# Lean Product Development and Ford's Product Driven Revitalization

**Jim Morgan**

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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)
- MIT Studies and "The Machine That Changed the World" *Womack, Jones & Roos (1990) Product Development*
- " Product Development Performance" *Clark & Fujimoto (1991)*
- University of Michigan Japan Auto Studies (1991-98) *(Liker/Ward/Sobek/Hammett)*
- High Performance Product Development U of M Research *(J. Morgan 1999 to 2003)*

# 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

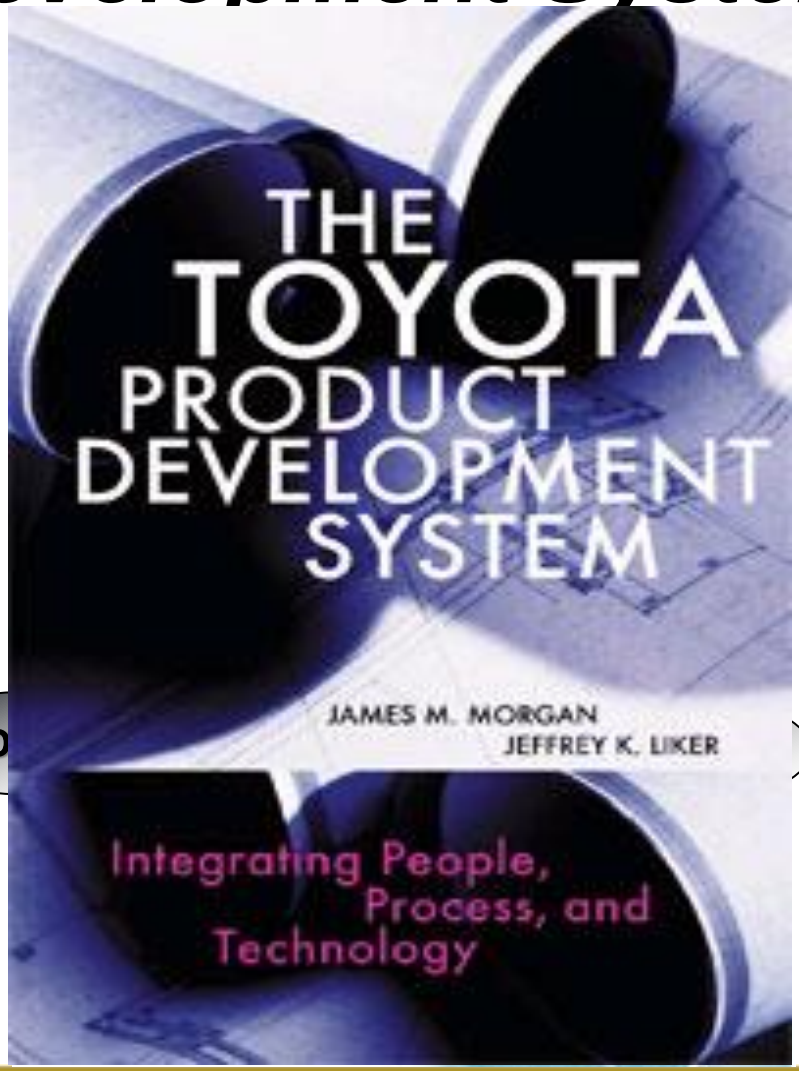
- Best in industry engineering efficiencies and fraction of the engineering changes than competitors. Designs that drive the worlds most efficient plants, T.P.S. and smoothest launches

# Toyota Product Development

*We found that Toyota's product development system is as powerful and profound as their manufacturing system…*

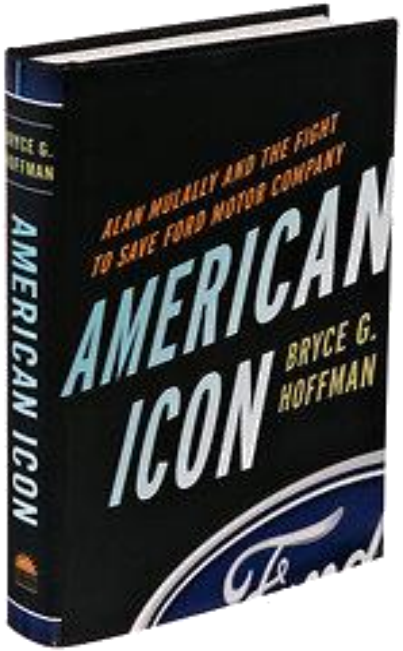
*…and may be even more important*

# Framework for a Lean Product Development System




pro

# Transforming An American Icon

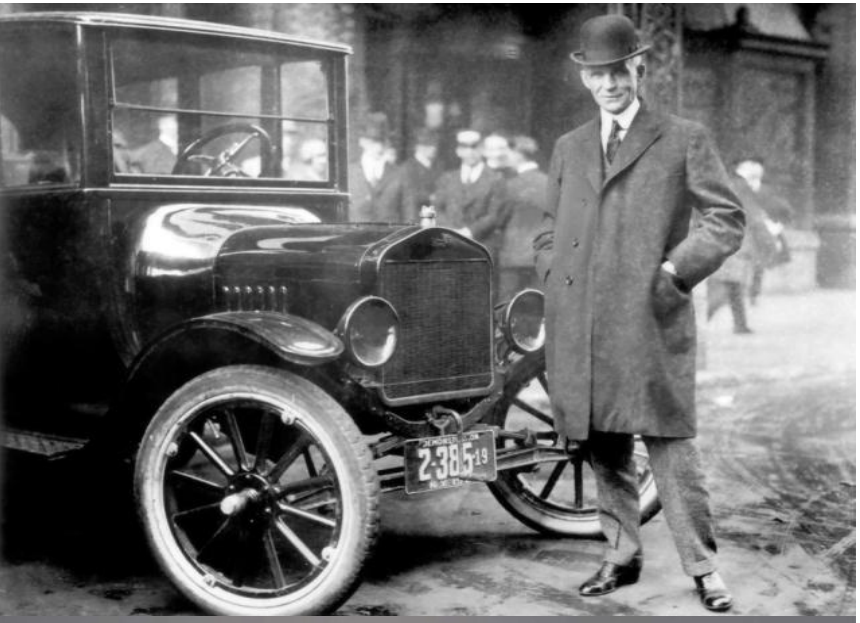


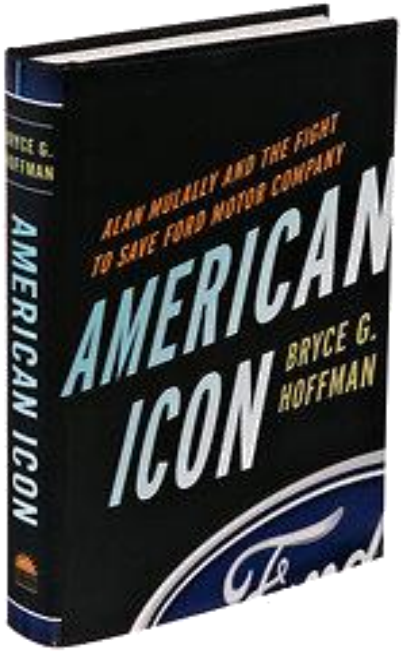

***It's nearly impossible to describe…***

- ($17B) in losses
- 20yr market share decline
- $1.90 stock price
- Sudden supplier bankruptcies
- "Cage fighting" culture
- Massive layoffs
- Betting the company on a $23B loan

***"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







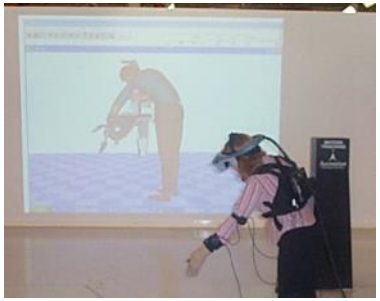
people

lean product development system

process

tools



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

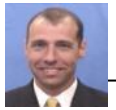
Jim Morgan
Director Global Body Exterior, Safety & SBU Engineering

North America | Europe | FAPA | FSA




Global Functional Skill Teams


Body Structures


Exterior Systems


Stamping Program Mgt


Stamping


Business Office


Craftsmanship


Safety


TDM




# 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**

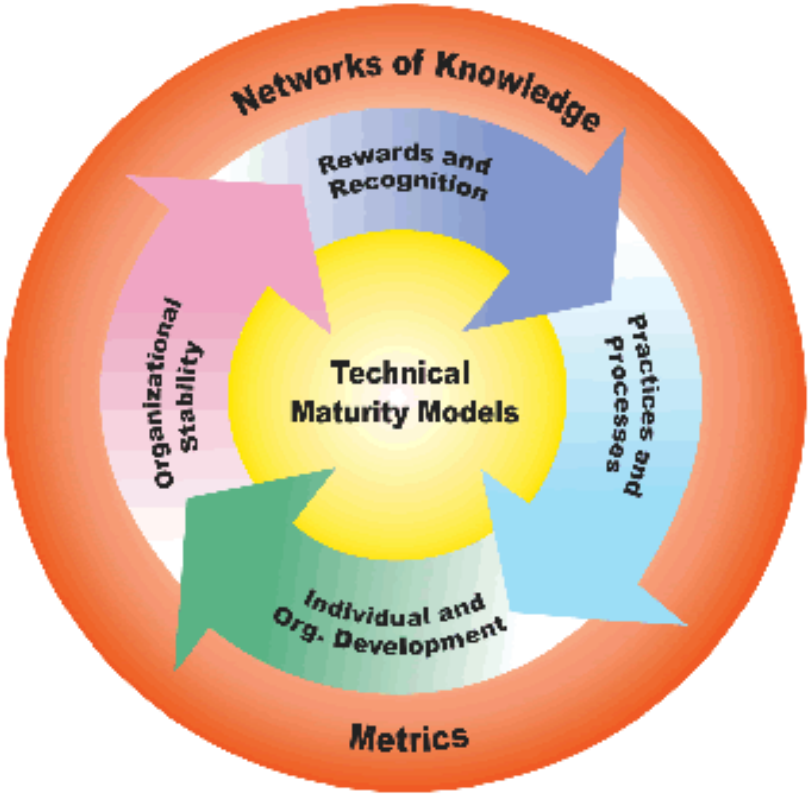
- TMM
- ITDP
- Mentoring & targeted assignments
- Design reviews – for developing people and products
- Technical mastery

**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

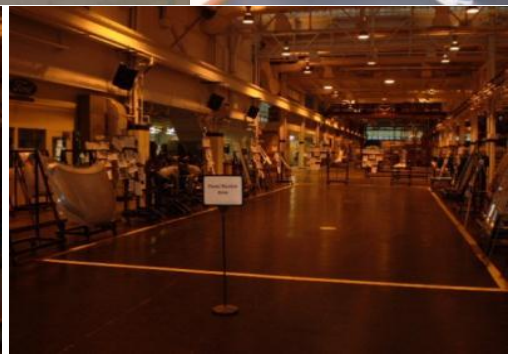










# Include The Extended Enterprise

*"Fully integrate and align around delivering great products"*

Bloomberg Businessweek

## Ford Boosts Supplier Standing in Placing Among Top 3

May 10, 2010, 4:31 PM EDT

(Updates closing share prices in the eighth paragraph.)

By Doron Levin

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

The Detroit News

Wednesday, May 17, 2006 detnews.com Metro Edition

## Ford, UAW retooling work rules

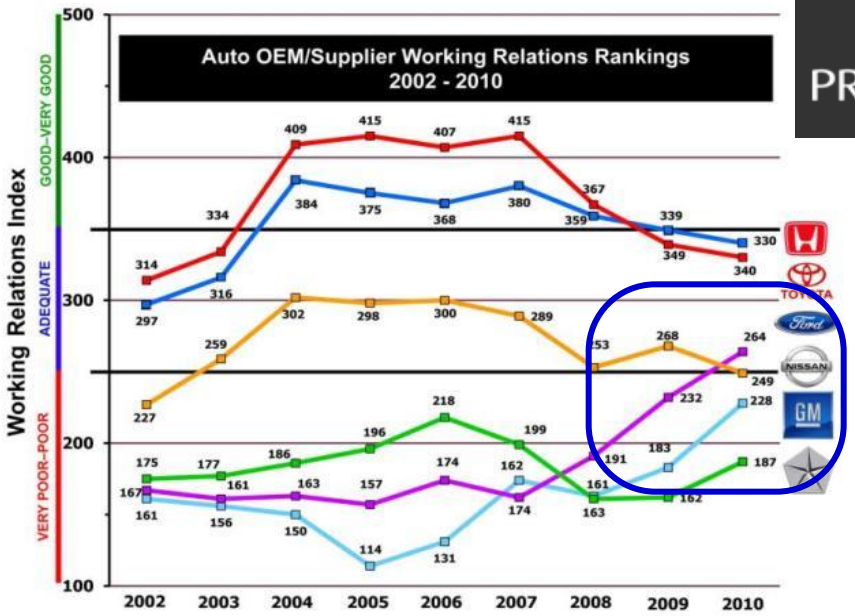
Changes at Dearborn plant may serve as model for more efficient factories in the future.

By Bryce G. Hoffman
*The Detroit News*

DEARBORN — Ford Motor Co. is sending a message to its remaining North American factories: Be competitive or beware.

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

PR Newswire
United Business Media




WARDSAUTO

## 'One Ford' Plan Making Auto Maker, Suppliers More Competitive

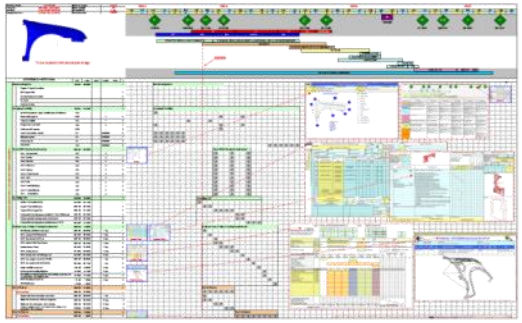
By James M. Amend
WardsAuto.com, Aug 3, 2010 4:52 PM

TRAVERSE CITY, MI – 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, Birgit Behrendt, Ford's newly appointed purchasing director of global

# 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

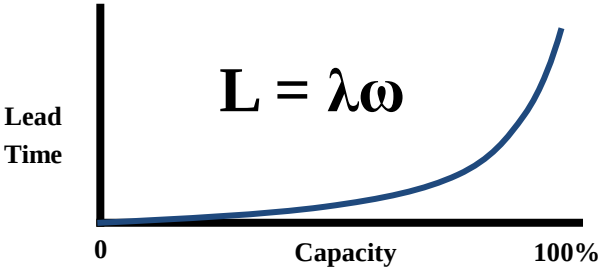


STANDARD PROCESS & ARCHITECTURE

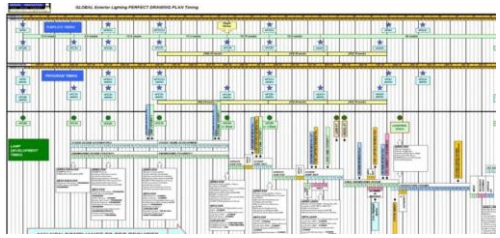

STANDARDIZATION

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

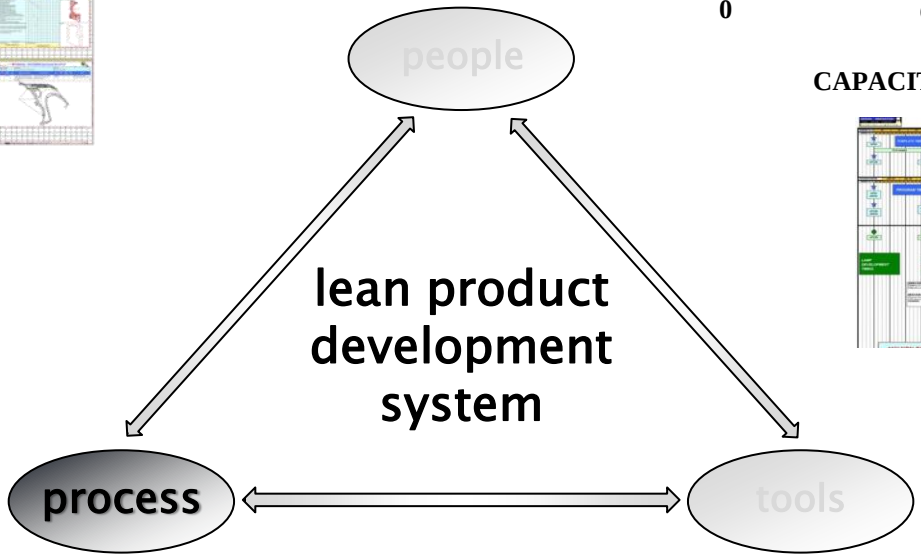
REDUCE VARIABILITY

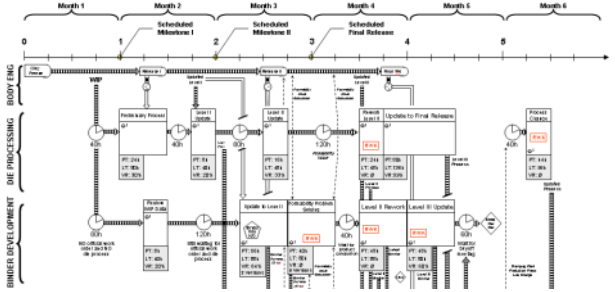



CAPACITY UTILIZATION



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.)

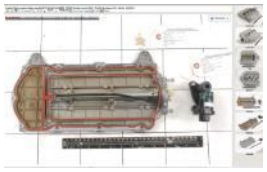
**REFLECTION/LEARNING**

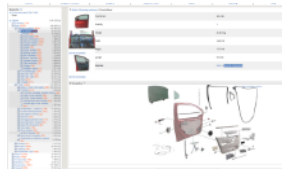
- Learning at GEMBA
- Reflection/Hansei

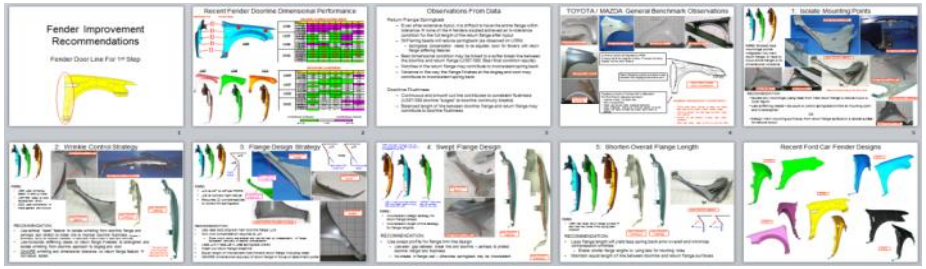
# Study: Create the Right Product

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*



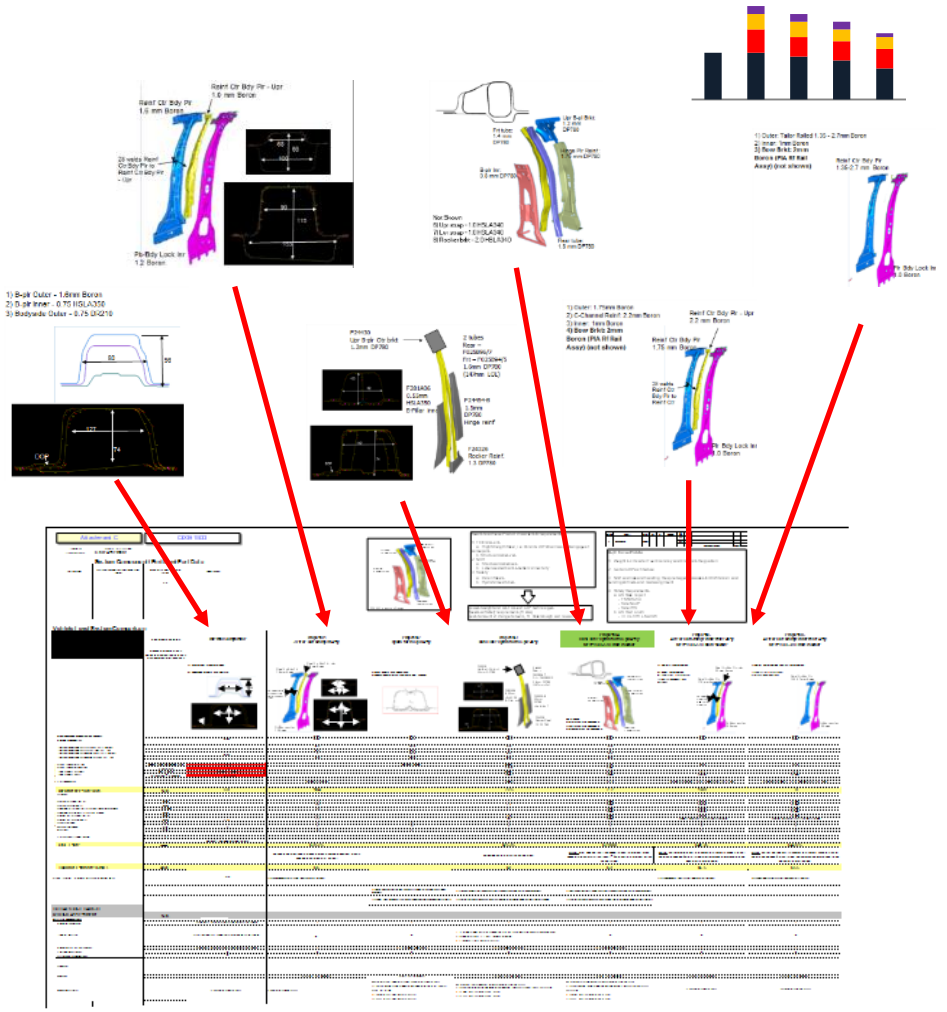




# Study: Create the Right Product

"Set Based" Enablers:

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

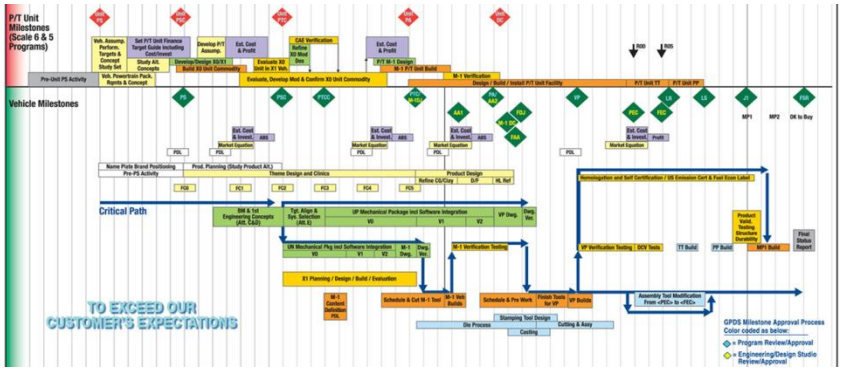


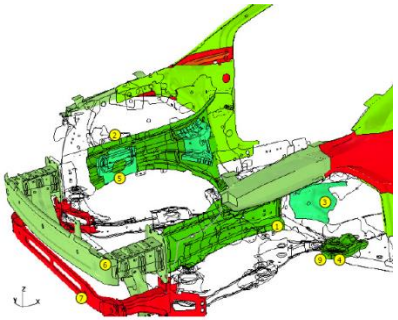
# Creating Flow

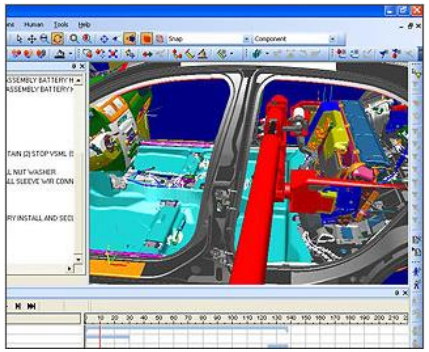
- Capacity/Capability
  - Linked
  - Dynamic
  - Capability study
- Enabling Process Logic
  - Clear quality of event criteria
  - Scalable
  - Built in C.I. mechanism
  - Synchronize cross-functionally
- Create Flow
  - CbC (Compatibility before Completic
  - MFM (Minimum Feasible Maturity)
  - Virtual / Physical
- Detailed Scheduling / Execution Discipline
  - Block timing = “traveling hopefully”

*Powerful Standards Underpin the Process*

*Fixed and flexible*

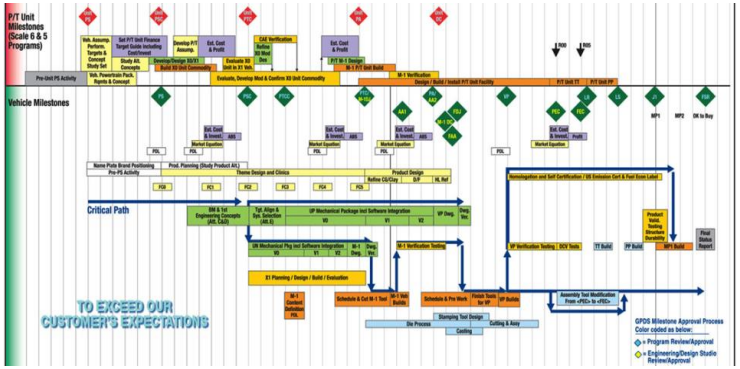




# Capability & Capacity

- 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

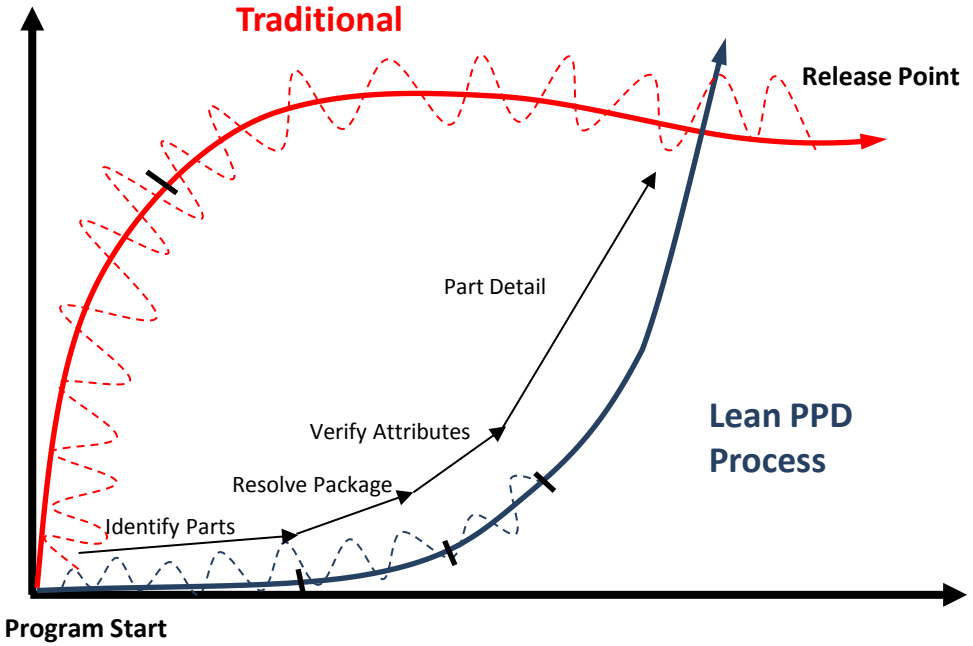
# Compatibility Before Completion

**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**

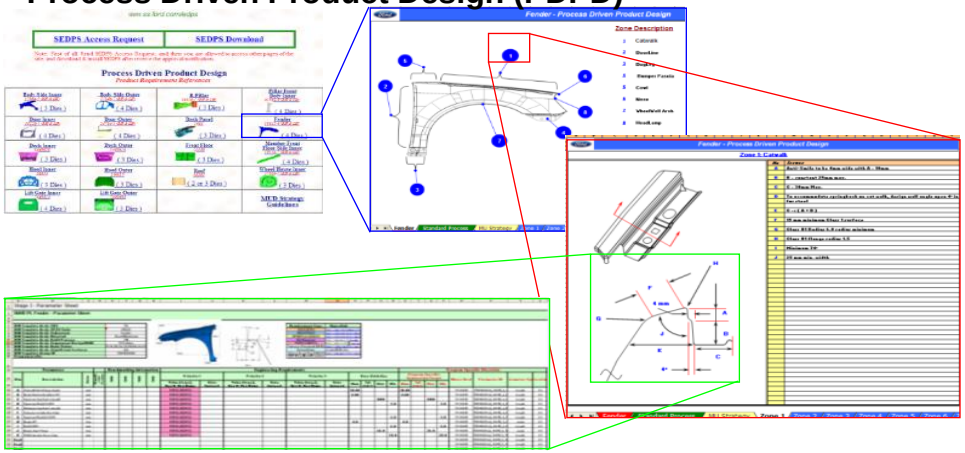
Should be a subset of completeness, virtual (CAD/CAD) checks done prior to CAD freeze for robust release. DPA work streams ensure critical interdependencies are checked.

**Synchronization**

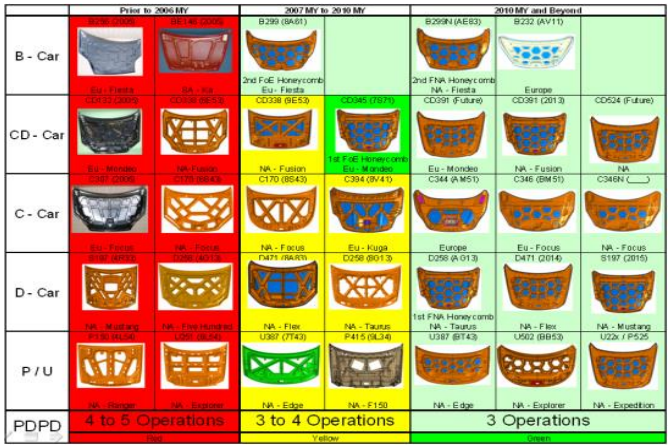
Sequencing value-added work across Functions to eliminate rework loops (gives & gets)

# Powerful Global Standards

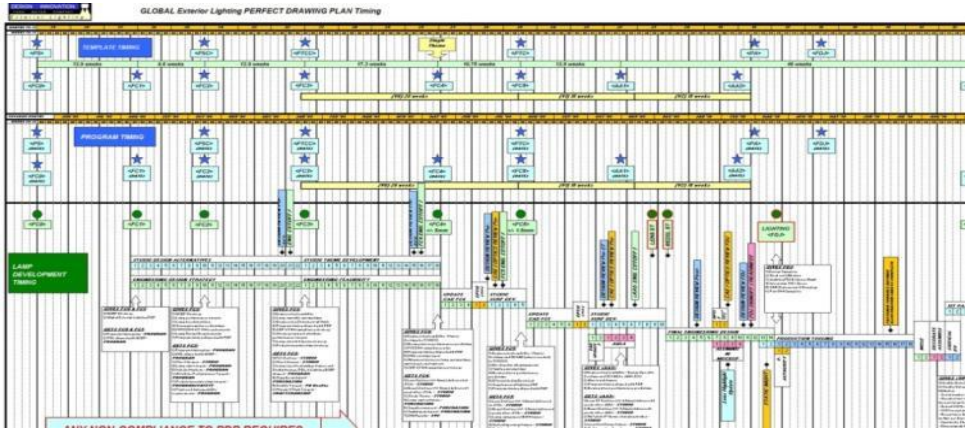
## Process Driven Product Design (PDPD)




## Standard Architecture




## Perfect Drawing Plan (PDP)



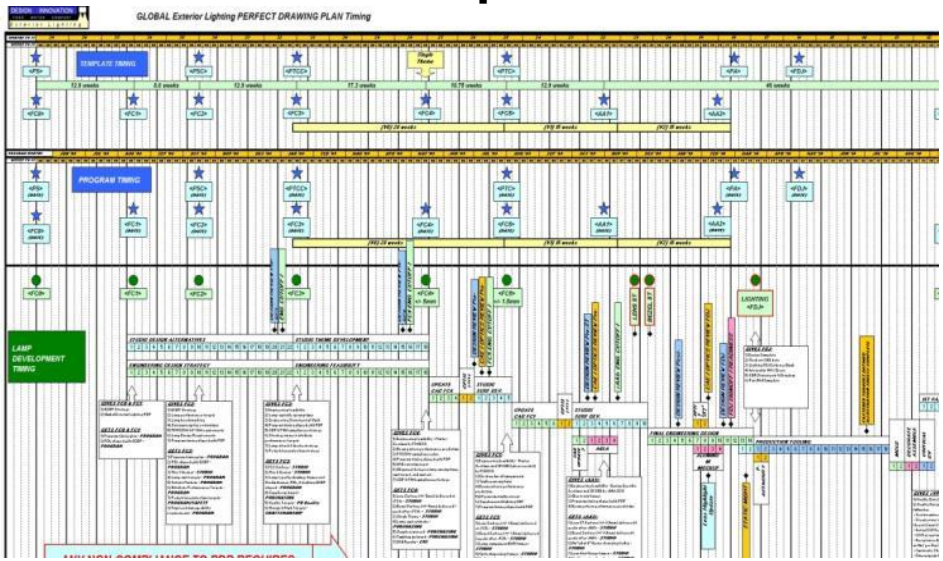

## Global Standard Press Equipment


*"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**

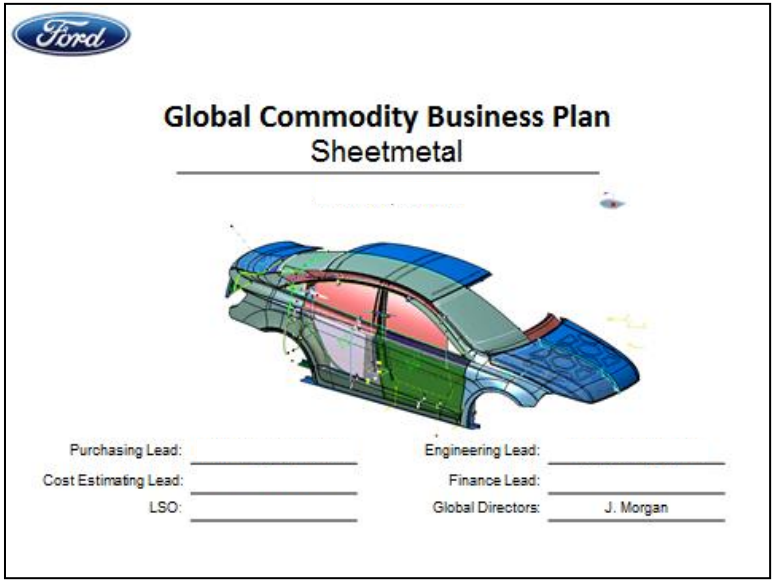
# A Plan for Every Part

## 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

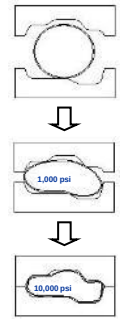
- Enabling standards and strong foundational knowledge allow innovation in complex systems
- A challenging environment
- Enabling process
- Skilled, creative, motivated people working collaboratively. Opportunities often cross Functions

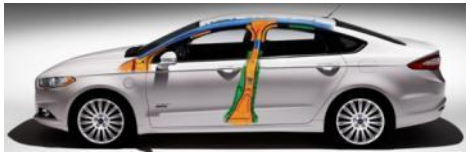
## Hydroforming

***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

**PSH Process**



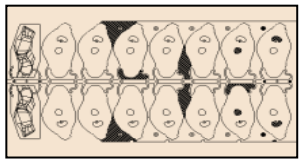
## Magnesium Liftgate

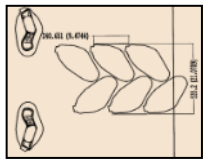
Mg/AL Liftgate
- Weight
- Cost
- Package Efficiency
- Technical 1st

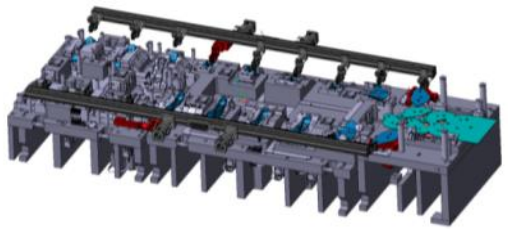

# Enabling Standards & Innovation

- 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…

**Prog Die vs. In-Die Automation**



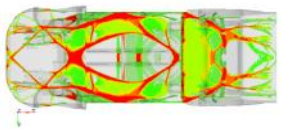




**Scallop Blanks**

**Laser Welding**

**BIW Topology Optimization**



Frontal ODB

Roof Crush

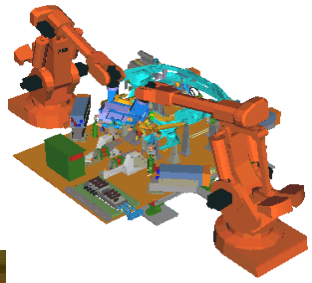
Side Impact

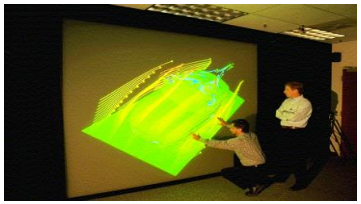
INNOVATION SUMMIT

IRVINE • CALIFORNIA • MARCH • 13 • 14 • 2014

AME Association for Manufacturing Excellence

Share • Learn • Grow℠



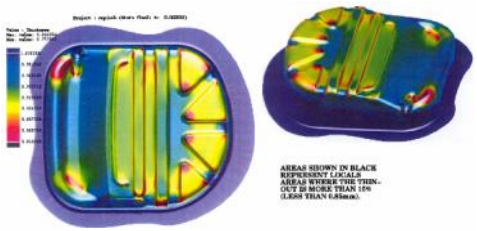


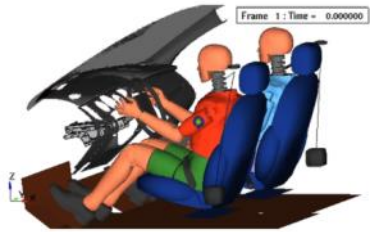
people

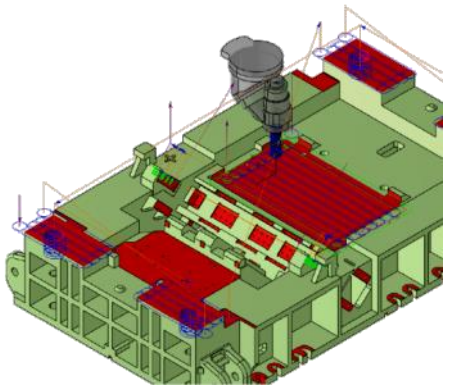
lean product development system

process

tools







# Tools That Enable People & Processes

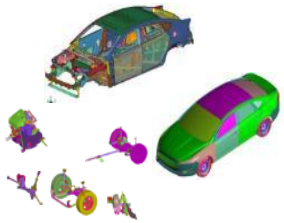
# TOOLS and TECHNOLOGY

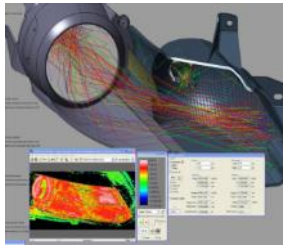
- **Adapt Powerful Technology** to Fit Your People and Process to Fully Leverage Their Capabilities
- **Align Your Organization** Through Simple, Visual Communication
- **Use Powerful Tools** for Standardization, Alignment and Organizational Learning

# 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

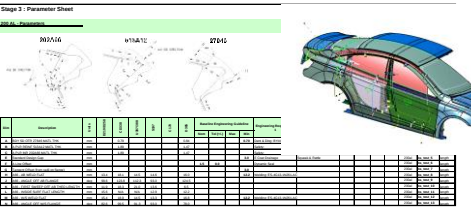
Analytical Prototypes





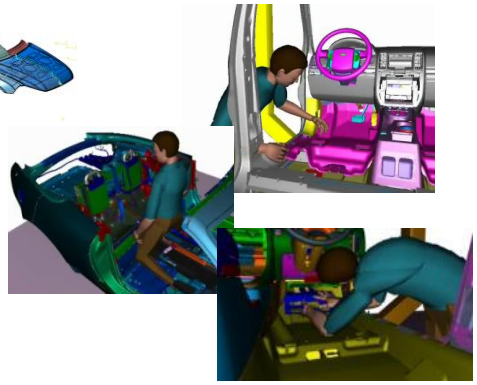
Lighting Simulation

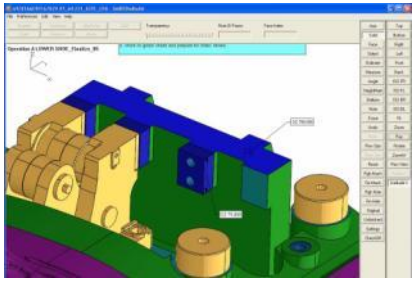
CAD/Engineering Templates



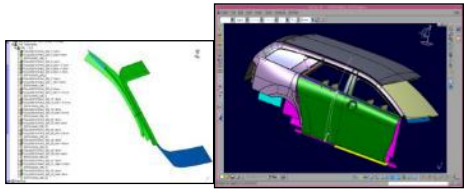


Virtual Manufacturing

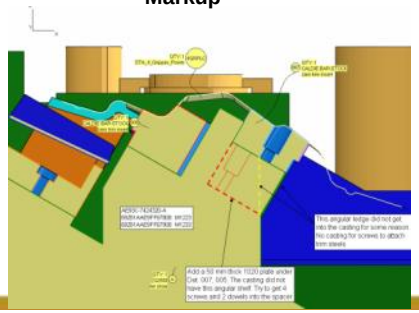




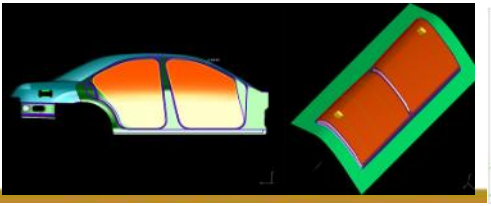
Digital Design Verification



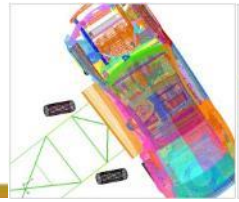
Shop Floor Die Design Viewing, Measurement, & Markup

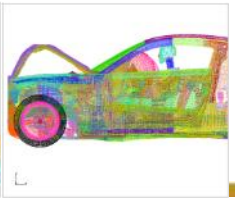


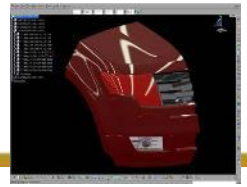
Studio Stamping Feasibility

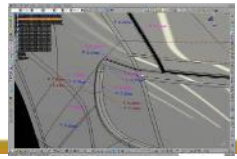


Virtual Crash Simulation

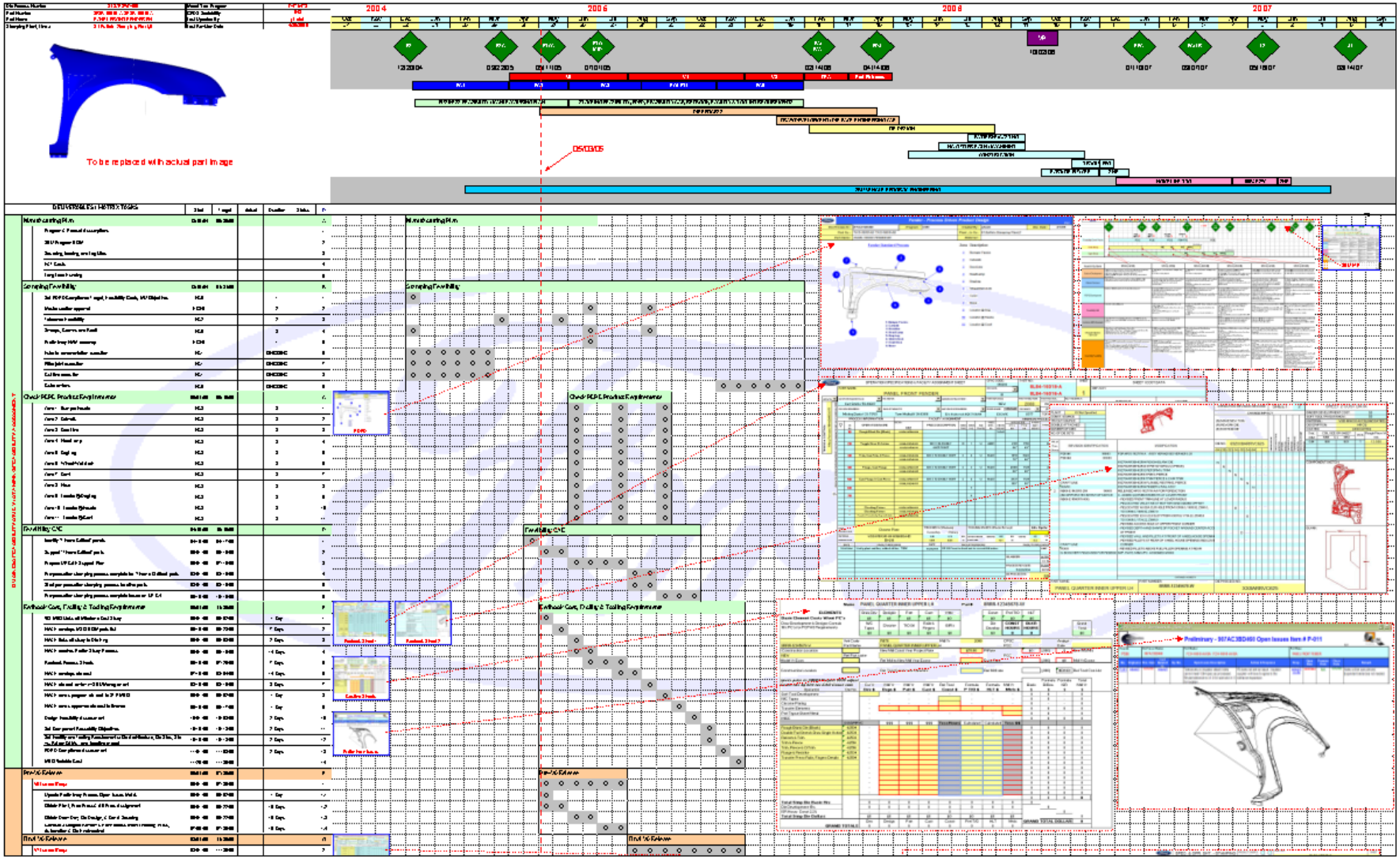






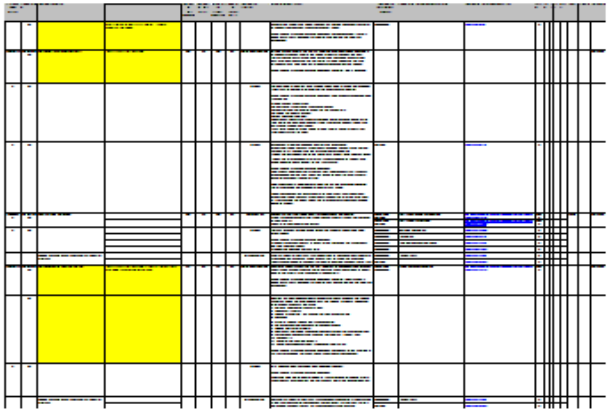


# Stamping Development Plan



# Basic Engineer Development Management Tools

## Completeness

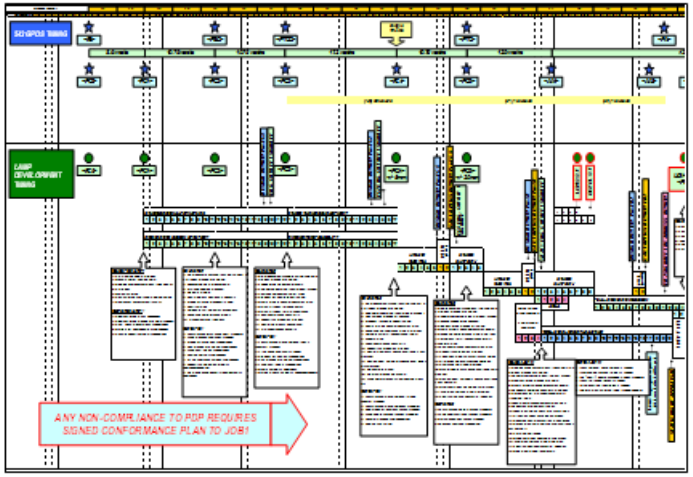


Verification Matrix

## Compatibility

DPA Checklist

## Synchronization




Design Development Chart (Perfect Drawing Plan)

# Make Critical Metrics & Quality Visible

## C346 Body Engineering Efficiency

Ford Confidential — Design Efficiency: Body Structure

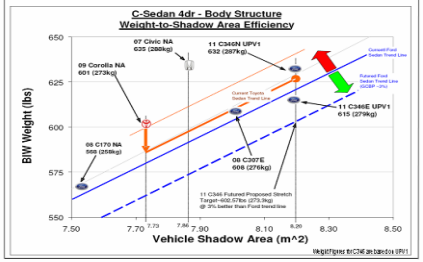
**Program:** 4 Door MY11 C346 / MY12 C346N (GPDS Scaling: 8.5-6 (Fe)3.45 (FNA))

| | |
|---|---|
| **Champion:** | James Morgan |
| **Chief Engineer:** | Steve Causey |
| **Manager:** | Thomas Mueller |
| **Supervisors:** | |
| Underbody | Georg Gleizitze |
| Body Shell | Reiner Quick |
| Framing | Guenter Behnke |
| **Core Engineering:** | Geoff Cooper |
| **FNA Engineering:** | Bruno Barthelemy, Ulrich Stuhec, Mark Keller, Ali Kanberoglu |

| Program Timing | | | |
|---|---|---|---|
| <PSC> | 08/21/07 | <MT> | 10/24/08 |
| <PTCC> | 11/12/07 | <VP> | **08/28/09** |
| <PTC> | 08/15/08 | <PCF1> | 03/01/10 |
| <PA> | 05/14/09 | <PCF2> | 08/14/10 |
| <FDJ> | 05/04/09 | <IT> | 08/14/10 |
| <SPyB> | 07/03/09 | <PP> | 09/07/10 |
| **<PEC>** | **04/22/10** | <MP1> | 11/15/10 |
| <FEC> | 05/31/10 | | |
| </I> | 4D/4Sd FNA | 11/29/10 | |
| | 5D/5SB | 12/09/10 | |
| | 4D/4NE | 03/01/11 | |
| | Alpha FNE | 03/21/11 | |
| | AP&A Cross | 05/09/11 | |
| | 4D/4SD/STP | 06/21/11 | |
| | AP&A Hatch | 07/11/11 | |
| | Alpha STP | 09/29/11 | |

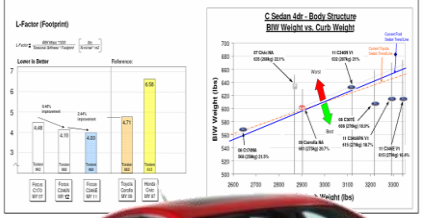
**Body Structure Weight Efficiency – Shadow Area**

The C346E Body Structure weight is 615 lbs (279 kg→ 12 lbs (5.5 kg) above the target line for 'Future Ford Efficiency'.
The C346N Body Structure weight is 17 lbs (9 kg) higher than C346E due to FNA safety upgrades on the CT platform.




**Lightweight Factor** — % Body Structure Weight of Vehicle Curb Weight

- C346 out performs competition primarily due to higher performance in Static Torsional stiffness.
- C346N Body Structure weighs 21% of max. Vehicle Curb Weight which is above the Ford Trend Line with an average of 20.5%.




Ford Confidential — Design Efficiency: Body Structure — Template version 1.0

**Design Content - Summary**

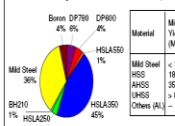
Additional parts on U502 compared with D471 is driven by architectural change of AB line moving outboard by 45mm. Increase in number of MIG welds is because of hydro-formed front rails.

| Design Content | U502 Status | D471 | B(W) to D471 | Comments |
|---|---|---|---|---|
| # of parts | 276 | 271 | (5) | • Front-End: 2 additional parts than D471 because of battery tray brackets.<br>• Underbody: 6 additional reinforcements in side sill due to A/B-line move<br>• Upperbody: 3 less parts |
| # of spot welds | 4486 | 4548 | 62 | • Front-End: 275 laser spot welds by the use of hydro-formed front rails<br>• Underbody: 107 more welded reinforcements due to A/B-line move<br>• Upperbody: 106 additional welds. Design optimization in progress |
| # of MIG welds | 193 | 24 | (169) | • Front-End: 169 additional MIG welds for hydro-formed front rails |
| Laser Welding (mm) | 1540mm | 0 | (1540mm) | • Upperbody: U502 roof laser welding estimated based on D219 (CAP) |

**Material Strategy**

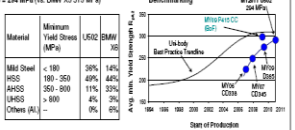
Benchmarking: U502 has closed the gap in usage of Advanced High Strength Steel with industry leaders such as BMW X5/X6.

MY11 U502: Average Min. Yield Stress = 294 MPa (vs. BMW X5 315 MPa)




| Material | Minimum Yield Stress (MPa) | U502 | BMW X5 |
|---|---|---|---|
| Mild Steel | < 180 | 36% | 14% |
| HSS | 180 - 350 | 49% | 44% |
| AHSS | 350 - 800 | 11% | 33% |
| UHSS | > 800 | 4% | 9% |
| Others (AL) | – | 0% | 6% |

Benchmarking




Benchmarking Source: Auto Steel Seminar Presentation, 04/09/2008

(II) PROCESS - Stamping: page 3, Body Assembly: page 4

Stamping - Design metrics: material utilization, PDPD compliance: # of dies, depth of draw

**Material Utilization Development (MUD)**

The U502 MUD target is greater than 60 %. Actions are being reviewed and planned for to exceed the target.

| MY11 U502 | Target | <FDJ> Status | Reference: | MY09 D471 | | MY09 D471 | MY11 U387 | MY07 U251 (BoF) |
|---|---|---|---|---|---|---|---|---|
| MUD (%) Body Structures | > 60% | 59.3 % | | 55.10% | MUD (%) Major Lt SBU Panels | 64.3% | 56.3% | 57.9% |

**PDPD Compliance** (Process Driven Product Design)

The U502 program assumptions combined with D-platform architectural restrictions do not support the PDPD requirements for Bodysides and Side Sill Inner.

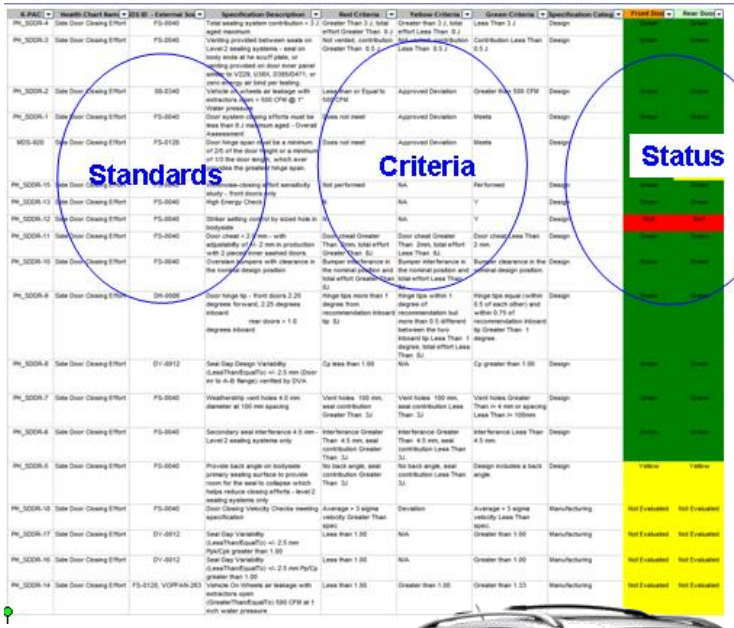
Number of Dies — Reference:

| Panel Name | | PDPD | U502 | Reason for Deviation | D472 | D471 |
|---|---|---|---|---|---|---|
| Panel Roof | | 2 | 1 | SUV liftgate requires back angle on roof. | 3 | 3 |
| Bodyside Outer | RH/LH | 4 + 4 | 3 + 3 | Depth of draw | 4 + 4 | 4 + 4 |
| Bodyside Inner | RH/LH | 3 + 3 | 3 + 3 | Meets PDPD | 3 | 3 |
| Side Sill Inner | | 4 | 4 + 4 | Depth of draw does not permit double out. | 4 + 4 | 4 + 4 |

Draw Depth

| Panel Name | | PDPD | U502 | Reason for Deviation | D472 | D471 |
|---|---|---|---|---|---|---|
| Side Sill | | < 75 mm | 140 mm | AB line move increased depth of draw | 130 mm | 130 mm |
| Bodyside Outer | RH/LH | < 150 mm | 155 mm | Development of design is in progress to meet PDPD | 154 mm | 152 mm |

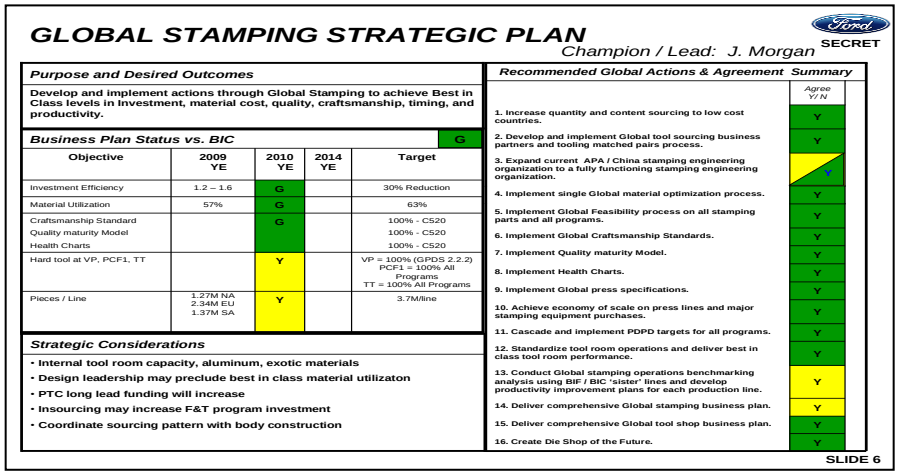
## Health Charts




**PD Development Process Early HC Assessments**

| Quality Panel Milestone Requirement |
|---|
| PS |
| PSC |
| PTCC |
| PTC |
| PA |
| FDJ |

# Align your Organization with Tools and Stretch Your Team



GLOBAL STAMPING STRATEGIC PLAN

Champion / Lead: J. Morgan

SECRET

**Purpose and Desired Outcomes**

Develop and implement actions through Global Stamping to achieve Best in Class levels in investment, material cost, quality, craftsmanship, timing, and productivity.

**Business Plan Status vs. BIC** — G

| Objective | 2009 YE | 2010 YE | 2014 YE | Target |
|---|---|---|---|---|
| Investment Efficiency | 1.2 – 1.6 | G | | 30% Reduction |
| Material Utilization | 57% | G | | 63% |
| Craftsmanship Standard<br>Quality maturity Model<br>Health Charts | | G | | 100% - C520<br>100% - C520<br>100% - C520 |
| Hard tool at VP, PCF1, TT | | Y | | VP = 100% (GPDS 2.2.2)<br>PCF1 = 100% All Programs<br>TT = 100% All Programs |
| Pieces / Line | 1.27M NA<br>2.34M EU<br>1.37M SA | Y | | 3.7M/line |

**Strategic Considerations**

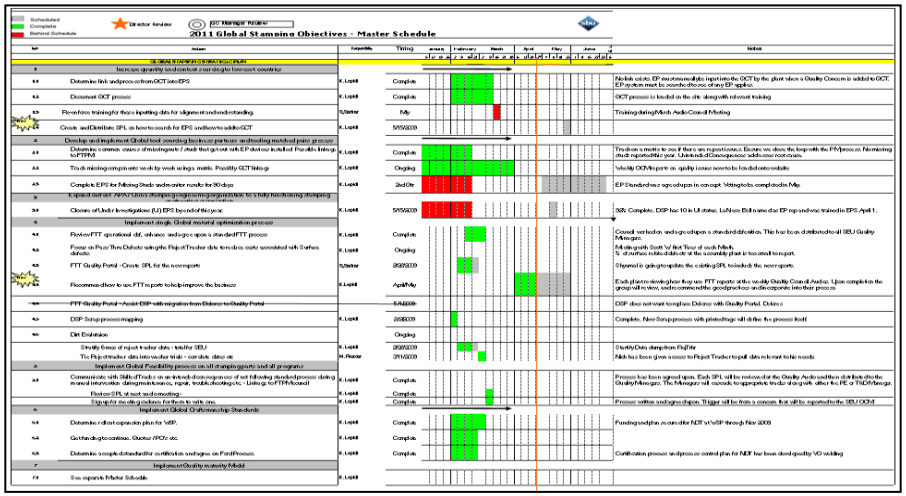
- Internal tool room capacity, aluminum, exotic materials
- Design leadership may preclude best in class material utilizaton
- PTC long lead funding will increase
- Insourcing may increase F&T program investment
- Coordinate sourcing pattern with body construction

**Recommended Global Actions & Agreement Summary**

| | Agree Y/ N |
|---|---|
| 1. Increase quantity and content sourcing to low cost countries. | Y |
| 2. Develop and implement Global tool sourcing business partners and tooling matched pairs process. | Y |
| 3. Expand current APA / China stamping engineering organization to a fully functioning stamping engineering organization. | Y |
| 4. Implement single Global material optimization process. | Y |
| 5. Implement Global Feasibility process on all stamping parts and all programs. | Y |
| 6. Implement Global Craftsmanship Standards. | Y |
| 7. Implement Quality maturity Model. | Y |
| 8. Implement Health Charts. | Y |
| 9. Implement Global press specifications. | Y |
| 10. Achieve economy of scale on press lines and major stamping equipment purchases. | Y |
| 11. Cascade and implement PDPD targets for all programs. | Y |
| 12. Standardize tool room operations and deliver best in class tool room performance. | Y |
| 13. Conduct Global stamping operations benchmarking analysis using BIF / BIC 'sister' lines and develop productivity improvement plans for each production line. | Y |
| 14. Deliver comprehensive Global stamping business plan. | Y |
| 15. Deliver comprehensive Global tool shop business plan. | Y |
| 16. Create Die Shop of the Future. | Y |

SLIDE 6

**STRATEGIC PLAN A3 DOCUMENT**

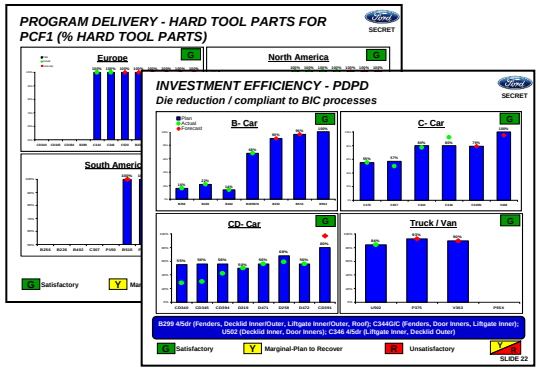


2011 Global Stamping Objectives - Master Schedule

**MASTER SCHEDULE**

A3 / Business Planning Process

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



PROGRAM DELIVERY - HARD TOOL PARTS FOR PCF1 (% HARD TOOL PARTS)

SECRET

Europe G

North America G

INVESTMENT EFFICIENCY - PDPD

Die reduction / compliant to BIC processes

SECRET

B- Car G

C- Car G

CD- Car G

Truck / Van G

B299 4/5dr (Fenders, Decklid InnerOuter, Liftgate InnerOuter, Roof); C344GIC (Fenders, Door Inners, Liftgate Inner); U502 (Decklid Inner, Door Inners); C346 4/5dr (Liftgate Inner, Decklid Outer)

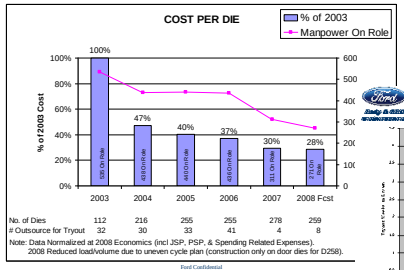
G Satisfactory Y Marginal-Plan to Recover R Unsatisfactory

SLIDE 22

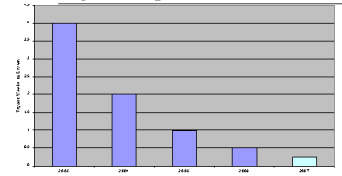
**B.P.R. METRICS**

# Obeya System

T&D Results: Cost

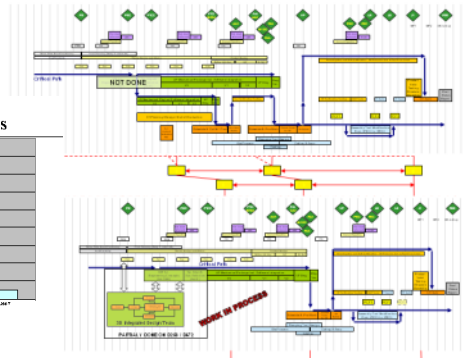



Impact of Engineered Draw Beads

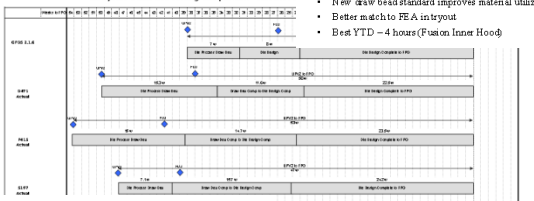


- Reduction of time and manpower - 93% reduction since 2003
- New draw bead standard improves material utilization
- Better match to FEA in tryout
- Best YTD – 4 hours (Fusion Inner Hood)

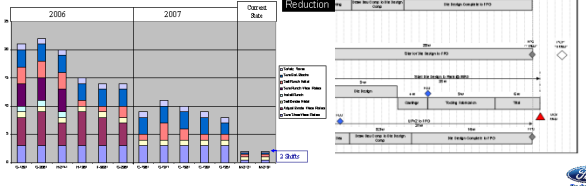
Current Program → Future Vision




Bodyside Outer Die Timing Comparison - Recent Pr

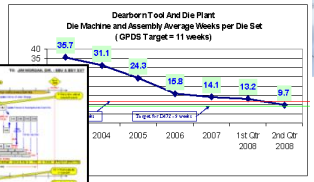


Effect of Scanning on Draw Die Press Time

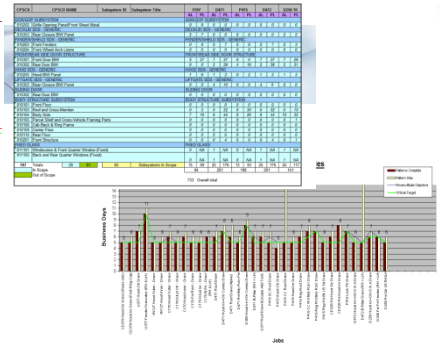




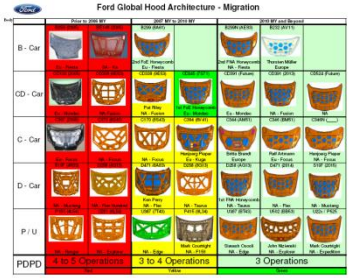

Timing

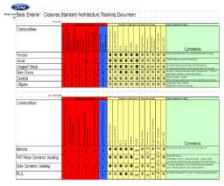


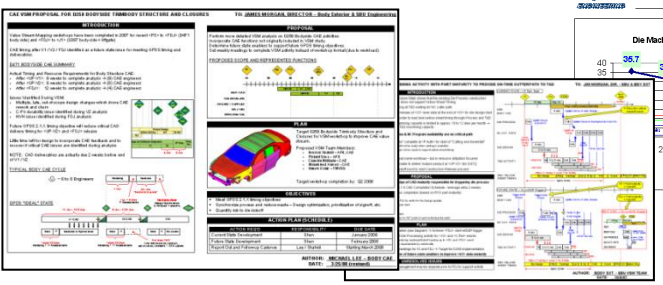

Reusable CAD files



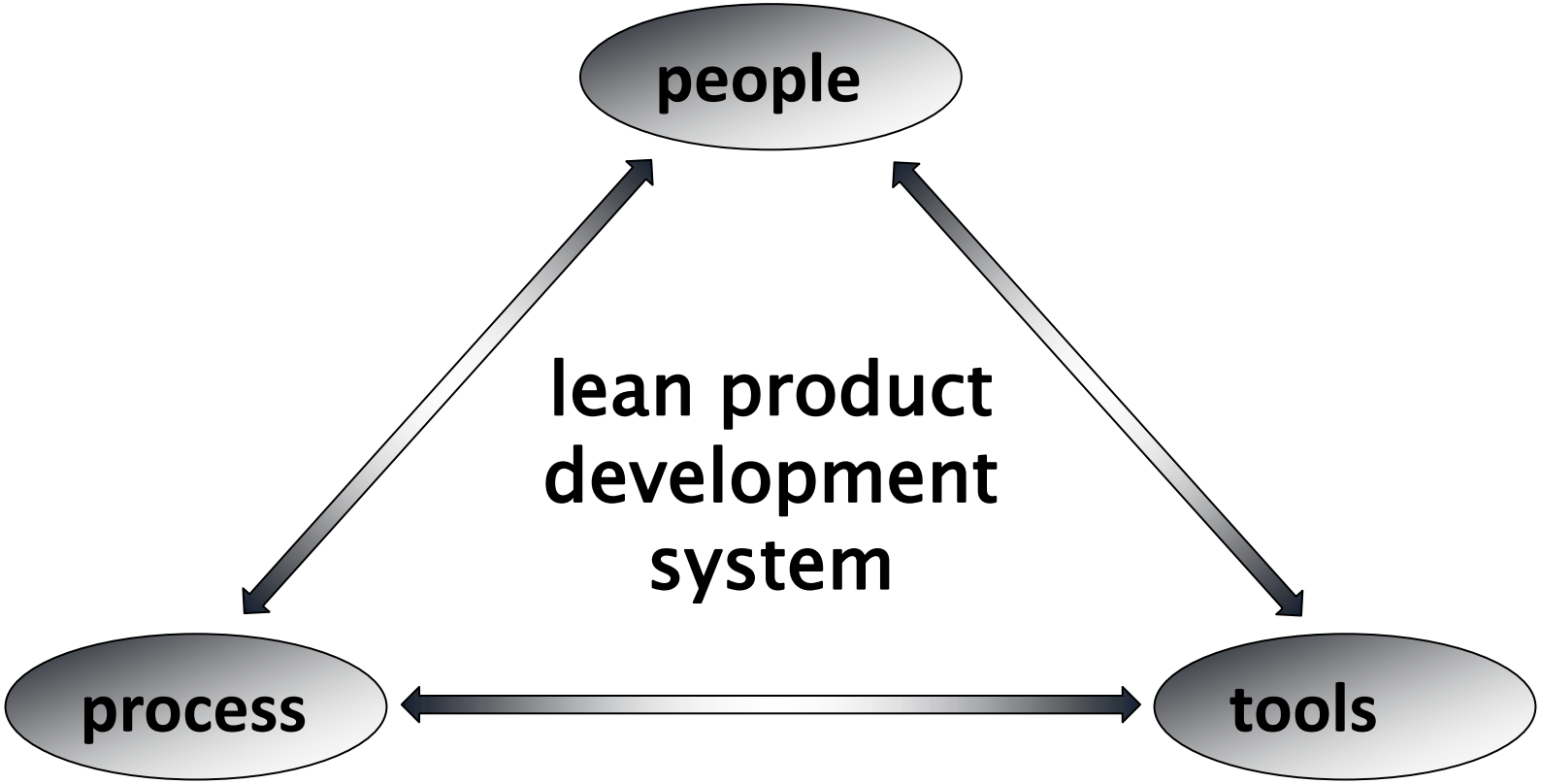
Ford Global Hood Architecture - Migration



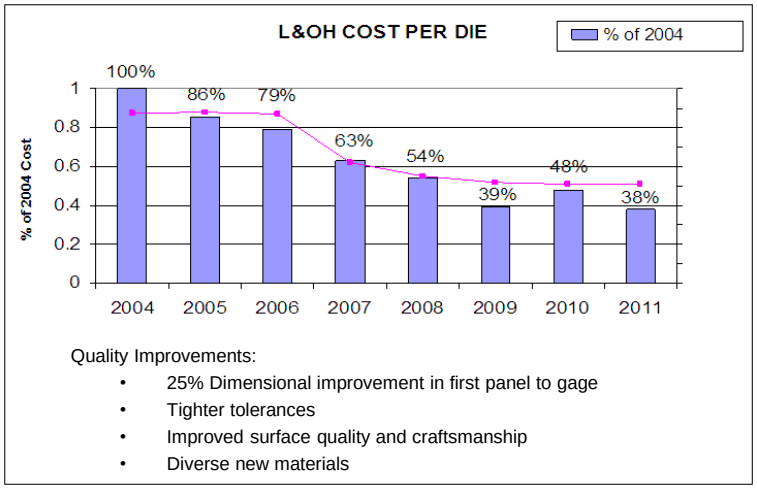


# A Systems Approach




## Results

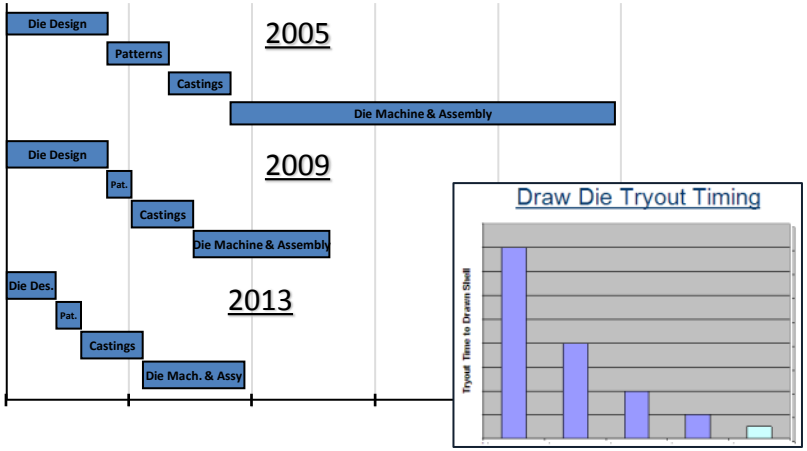
# Dearborn Tool and Die




Quality Improvements:

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

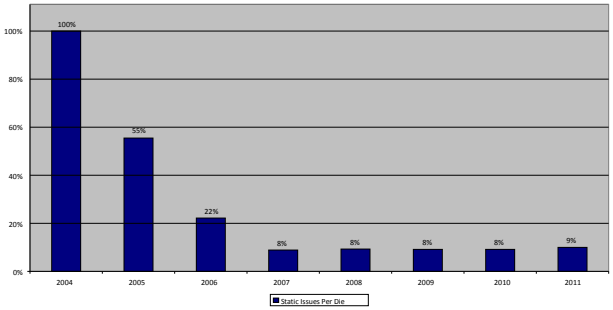
**Tool/Die Timing Improvement**



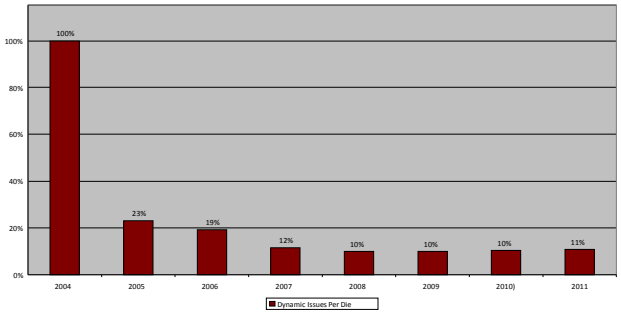

***62% Improvement Hrs Per Die***

***60% Reduction in Lead Time***

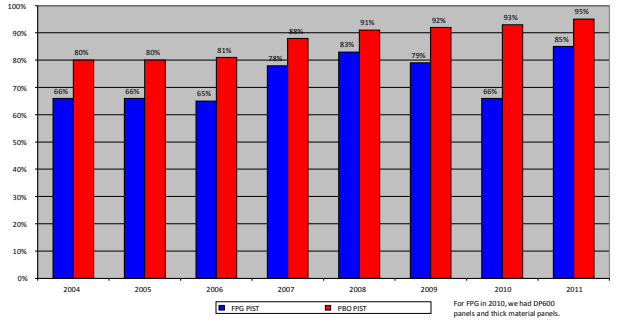
**Static Issues Per Die**




**Dynamic Issues Per Die**




**FPG & PBO PIST%**



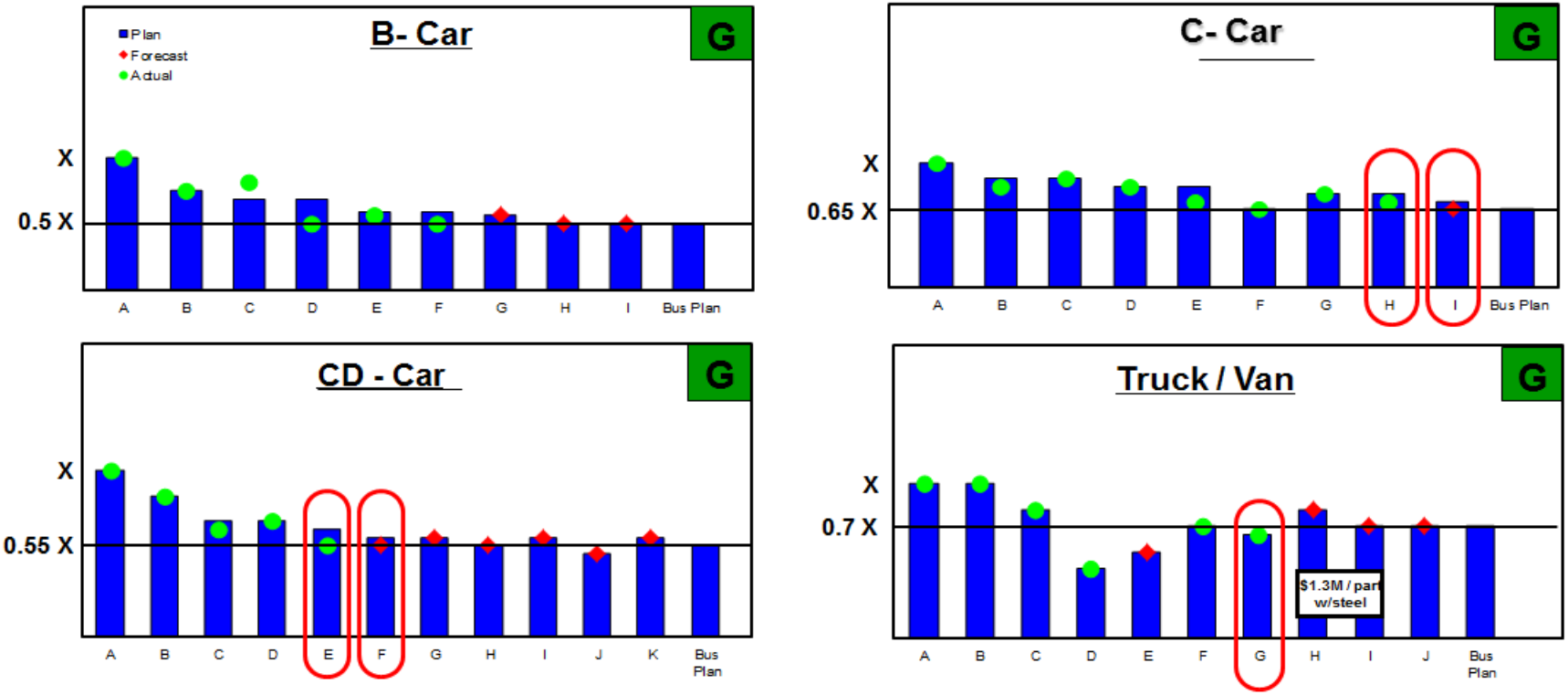

***90% Reduction – Static Issues***

***89% Reduction – Dynamic Issues***

***19pt FPG PIST % Improvement***

# Exceeded investment targets

***INVESTMENT EFFICIENCY -- TOOL INVESTMENT***




## 55% Reduction

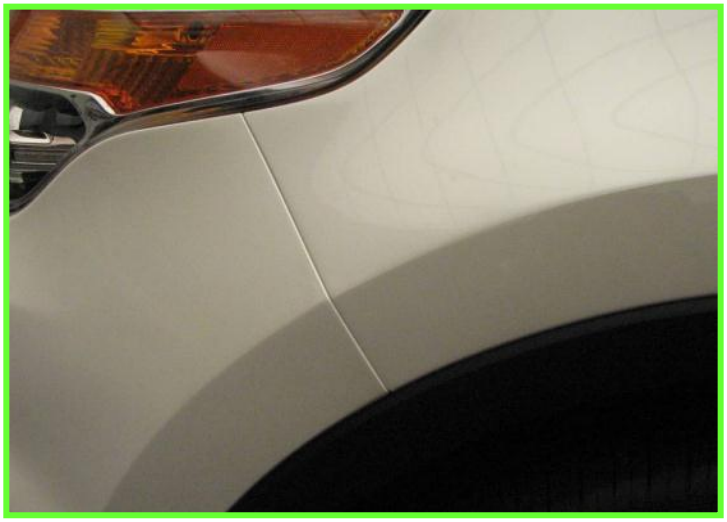
# PRODUCT EXCELLENCE

# Precision & Design Fidelity

EXPLORER

# Precision & Design Fidelity

2006 - 2010 Explorer



2011 Explorer

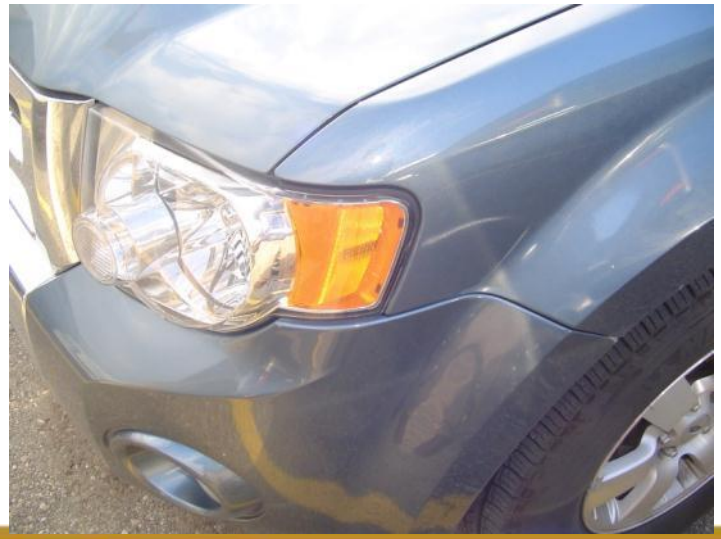
# Precision & Design Fidelity

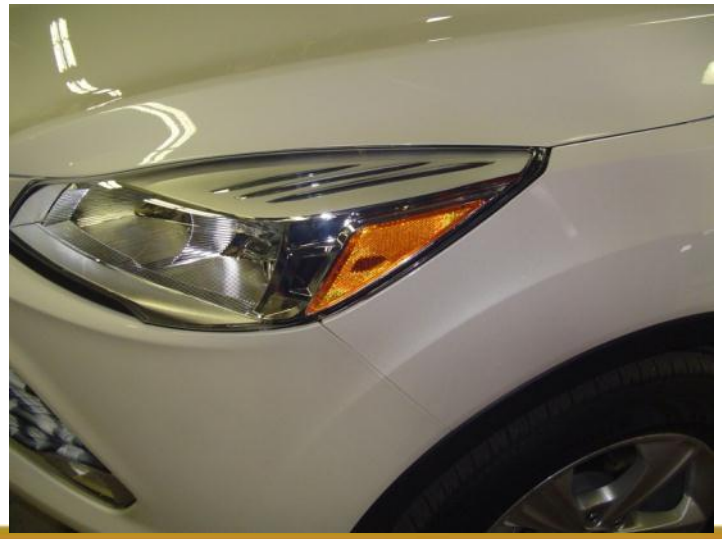
ESCAPE

# Precision & Design Fidelity

Current Escape

2012 Escape





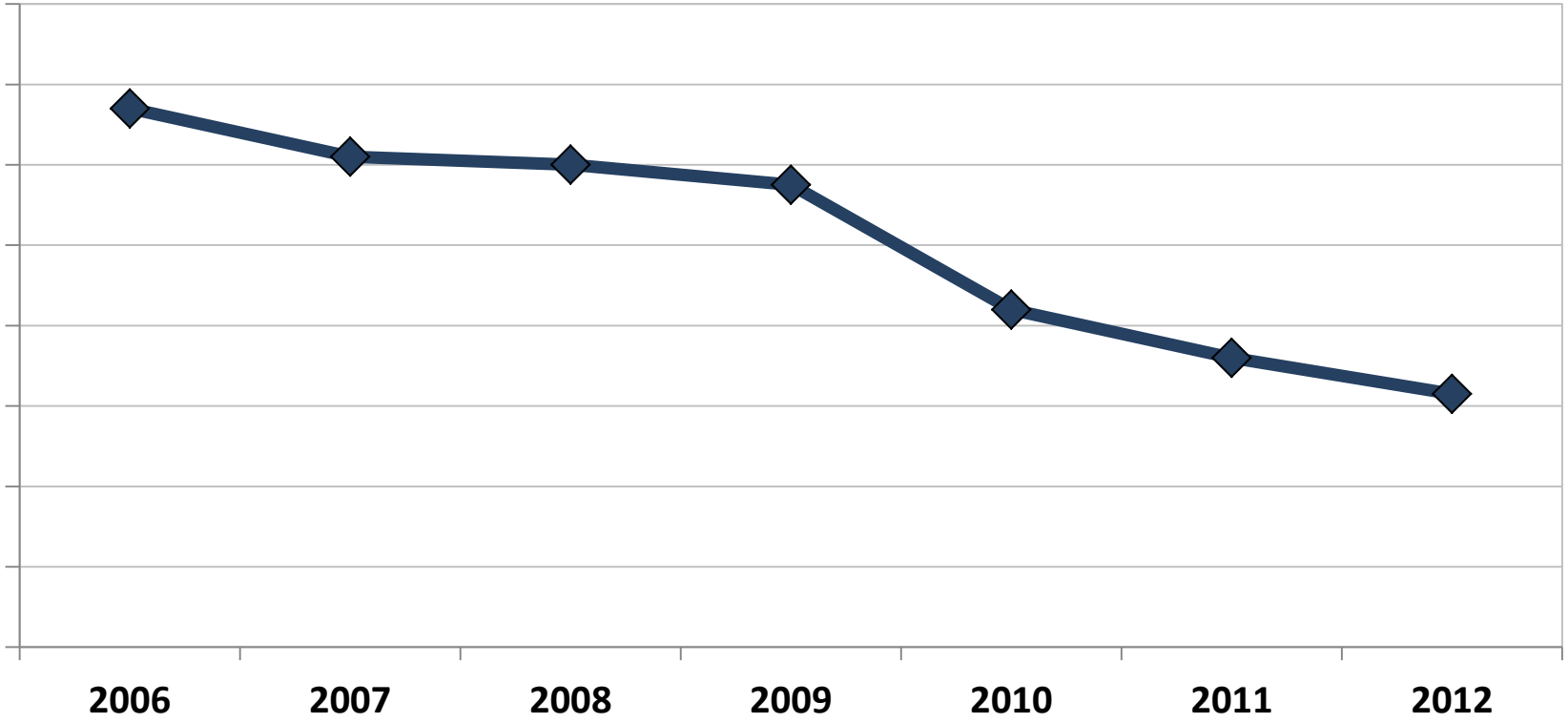
# Precision & Design Fidelity

Current Escape

2012 Escape

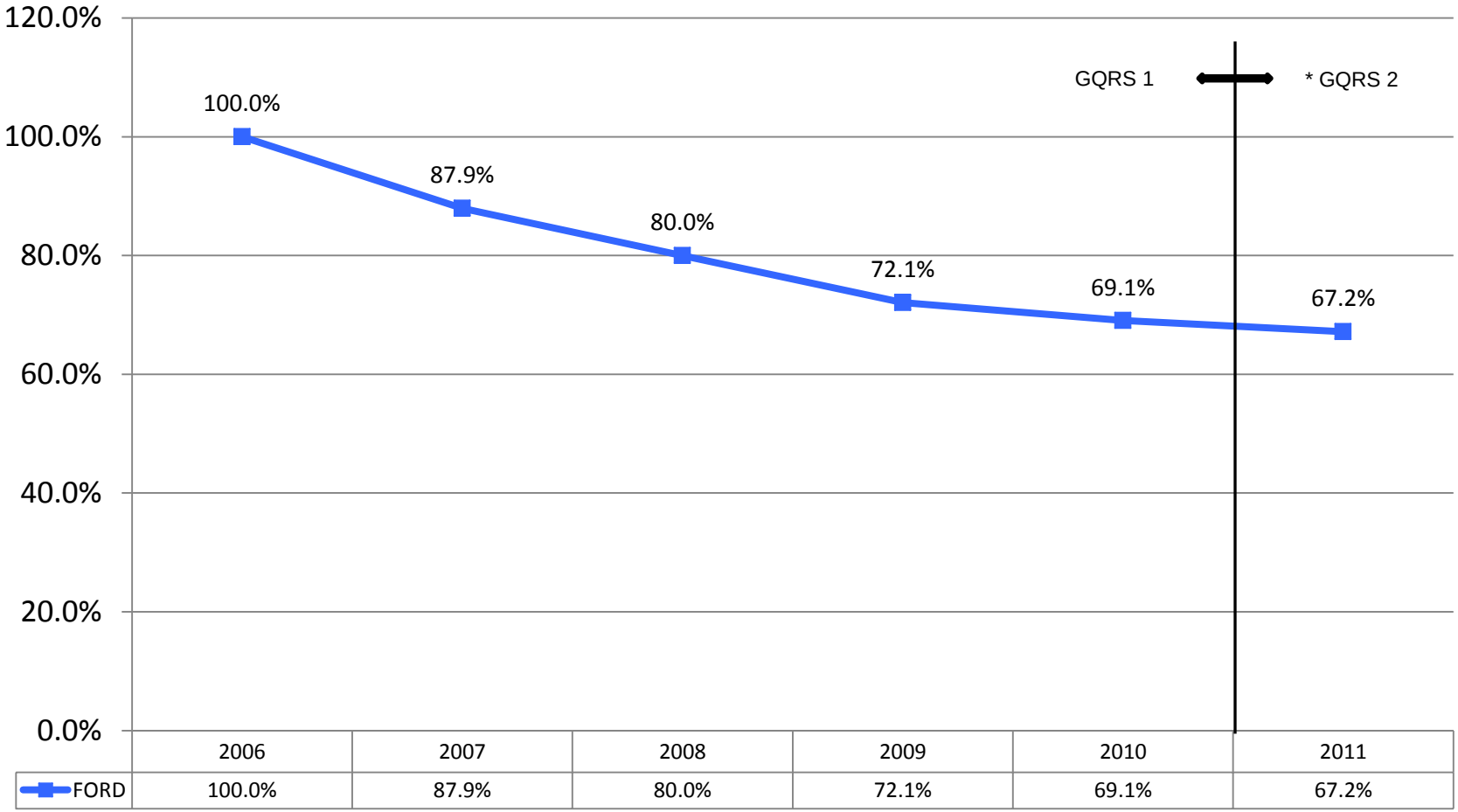
# Repairs

## R/1000 Trend By Function




**Reduced 53%**

# TGW




| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|
| FORD | 100.0% | 87.9% | 80.0% | 72.1% | 69.1% | 67.2% |

## 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)

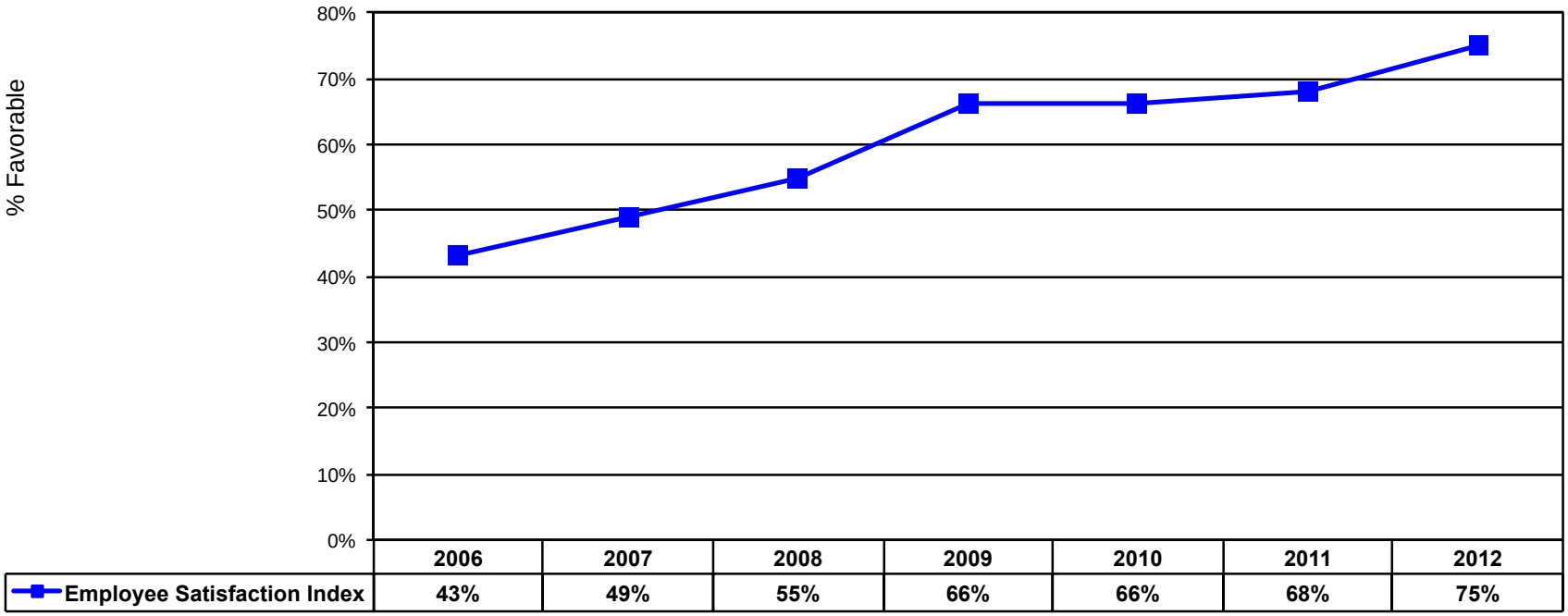
"Under no uncertain terms, we would not have walked away with a lesser vehicle."
- Head on Crash (no injuries)

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*

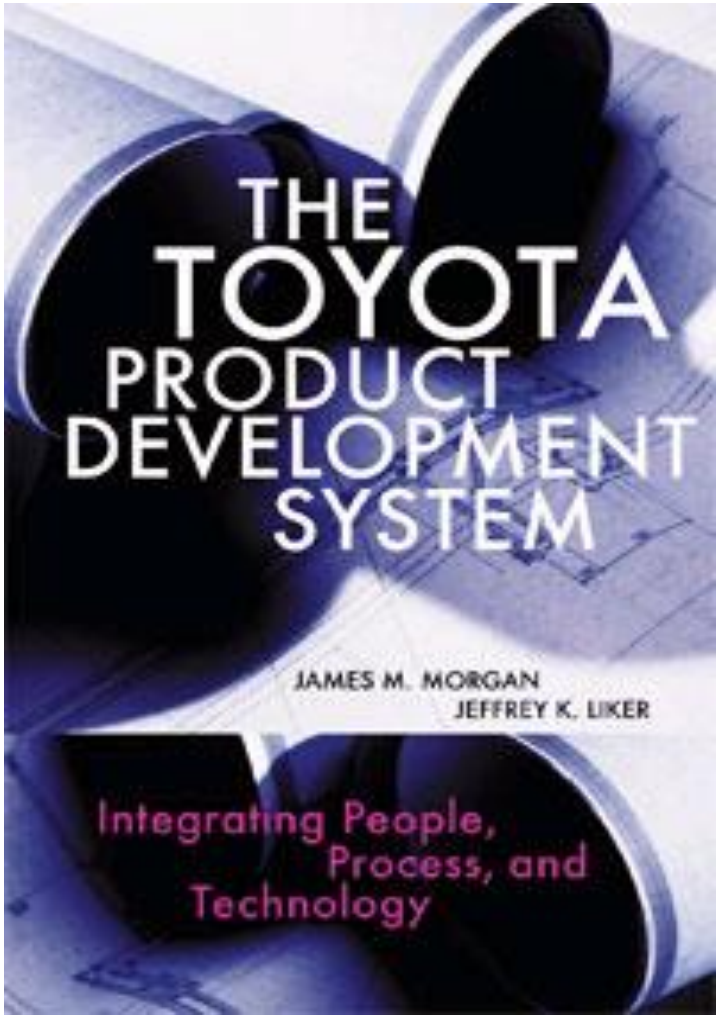
## Employee Satisfaction Index

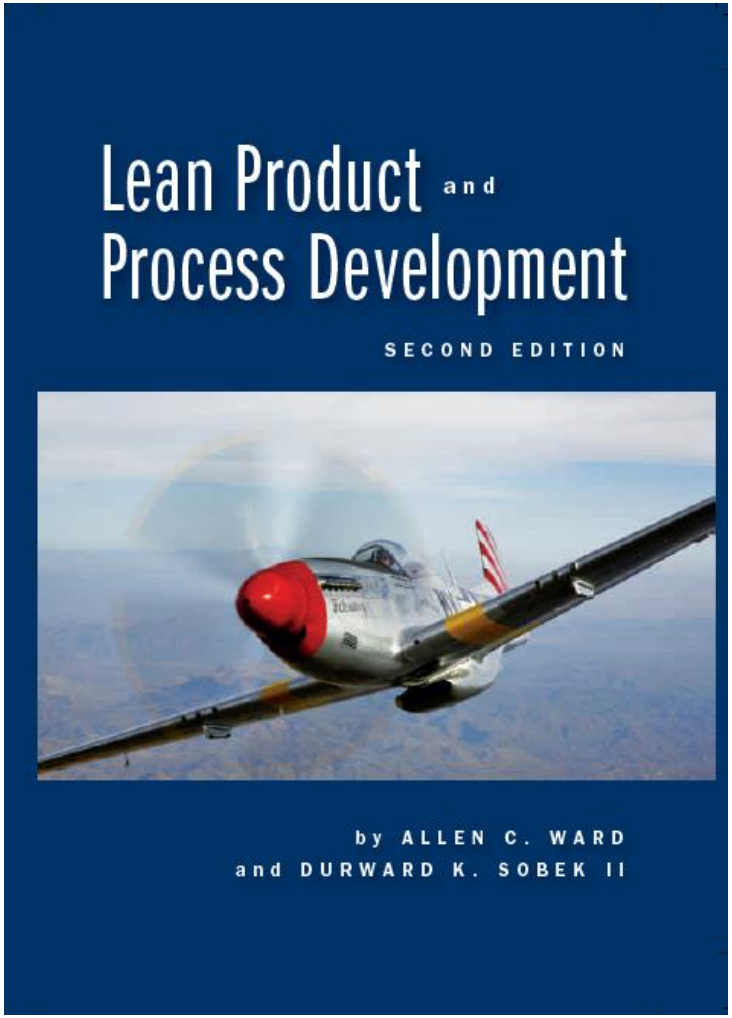



| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| Employee Satisfaction Index | 43% | 49% | 55% | 66% | 66% | 68% | 75% |

**32 Point Improvement**

# To Learn More…..



# THANK YOU!