co. intends to slash its global supplier list to 750 from the 3,000 it employed just a few years ago, one of the auto maker's top purchasing executives says.

The reduction is part of the company's vaunted 'One Ford' strategy. Ford rebooted Ford's new global purchasing strategy in 2006.
The Matched Pair Process

- “Matched pairs” at Director, Chief & Manager levels in Engineering & Purchasing
- Speak with one voice of Ford Motor Company
- Align processes, tools & objectives around delivering great products
- Improved quality & speed decision making
- ABF (Aligned Business Framework) for major suppliers
STANDARD PROCESS & ARCHITECTURE

STANDARDIZATION

\[ CT_q = \left( \frac{C_a^2 + C_e^2}{2} \right) \left( \frac{u}{1-u} \right) t_e \]

REDUCE VARIABILITY

LEAD TIME

\[ L = \lambda \omega \]

CAPACITY UTILIZATION

PERFECT DRAWING PLAN

PDVSM
Process

STUDY/KENTOU (Front Loaded process to create the right product)

- Product immersion
- Chief engineer concept paper
- Set-based collaboration

EXECUTION (to deliver the product right)

- Capacity/ Capability
- Enabling process logic
- Create Flow/Synchronize cross functionally
- Compatibility before completion/minimum feasible maturity
- System of standards (fixed and flexible / C.I.)

REFLECTION/LEARNING

- Learning at GEMBA
- Reflection/Hansei
Study: Create the Right Product

Create mechanisms to align the enterprise around delivering the greatest value to the customer

- **Mono-sukuri** – Brings enterprise together to deliver value to the customer
- **Kara-kuri** – teardown link to attributes
- **Bundled Planning**
Study: Create the Right Product

“Set Based” Enablers:

- Utilize mechanisms to examine multiple designs/solution sets
- Early Design Reviews
- 3x Internal
- 3x Competition
- R&D
- Supplier Tech
- Design Efficiency
Creating Flow

- Capacity/Capability
  - Linked
  - Dynamic
  - Capability study

- Enabling Process Logic
  - Clear quality of event criteria
  - Scalable
  - Built in C.I. mechanism
  - Synchronize cross-functionally

- Create Flow
  - CbC (Compatibility before Completic
  - MFM (Minimum Feasible Maturity)
  - Virtual / Physical

- Detailed Scheduling / Execution Discipline
  - Block timing = “traveling hopefully”

Powerful Standards Underpin the Process

Fixed and flexible
Capability & Capacity

• Tough to know one without really understanding the other

• Task and inter-arrival variability and system capacity effects

• Numerous dynamic contributing variables to consider

• Process capability studies

• Create flexible capacity where possible

• Understand and monitor critical milestones
Compatibility Before Completion

**Completeness**
Engineering thoroughness of given design including design analysis for failure mode avoidance, testing and verification.

**CONCLUSION**
Early focus on completion creates more CAD work and late engineering changes. LPPD synchronizes the processes of compatibility and completeness minimizing rework workload and shortening lead time.

**Compatibility**
Should be a subset of completeness, virtual (CAD/CAD) checks done prior to CAD freeze for robust release. DPA work streams ensure critical interdependencies are checked. **Synchronization** Sequencing value-added work across Functions to eliminate rework loops (gives & gets).
“Today's standardization is the necessary foundation on which tomorrow's improvements will be based... the best you know today... to be improved tomorrow. But if you think of standards as confining, then progress stops”

Henry Ford
A Plan for Every Part

PDP Overview – “Recipe for Success”

- Commodity Specific Development Timing
- Defines Engineering Needs and Deliverables By Milestone To Enable Success – Clear Quality of Event Criteria and linked to high level process
- Highlights Any Disconnects Between Program Timing, and Commodity Timing
- Consistent Program to Program
- Template for Engineers and basis for CI

Commodity Business Plan

- Medium range plan for platform architecture and materials
- Supplier strategy development
- Manufacturing footprint development
- Value chain analysis
Enabling Standards & Innovation

Hydroforming

- Enabling standards and strong foundational knowledge allow innovation in complex systems
- A challenging environment
- Enabling process
- Skilled, creative, motivated people working collaboratively.

Opportunities often cross Functions

Hydro-Forming Process:
1. Rolled tube
2. Pre-bend part to approximate configuration
3. Pre-crush the bent tube with an internal pressure in the tube of approximately 1000 psi to control the deformed shape
4. Pressurize tube to achieve final geometry
5. Final Trim and Pierce

Magnesium Liftgate

Steel Liftgate

Mg/AL Liftgate
- Weight
- Cost
- Package Efficiency
- Technical 1st
Enabling Standards & Innovation

• Often a response to complex and conflicting market/regulatory demands. Front end challenge: design leadership/ pedpro/ LSD/ crash/aero & CO2 emissions

• Or “adjacent innovation” to change an entire industry...
Tools That Enable People & Processes
TOOLS and TECHNOLOGY

• **Adapt Powerful Technology** to Fit Your People and Process to Fully Leverage Their Capabilities

• **Align Your Organization** Through Simple, Visual Communication

• **Use Powerful Tools** for Standardization, Alignment and Organizational Learning
Powerful Technology: The Digital Value Stream

- Common language from studio to shop floor
- Eliminate data conversion steps, errors & other waste
- Enabler for global PD strategy and re-usability
Basic Engineer Development Management Tools

Completeness

Verification Matrix

Compatibility

DPA Checklist

Synchronization

Design Development Chart (Perfect Drawing Plan)
Make Critical Metrics & Quality Visible

C346 Body Engineering Efficiency

Health Charts

PD Development Process
Early HC Assessments

Standards
Criteria
Status

Quality Panel Providence Requirement

PS
PSC
PICO
PTCC
PEU
PA
Align your Organization with Tools and Stretch Your Team

GLOBAL STAMPING STRATEGIC PLAN

Champion / Lead: J. Morgan

**A3 / Business Planning Process**

1. Global BPR Process
2. A3 Hierarchy / Clear Objectives
3. Master Schedules
4. B.R.P. Metrics
5. Global Leadership Week
6. All Hands Meeting
Obeya System
A Systems Approach

People

Lean Product Development System

Process

Tools

Results
Dearborn Tool and Die

Quality Improvements:
- 25% Dimensional improvement in first panel to gage
- Tighter tolerances
- Improved surface quality and craftsmanship
- Diverse new materials

90% Reduction – Static Issues
89% Reduction – Dynamic Issues
19pt FPG PIST % Improvement

62% Improvement Hrs Per Die
60% Reduction in Lead Time

90% Reduction – Static Issues
89% Reduction – Dynamic Issues
19pt FPG PIST % Improvement
Exceeded investment targets

INVESTMENT EFFICIENCY -- TOOL INVESTMENT

55% Reduction
PRODUCT EXCELLENCE
Precision & Design Fidelity

EXPLORER
Precision & Design Fidelity

2006 - 2010 Explorer

2011 Explorer
Precision & Design Fidelity

ESCAPE
Precision & Design Fidelity

Current Escape

2012 Escape
Precision & Design Fidelity

Current Escape

2012 Escape
Repairs

R/1000 Trend By Function

Reduced 53%
TGW

Reduced 33%
Ford Safety Leadership

Most number of 5 stars
Most number of IIHS Top Picks
Fiesta Global 5-star and first B-car named IIHS Top Pick
2013 Fusion Top Safety Pick Plus

“I am writing to express my heartfelt thanks….”
- High speed roll-over (no injuries)

“Under no uncertain terms, we would not have walked away with a lesser vehicle.”
- Head on Crash (no injuries)

Semi lands on top of Fusion…Roof Crush
(Only Minor Injuries to Driver)

“…sincerest thanks, to the engineering team…”
5-Star Edge  (Driver walked away)
Great people, great products and a great place to work

Employee Satisfaction Index

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32 Point Improvement
To Learn More.....

**The Toyota Product Development System**

*Integrating People, Process, and Technology*

by James M. Morgan and Jeffrey K. Liker

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**Lean Product and Process Development**

*Second Edition*

by Allen C. Ward and Durward K. Sobek II

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**AME**

Association for Manufacturing Excellence

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THANK YOU!