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Tearing Down the Barriers:

How Honda Is Using LEAN Principles to Prepare for The Future

Designing the Future Summit 2019

lppd Lean Product & Process Development

Intro → 33 years Industry experience

‘86 OSU Grad

BS Aero Engineering

- Honda America Manufacturing → New Model, Purchasing, Quality
- Honda R&D America’s → Auto, power sports, power equipment dev’t
- Honda North America → New Model, Profit & Cost Strategy
- R&D America’s Development:
  - → Frame & PT engineering, IT & operations
  - → Body engineering, design, test & research
    - Team LPL → ’07 Acura MDX
    - Team LPL → ‘03 Honda Pilot
    - Team LPL → ‘01 Acura MDX
      - Team PL → ‘97 1.6 Acura EL
      - Team PL → ‘95 Honda Accord V6 (in Japan)

- McDonnell Douglas → Aircraft Structural Design
- US Army → 12B Combat Engineer

Global
Honda

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Global Honda Celebrates 70 Years!












Focus on what we need to do in the next 30 years to achieve 100 years!

Global sales

FY19 results: → *15,888.6¥ revenue/762.3¥Profit

20,238,000 Motorcycles
5,323,000 Automobiles
6,301,000 Power products
31,862,000

*(Billion Yen)

North America business

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60 YEARS

of business
in America

40 YEARS

of manufacturing in
North America

North America Manufacturing history

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1982 (2 models 1 line)

Today (15 models 11 lines)

THEN

NOW

Manufacturing in North America

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Ohio
Honda of America Mfg., Inc.
- Marysville Auto Plant
- East Liberty Auto Plant
- Anna Engine Plant
- Performance Manufacturing Center

Honda Transmission Mfg. of America, Inc.

Indiana
Honda Manufacturing of Indiana, LLC

Alabama
Honda Manufacturing of Alabama, LLC

Georgia
Honda Precision Parts of Georgia, LLC

North Carolina
Honda Power Equipment Mfg., Inc.
Honda Aircraft Company, LLC
Honda Aero, Inc.

South Carolina
Honda of South Carolina Mfg., Inc.

Canada
Honda of Canada Mfg.
- Plant 1
- Plant 2
- Engine Plant

Mexico
Honda de Mexico S.A. de C.V
- Guadalajara Motorcycle/Parts Plant
- Guadalajara Auto Plant
- Celaya Auto Plant
- Celaya Transmission Plant

22 Factories across North America

R&D global organization

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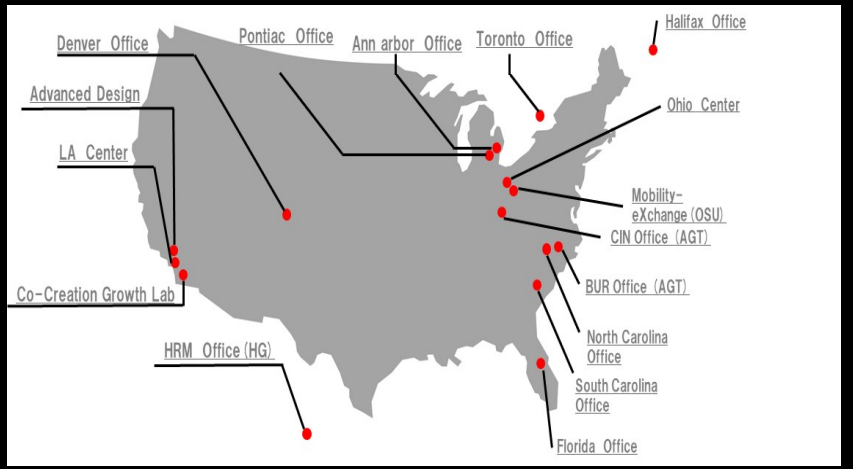
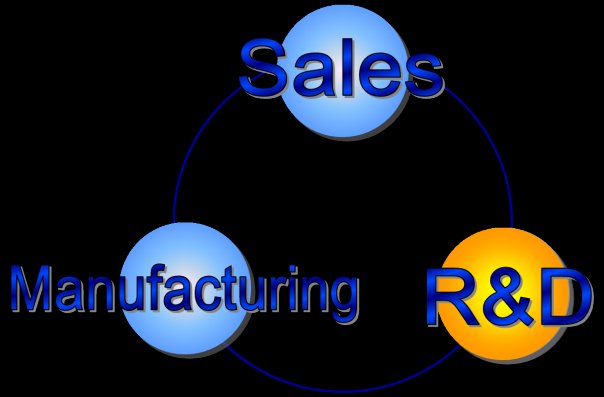
6 regions Globally: →

19 offices in North America

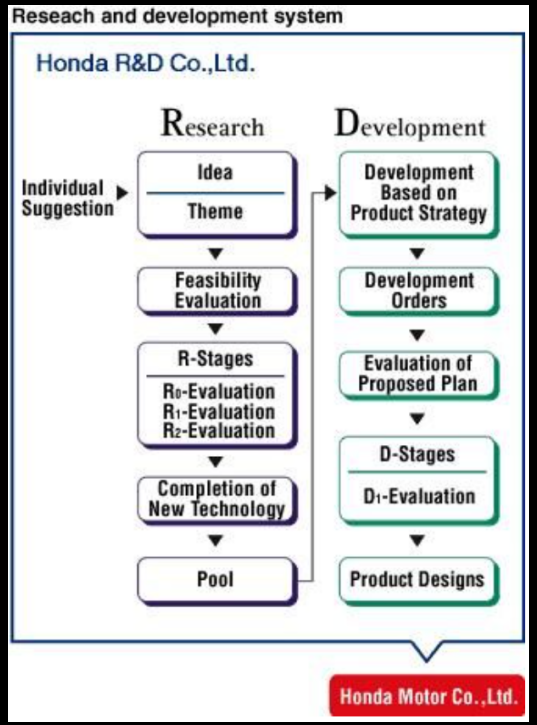


Honda organization

Separate companies:



R&D proposes direction & technology:



Management Policies:

- Proceed always with ambition and youthfulness.
- Respect sound theory, develop fresh ideas and make the most effective use of time.
- Enjoy your work, encourage open communications.
- Strive constantly for harmonious flow of work.
- Be ever mindful of the value of research and endeavor.
- Respect for the individual (Initiative, equality, trust)
- Open no wall environment with common white uniform

"LEAN"

Rigorous gated development system:

LEAN Journey

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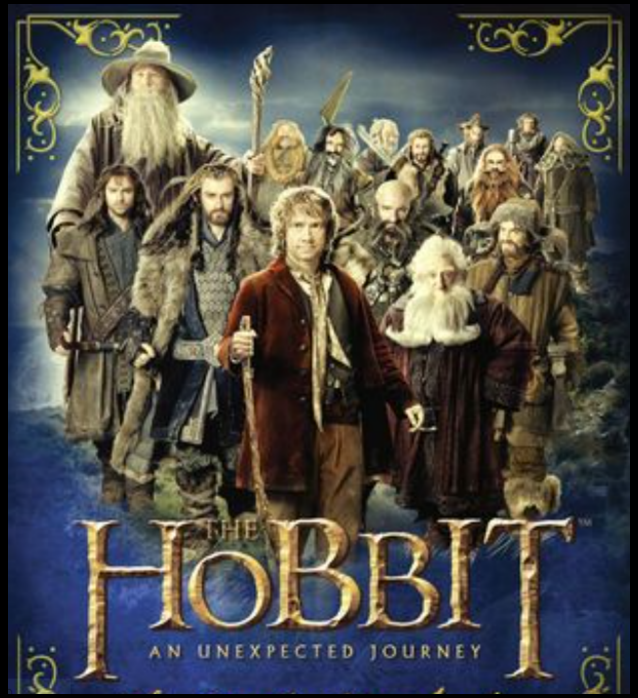
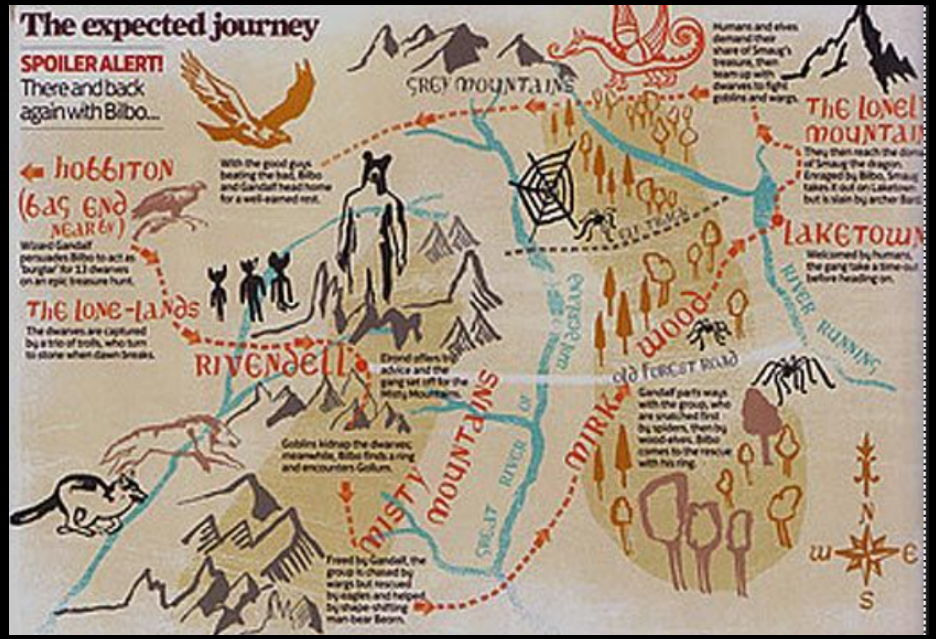


AN UNEXPECTED JOURNEY

A long and winding path to get GOLD



Help from Elves & Eagles & Men…
Pass thru dangerous woods…
Battle a Dragon…

All started with a knock on the door

Part 1: CRISES + new CEO

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Lehman Shock

Earthquake

"We must break out of our shell and we must make a new Honda for a new era"

- Ito-san

- Since HRA is small and agile, investigate prototype-less development to improve quality and reduce cost → and reflect back to global R&D

Introduce No Prototype development (NPD)

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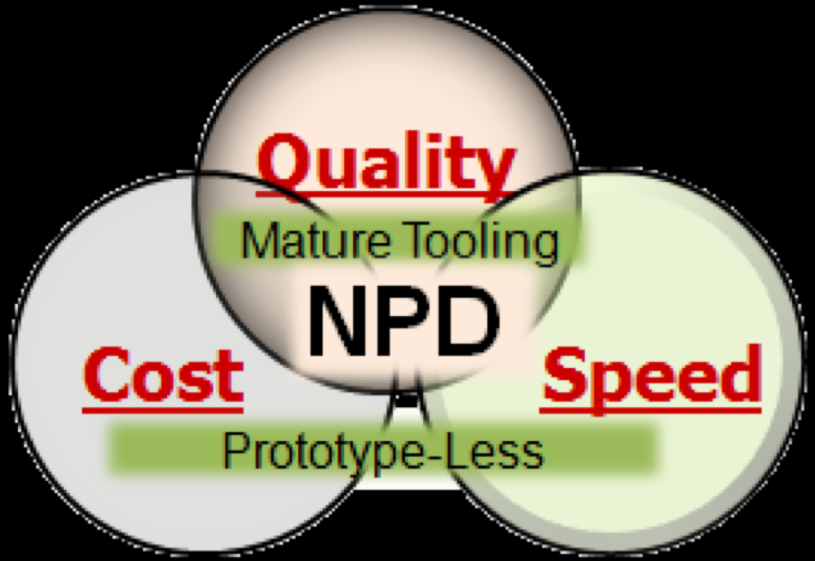
Change Mindset

PHYSICAL PROTOTYPE CONFIRMATION →

Set Goals



DIGITAL CONFIRMATION

Innovate product dev't flow for business

NPD concept

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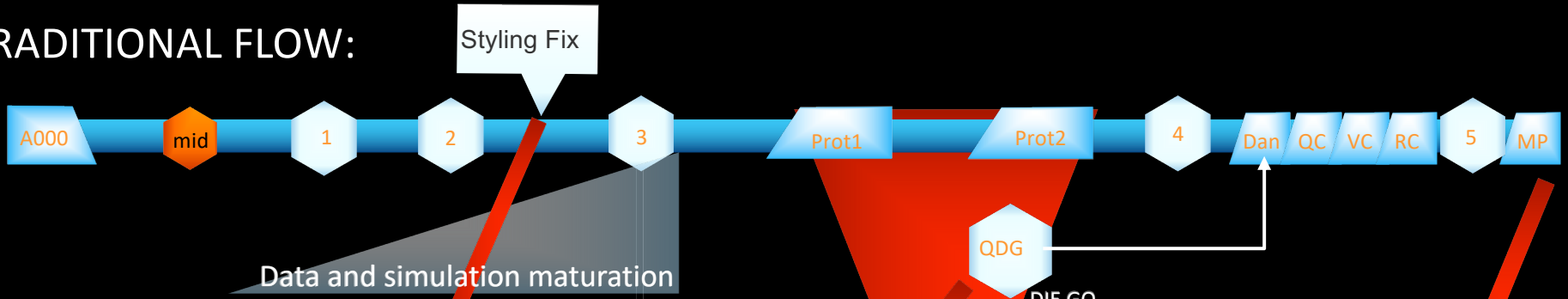
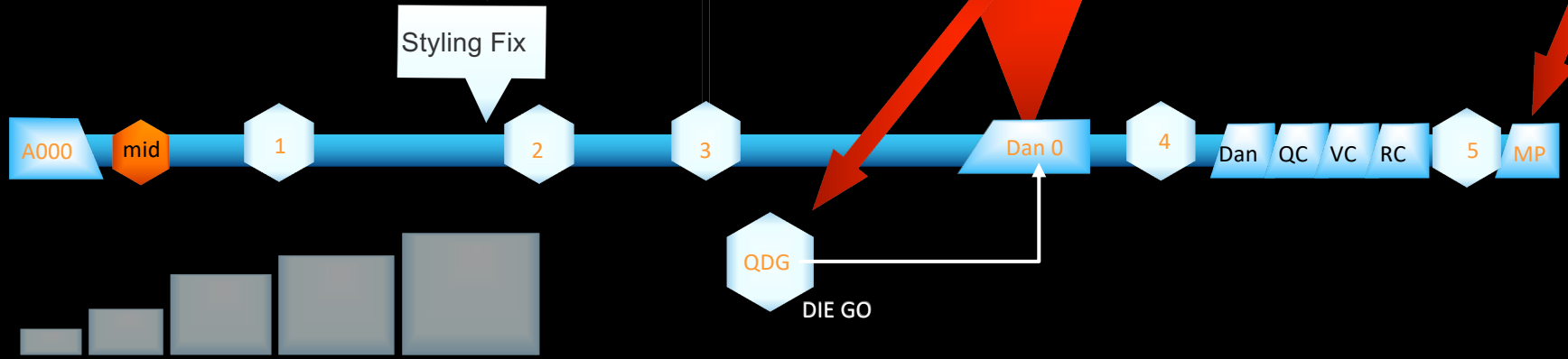
TRADITIONAL FLOW:



INNOVATIVE FLOW:



NPD concept

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Opportunities:

- Early review and input to styling for manufacturing feasibility
- Additional progress check of Q&D maturation
- Increased process maturation
- Joint testing and quality verification activity

Challenges:

- Front-loading activity
- Digital confirmation skills
- Infrastructure for collaboration
- Early process development and factory event

Restructure seating and organization

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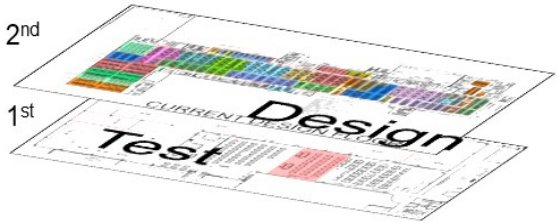
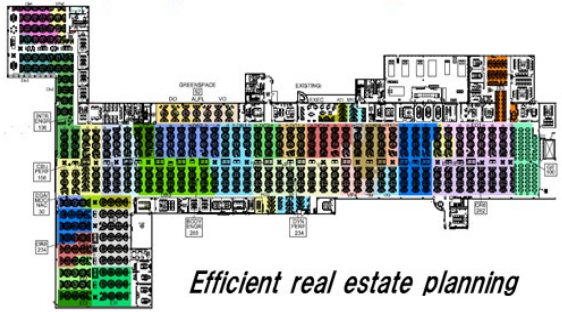
1) Re-locate and re-organize so location and management are same

Old: Test & design management separated → New: Test/Design combined management

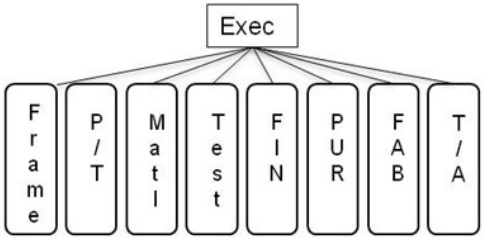




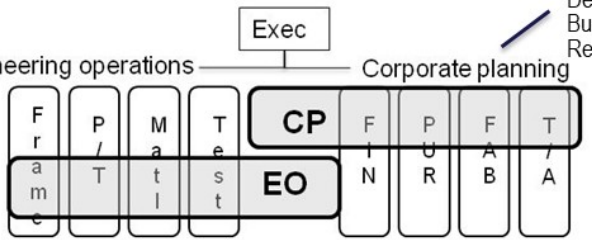
Efficient real estate planning

2) Created cross functional departments

Old: Groups independent operations → New: Standardized metrics and practices



EO Examples:
WBOM - attributes
CAE standards
Data (ASAM)
MBD
1D simulation



CP examples:
Resource Mgmt
Dev't Flow
Business Flow/Rpt
Resource scenario

Path to Digitalization

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Define areas

	Objective	A00-1/P0 Target	A00-1/P0 Actual
DPM Management	Improve Content & Accuracy		
CAE Simulation	Improve Accuracy		
Maintenance/ Service	Improve Capability		
DE Feasibility	Front Loading		
Virtual Conf Build	Improve Capability		
Dan-O	Front Loading, Improve Capability /Accuracy		
M/L FIX	Front Loading		
TE Flow	Front Loading		
Feature FIX	Front Loading		

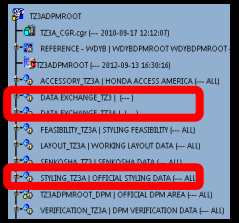
KPI

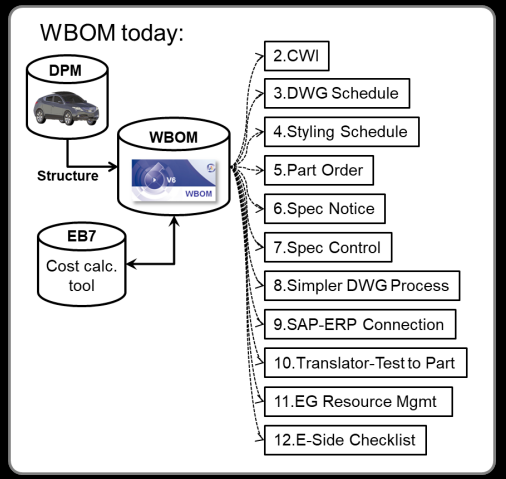
Activities

Reorganize	create dedicated CP group
	Standardize metrics
	Standardize practices
Data control	data storage & HW
	Rules for data control
	Data content
	Clear req'ts for SEDB
	Supplier access & data
DPM Structure	BOM Tree
	Zone arrangement
	Attributes:
	Part number
	Part name
	mesh
	material
	thickness
	connections
	position
	Variation builds
Data Share	Styling
	CAE
	Factory - VCB
	Sales - service
	Sales - ad/brochure
	Supplier access & data
	Purchasing -quote
WBOM	single version of truth
	Lifecycle control data
	styling schedule
	part schedule
	Drawing schedule
	test schedule
	Parts data (PD) list
	access/input:
	Engineer,
	Styling
	Purchasing
	Test/CAE
	Factory
	Supplier
Styling	Feasibility maturation:
	Dataset definition
	Feas checklist/order
	FCE ~ Feas completion event
	Feas Schedule
	Styling confirmation:
	Full scale CG
	Power wall
	rendering
	DQE~design quality eval

Templates	Start part for CATIA
	Auto transfer CAE meshing
	Single entry for info
	connect to 3DA
	CAE data created from styling
	Optimized component design
VPV	Virtual performance verification
	CAE
	DPM
	Mock-up
	Bench
	system/part risk assessment
	high risk --> prototype
	low risk --> no Prototype
	BIW auto mesh & assy
	Assy parts mesh & connect
Factory	Factory data req'ts in DPM
	-tools/Jigs/fixtures~3D
	Delmia simulation prep/train
	VCB- method/process: CRF
	Checklist centralization
	verify w/experts in sequence
Sales	Maintenance data req'ts
	Maint sequence/process
	Maintenance checklist
Relocate	Concern tracking
	Sit Test/design together
	Create team zone
	Centralize executives
Educate	Upward - train executives
	Sideways - train mangement
	Downwards - train associates

Visualization:





1) Styling → Move from Clay to CG
2) DPM/PLM → one source for data/BOM/resources
3) Virtual verification of engineering performance (simulation)
4) Virtual verification of Manufacturing/services/packaging/LOG
5) Advance confirmation of actual MP parts/processes
6) Advertising/Brochure/website virtual reality

Centralize data

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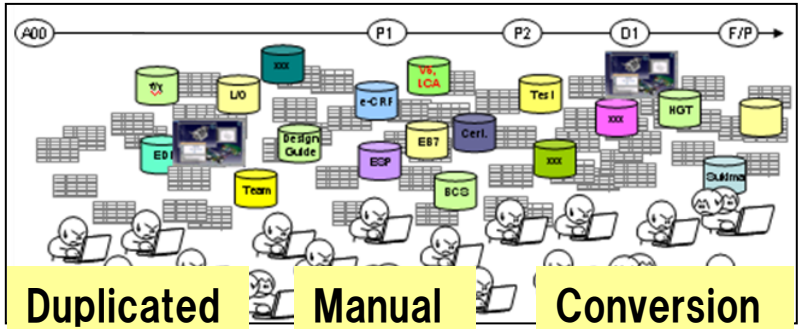
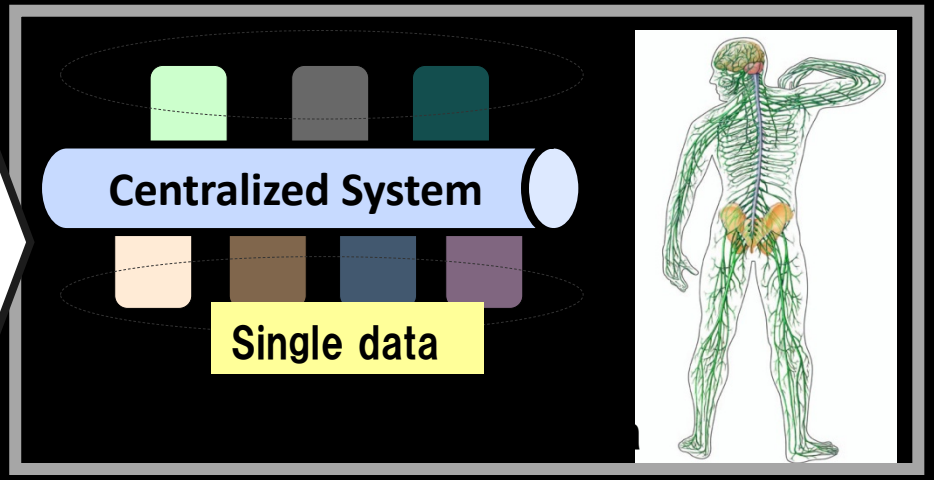
Past

Product developing scene



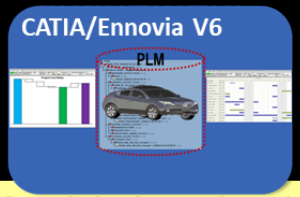
Individual Silo data

Present



●Engineering/Styling Data

Improve Accuracy/Speed / Efficiency in Development

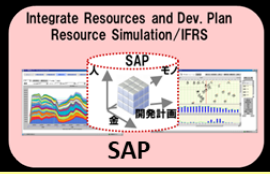


Avoid duplicated work

●Test Data

Efficiency up for Reuse

●Resource Data



Avoid manual operation

Visualizing

Organize data

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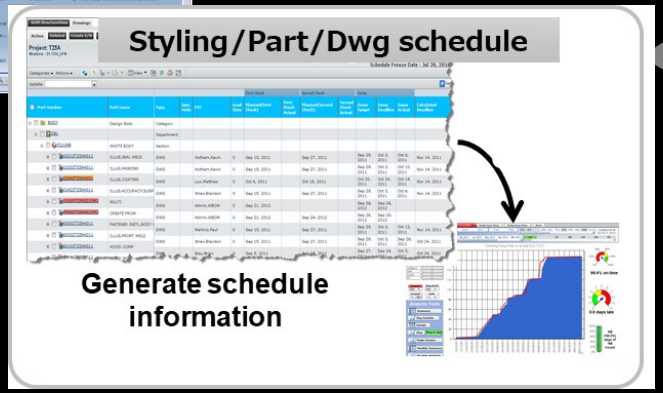
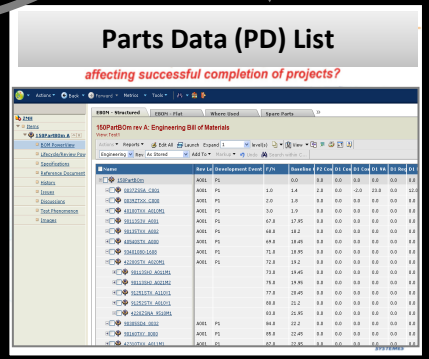
Create Structured Tree (Styling/Layout/Data/Dwg)

- E-BOM
- Application
- Attributes

Starting point for data mgmt

Synchronize Structure





Generate PD List

Report using QlikView

Virtual performance confirmation

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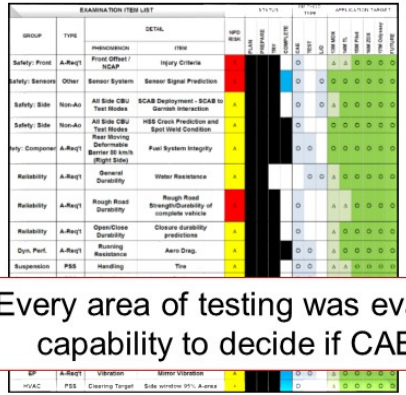
CAE maturation/application:



Every area of testing was evaluated for CAE capability to decide if CAE was mature

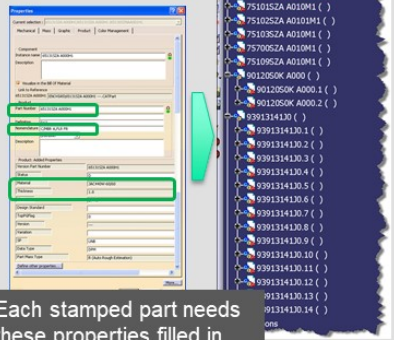
HRA Risk Assessment		Capability		
		High	Med	Low
Impact	High	B	A	S
	Med	C	B	A
	Low	C	C	B

Planned prototype (high risk)

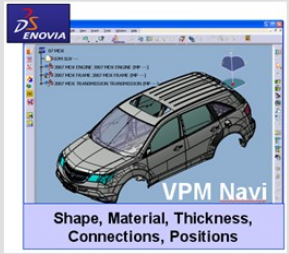
No prototype (low risk)

How to reduce time/effort?

DPM



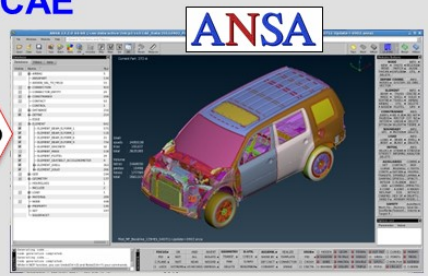
Each stamped part needs these properties filled in



- 1 part per part
- Final surf and thickness dir.
- HBF used (welding)
- No interference

Auto

CAE



- Part number
- Part name
- Mesh
- Material
- Thickness
- Connections
- Position

Process was automated for mature CAE practices by including key part info in DPM

Factory/Service virtual verification:

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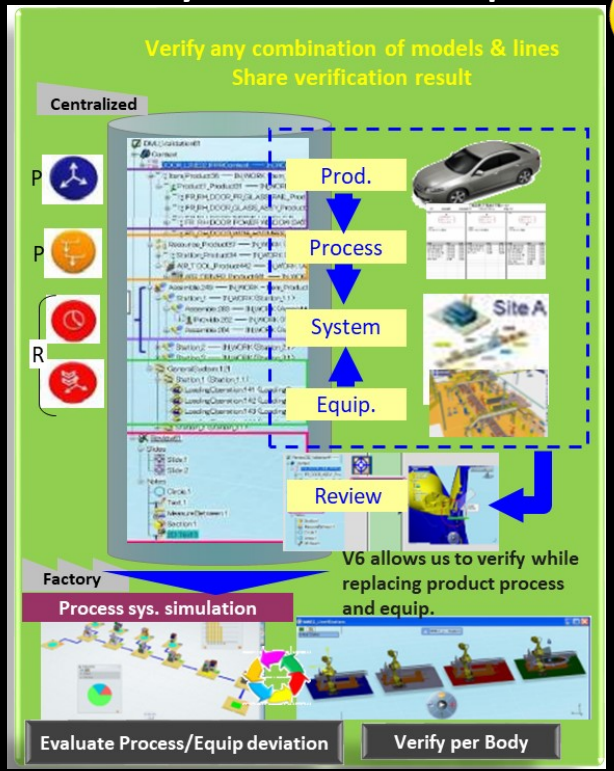
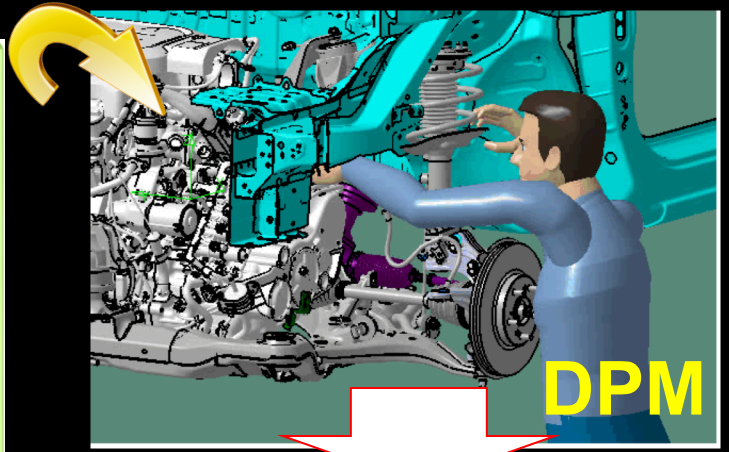
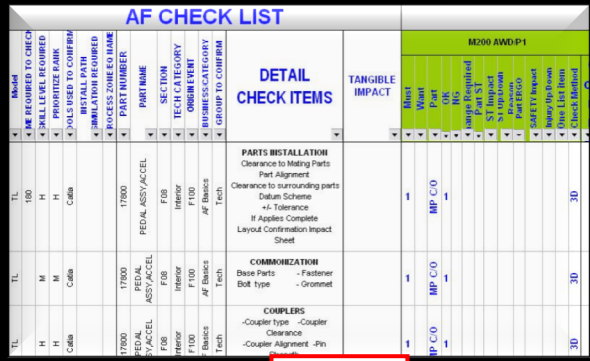
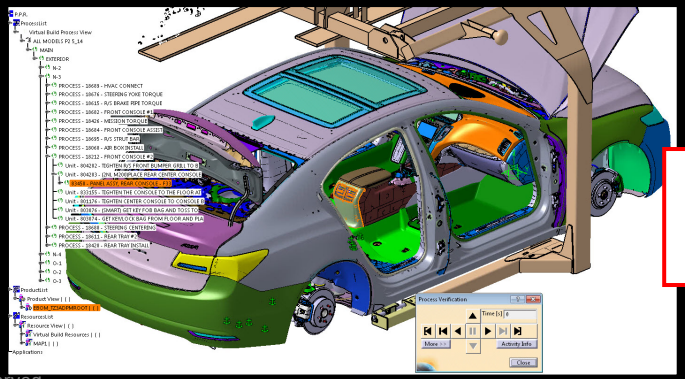
Factory/service data req'ts

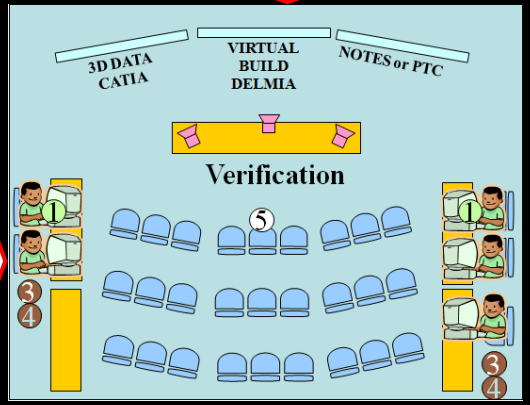




verification items







Measure the benefit

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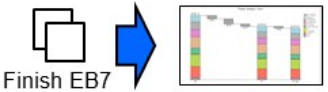
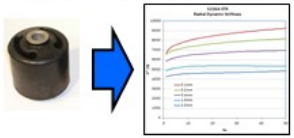
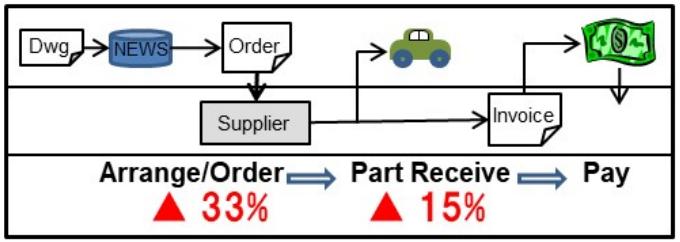
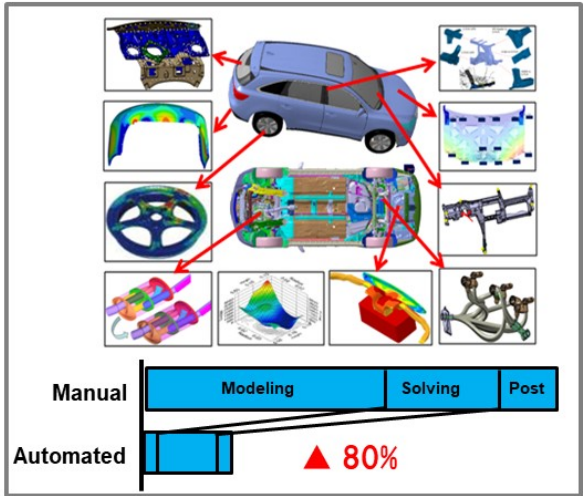
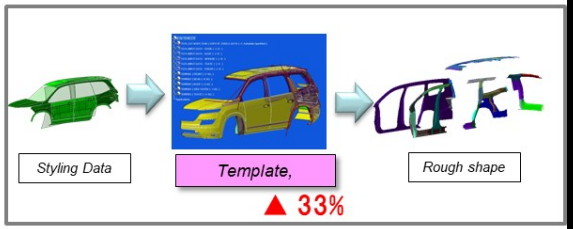
	Application result
Design/Styling Data 	Product Cost management  (▲ 89%) DWG Release  (▲ 25%)
Test Data 	Brake analysis  5 day ->6 min Bush analysis  4 hr ->12 min
Resource Data 	

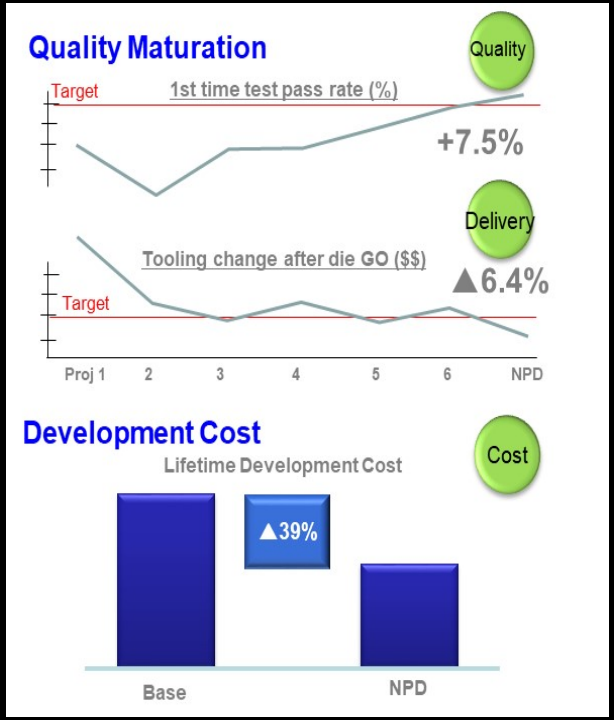
● Automated CAE operations



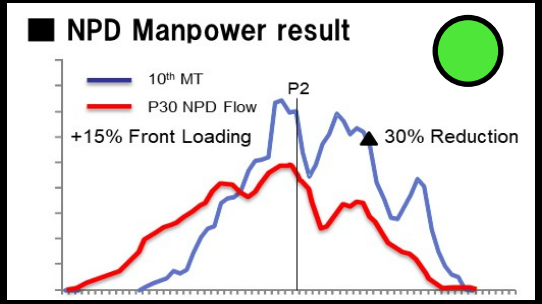
● Automated CAD operations (template)



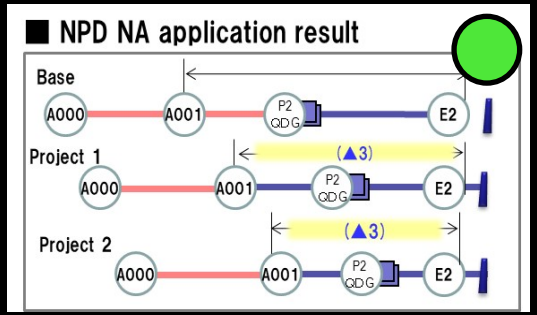
NPD application result



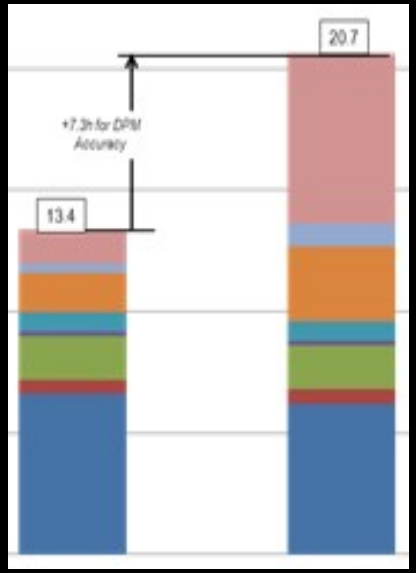
Quality improved
Development cost reduced



15% reduction Overall



6 month schedule reduction



X

+54% Time required to engineer the DPM

Part I: NPD – Results and Lessons learned

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I. DPM improvements were critical to success.
   A. Able to verify without spending money on tooling.
   B. Able to be checked by factory/supplier.
   C. Use of CAE+alpha to virtually validate/optimize systems.

II. NPD – Lean Application
   I. Product quality maturation was stable.
   II. Development cost reduction achieved–
   III. Development resource – NPD adoption was slow & resulted in higher than planned manpower usage, investment in systems, headcount and on time delivery was not understood.

III. Starting point did not engage genba associates for implementation.

IV. Activity driven by TEAM…not management… not connected to BP

V. impact to other areas not measured… communication, visualization improvements needed for REAL TIME problem resolutions

NPD: set foundation to build LEAN processes

Part II: New Crisis ……Uncertainty

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Disruptive Trends

TECHNOLOGY

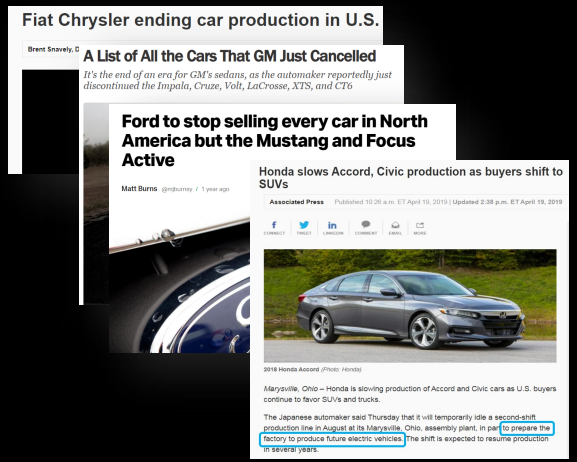
NEW COMPETITION

CUSTOMER

TALENT

SAFETY & ENVIRONMENT

SPEED OF CHANGE



End of Sedan… move to Electric

Quality issues..

Competition…

Tarriff / CAFÉ….

CRISES + New CEO direction…

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GOAL:

2030 VISION

2/3 of Honda fleet electrified by 2030

Method:

Be Competitive by Further Enhancing the Strengths of Honda

- Offer New Value through our Passion
- Streamline business to maximize resources for future Technologies
- Strengthening Inter-Regional and Inter-business Collaboration thru SEDB collaboration

CRISES + New CEO direction…

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GOAL:

2030 VISION

2/3 of Honda fleet electrified by 2030

Method:

Be Competitive by Further Enhancing the Strengths of Honda

- Offer New Value through our Passion
- Streamline business to maximize resources for future Technologies
- Strengthening Inter-Regional and Inter-business Collaboration thru SEDB collaboration

New CEO direction…Technology & business

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Inclusive planning &
Development efficiency

2050 outlook

Triple ZERO

CASE-IT domain

New business

New business

Connected

Realization of carbon-free society

Transformation and strengthening of existing business

Electrification

Realization of collision-free society

Existing business =
The art of making things

Revival of Honda identity

We make it Simple — Design, HMI, Dynamics

Inclusive planning

Powertrain

Development Efficiency

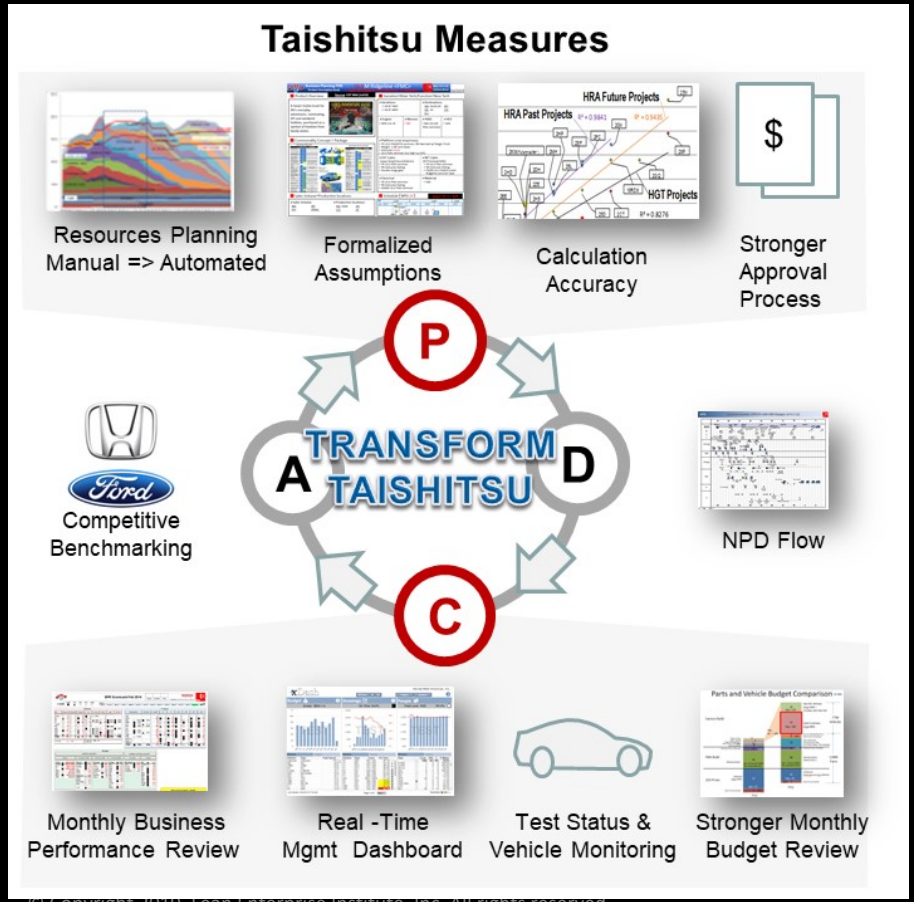
Automated drive

strengthening of existing business

NOW

2030

HRA direct measures…



体質 Taishitsu

Constitution, → A healthy ***taishitsu*** is one in which the organization functions the way should, doesn't easily get out of control and is not prone to disorder

Taishitsu is how we operate without an external force.

Operational
Characteristics
Innovation

} (Lean)

Research LEAN measures for R&D…

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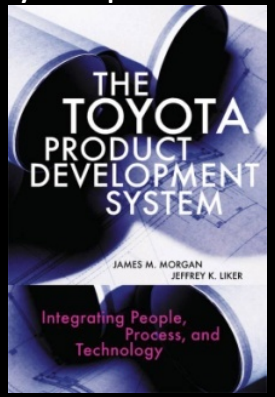
Eyes opened:



James Morgan

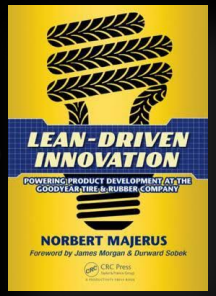
Lean Champion

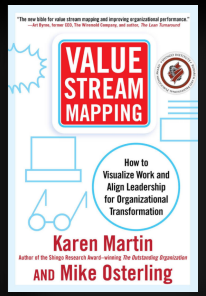
Dedicated to researching LEAN practices, training & starting LEAN initiatives for HRA

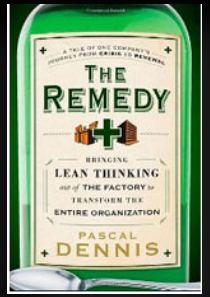
Ken Pyo

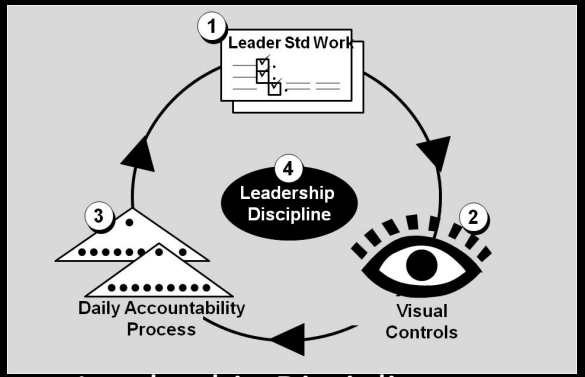
Senior Manager of Corporate Planning at Honda R&D Americas, Inc

Learning opportunities:

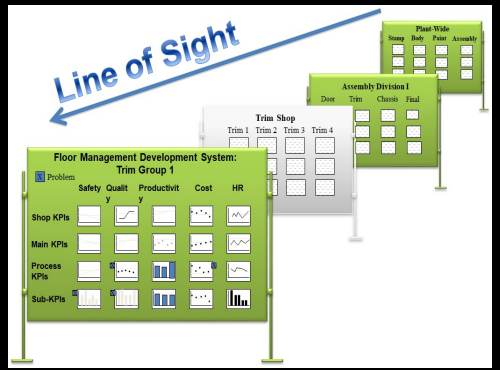




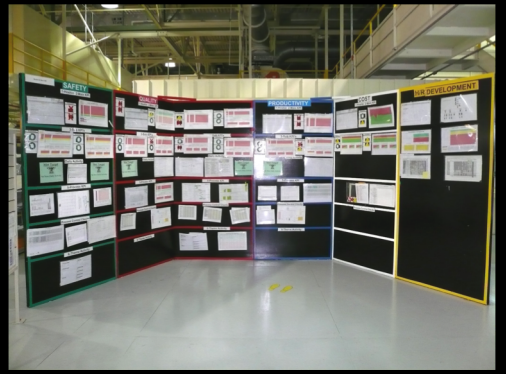




Leadership Discipline



Daily visual mgmnt



Obeya

Research LEAN from Honda Factory….

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Success through associate engagement & management commitment

R&D

FSI Model

- Identify cost drivers
- Value Stream Process Mapping
- Find the loss
- Eliminate the loss

P34 Activity Plan

- Identify cost drivers
- Value Stream Process Mapping
- Find the loss
- Eliminate the loss

Organization alignment

Management practices (Culture)

Business plan linkage

Elimination of waste (loss)

Documentation of processes / best practices

Visual Management

FSI

FSI

Performance metrics

Process value stream maps

PDCA culture

Visible Cost <-> Driver relationship

- ***Standard*** *processes*
- ***Visible*** *process flow*
- *Well-defined /* ***objective*** *control points*

- ***Creativity*** *is key; process differs person to person*
- ***Invisible*** *process flow (by human beings)*
- *Control points difficult to define <****subjective****>*

FSI built on well-established foundation

Know how transfer with PDCA

FSI needs to develop foundation

LEAN manufacturing→ R&D translator

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R&D Loss Definition

Cannot see loss in office setting

Easier to see flow in Mfg

Loss in Product Development

#	Type	Definition	Examples
1	Overproducing	Producing more than the next process needs	1. Issuing a drawing with more details than the factory/supplier requires. 2. Investments/BIs without the delivery of promised payback. 3. Making reports that customers do not value. 4. Underutilizing resources(equipment, space, budget, associates…) 5. New design instead of using an available carryover part that meets requirement
2	Waiting	Waiting for materials, information, or decisions	1. Can't meet with executives due to availability to make a decision that is on the critical path of the project. 2. Waiting for people to show up at meeting or showing up late to a meeting. 3. Delayed tests waiting for parts or equipment.
3	Transportation	Moving material or information from place to place.	1. Shipping cars/parts for testing/evaluation. 2. Travel
4	Processing	Doing unnecessary processing on a task or an unnecessary task	1. Drawing errors 2. Using wrong information, not the latest data. 3. Silo based cost negotiation processes with Honda 4. Redundant information between drawing and DPM. 5. Meetings where nothing is learned or decided and direction forward is unclear. 6. Support processes that do not add value to development.
5	Inventory	A build up of material or information is not being used.	1. Drawings/test results in "limbo" with unknown status. 2. Purchased parts/operational supplies not or never used 3. More people than necessary in a meeting to make a decision
6	Motion	Excess motion or activity during a task execution	1. Moving of associates from one location to another. 2. Creation and the presentation of redundant reports. 3. Looking for information
7	Correction/ Defects	Inspection to catch quality problems or fixing an error already made	1. Project has to reset midstream. 2. Late styling changes/CRFs/Juhins/Poor product market acceptance. 3. Failed Technical/D/SED Evaluations 4. Testing failures that require design change. 5. Unachieved profitability targets.
8	Knowledge Management	Learning the same thing over and over by self or others.	1. Issuing drawings that does not meet known requirements. 2. Research for same topics in different divisions 3. Ineffective Countermeasures. 4. Research themes (failed or not) where nothing is learned.

HRA c/m→ Operational characteristic Improvement

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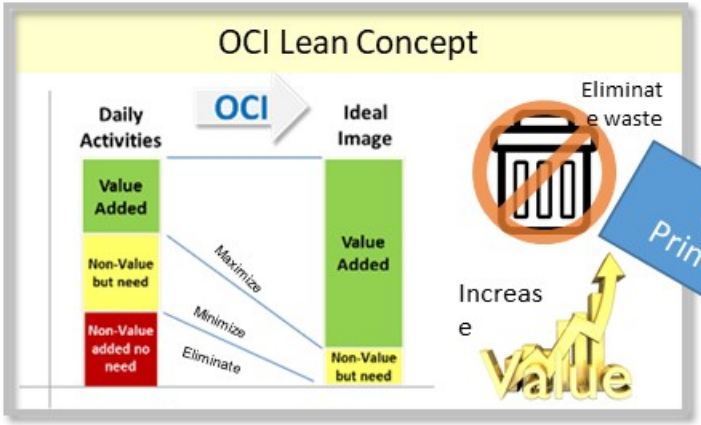
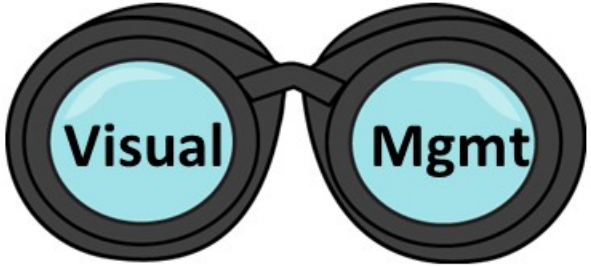
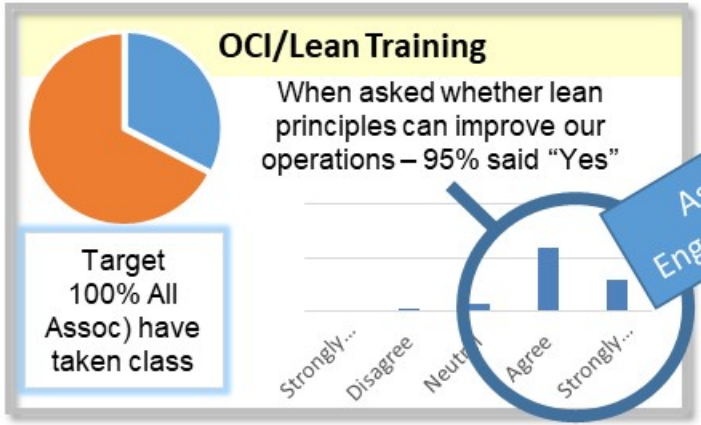


Lean Principles



Blame Process not People

Make Problems Visible



Assoc Engagement

Genba Based Lean Driven Innovation

Reduce Development cost to increase

OCI focus points

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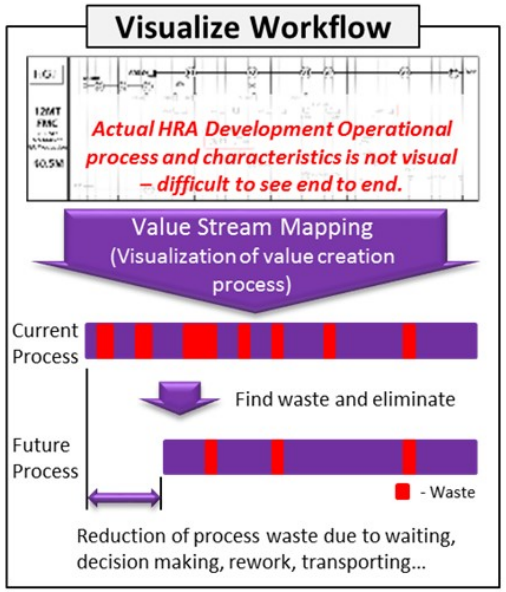

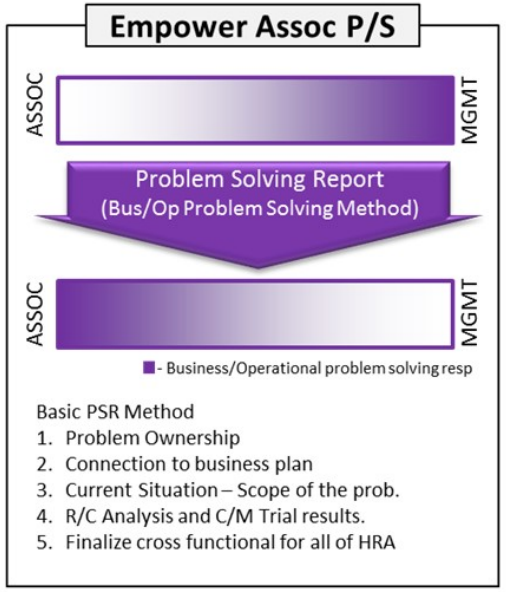

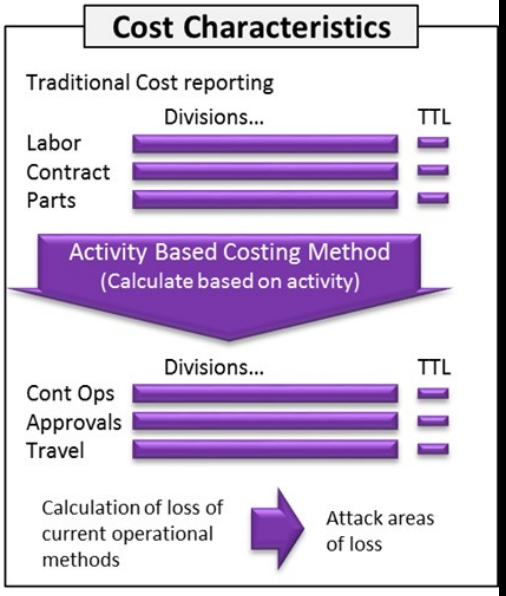

Visualize Workflow

See workflow, value, and waste in operations.

Empower Associates

Train in operational problem-solving methods.

Cost Characteristics Study

Find loss to C/M characteristics.

Activity Based cost characteristics

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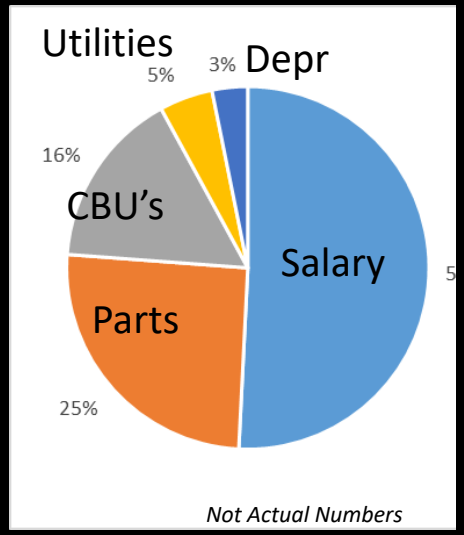
Company Characteristics

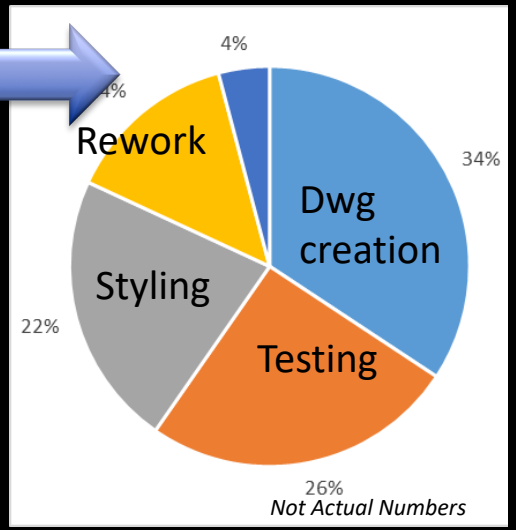
1. Company Policy
2. Company Operational Methods
3. Development Operations
4. Development Systems
5. Company Organizations
6. Other Characteristics

Actual Spending (Nouns)



Not much value for management
Value-added for budget analysts

Activity Spending (Verbs)



Value added for management
Not value-added for budget analysts

Value Stream Mapping

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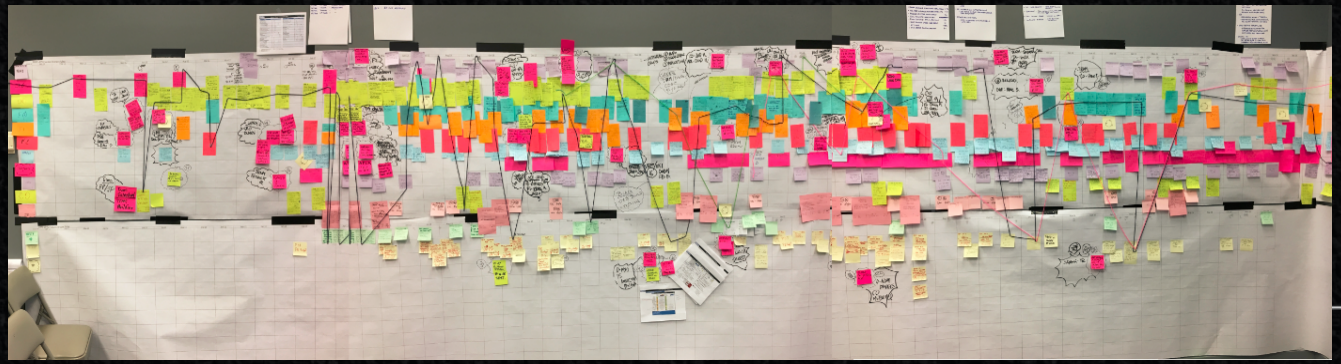
OCI Principle: Need to make workflow visible.

START

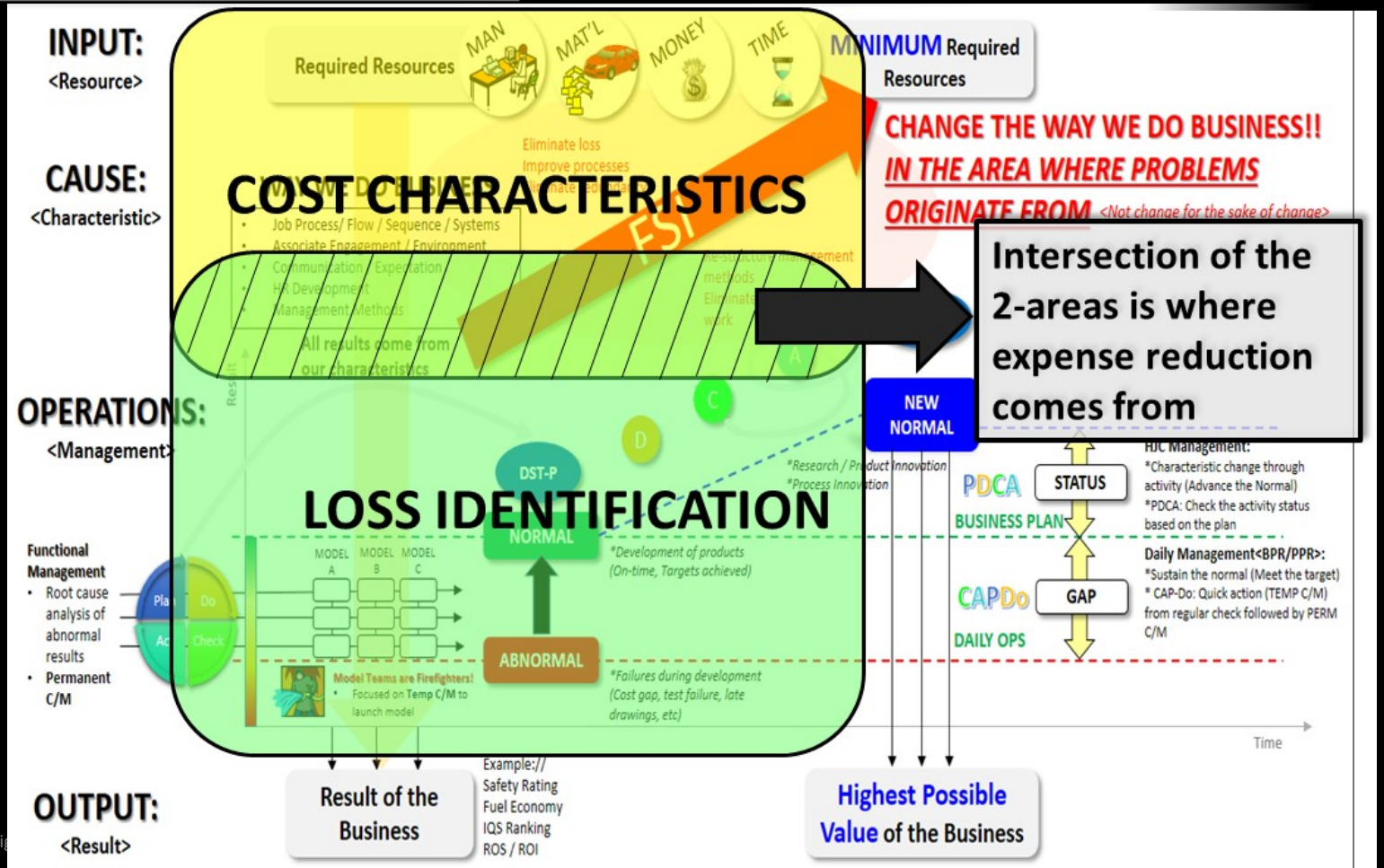
FINISH (2.5 DAYS LATER)



Key Output

- ❑ **29** improvement themes
- ❑ **7** best practices
- ❑ **DDs/Execs assigned** as cross-function owners
- ❑ **Problem-solving report** themes started

Cost & Loss→ Business viewpoint



Empower associates → tool

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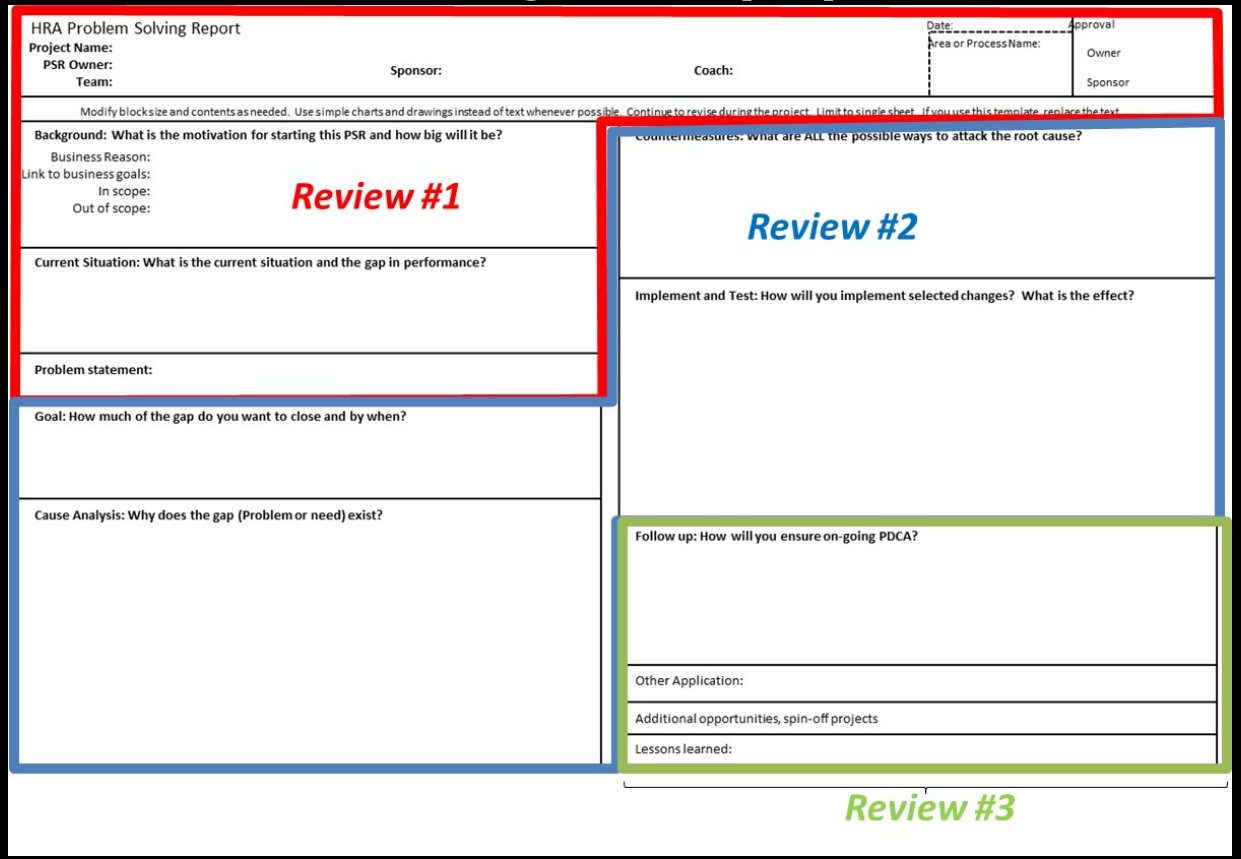
PSR-Problem solving report (A3)



Key Points

- ❑ Genba voice (anyone, anyplace)
- ❑ Describe situation
- ❑ State problem
- ❑ Describe ideal state
- ❑ Do root cause analysis
- ❑ Propose c/m
- ❑ Conduct test
- ❑ Follow up
- ❑ Reflect to standard practices

Visual management → Obeya

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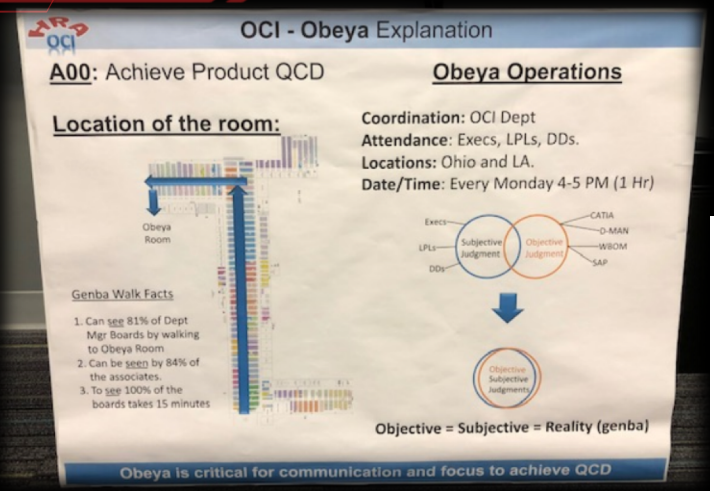
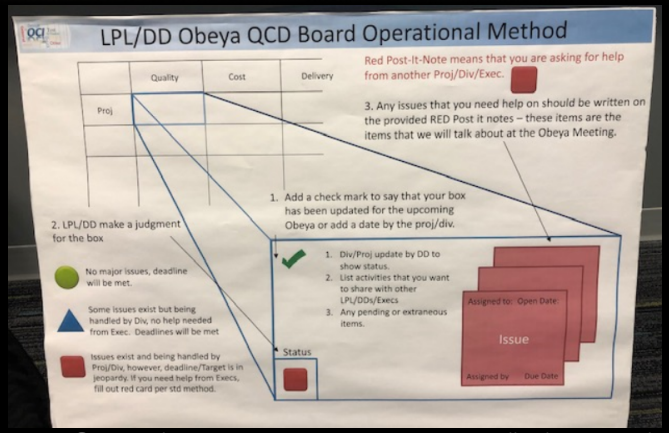
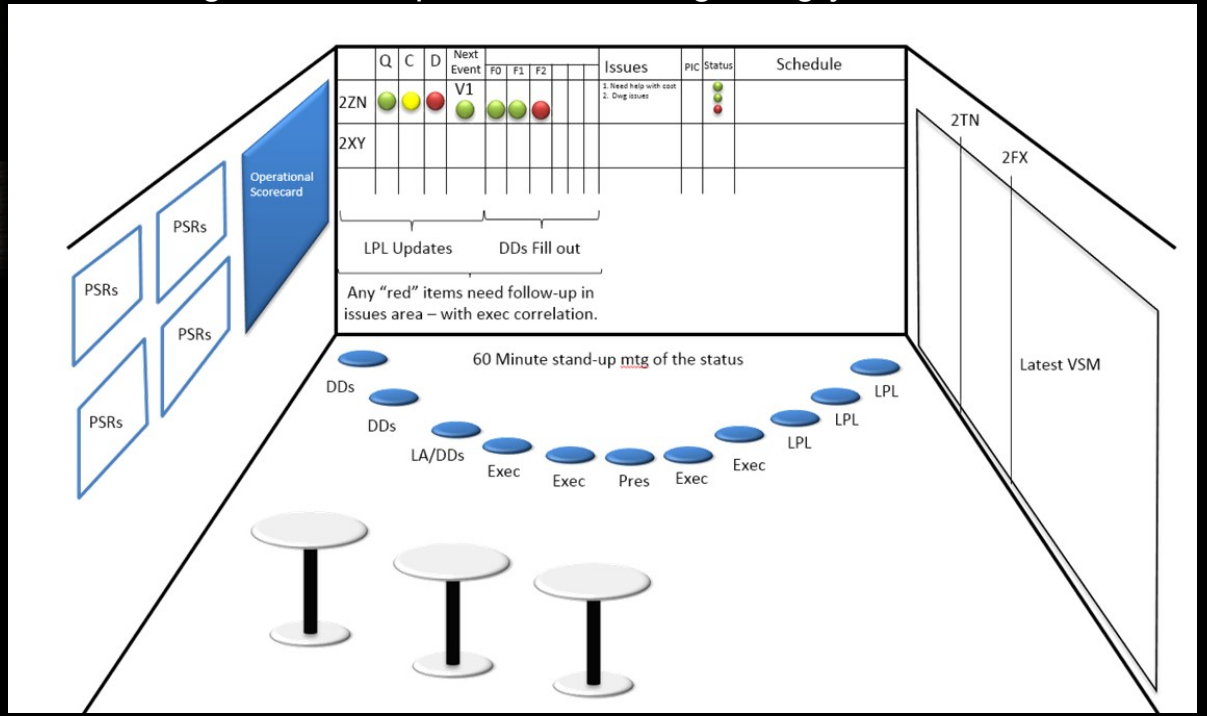




Keys to Successful Obeya

- ❑ Normal vs Abnormal immediately apparent
- ❑ Voice from Genba is a must focusing on QCD
- ❑ Mgmt must help not blame and get angry

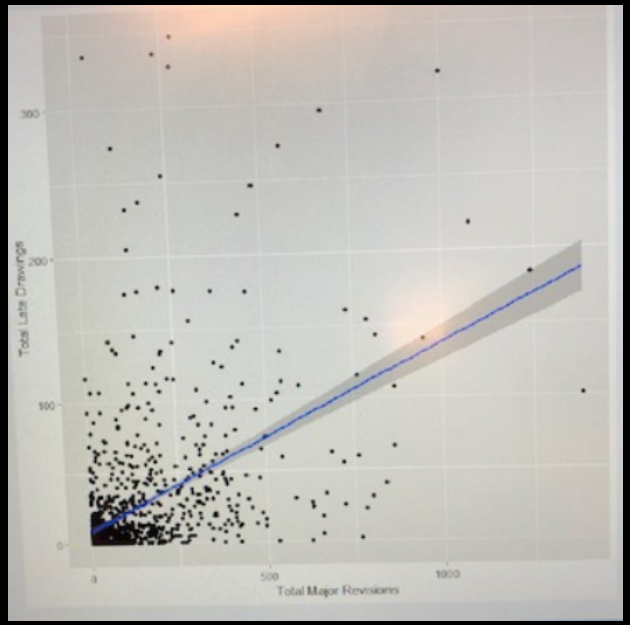


Data analytics opportunities

Potential of system:

- ❑ Systematically extract info
- ❑ Predictive analytics
- ❑ Behavior analytics
- ❑ Outliers can be identified
- ❑ Trends can be identified

Macro data PIC Delivery vs quality



Example of use cases:

- **PIC Drawings delivery vs Revision scatter**
  - Layering in tenure
- **Drawings Late vs Number of tasks/workload by PIC**
- **Child drawings vs late**
- **Schedule of drawings (plan-vs-fin)**
  - Layering in project schedule.
- **Connecting data from Drawing→ Purchasing (Parts) →Test**
- **Failed tests vs Drawing revisions %**
- **Failed tests vs Drawings late %**
- **Drawings late vs Late Part Cost**
- **Drawing revisions vs Part Revision/New Order Cost**

We are anticipating each of these to branch out in to a lot of analytics themselves.

Part II: OCI – Results and Lessons learned

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I. Visual management tools critical to success.
   A. Able to understand normal from abnormal.
   B. Able to rotate PDCA.
   C. Able to connect daily management to company goals
II. Obstacles in daily work flow were identified and PSR tool allows voice of genba
III. Project linkage to business plans established
IV. Inter-business issues still remain – many issues require coordination outside of R&D
   → with sales, manufacturing and purchasing
V. Starting point did not engage all SEDB for implementation.
VI. Activity driven by R&D…not from Top management.
VII. impact to other areas not visible… communication, visualization improvements needed for REAL TIME problem resolutions

Part III: CRISES + New CEO direction…

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S E D B

SALES | MANUFACTURING | DEVELOPMENT | PURCHASING

Strengthening the planning and execution of global strategy

Make it SIMPLE

Simplify getting info to R&D early in development

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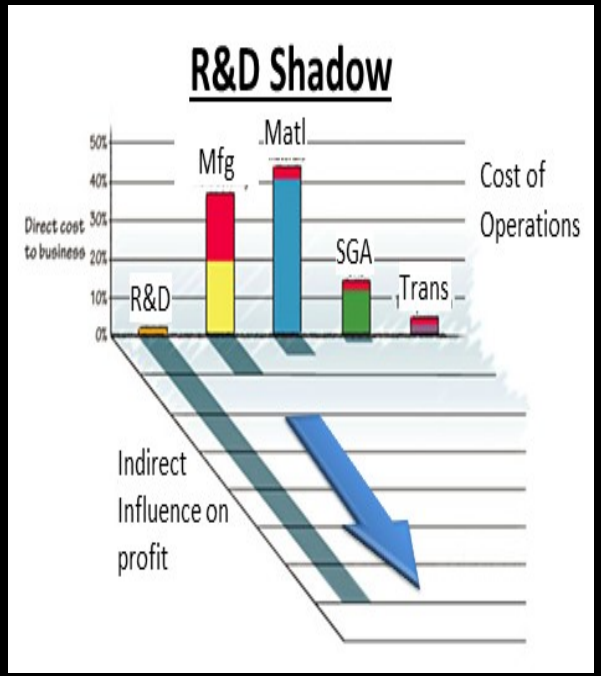
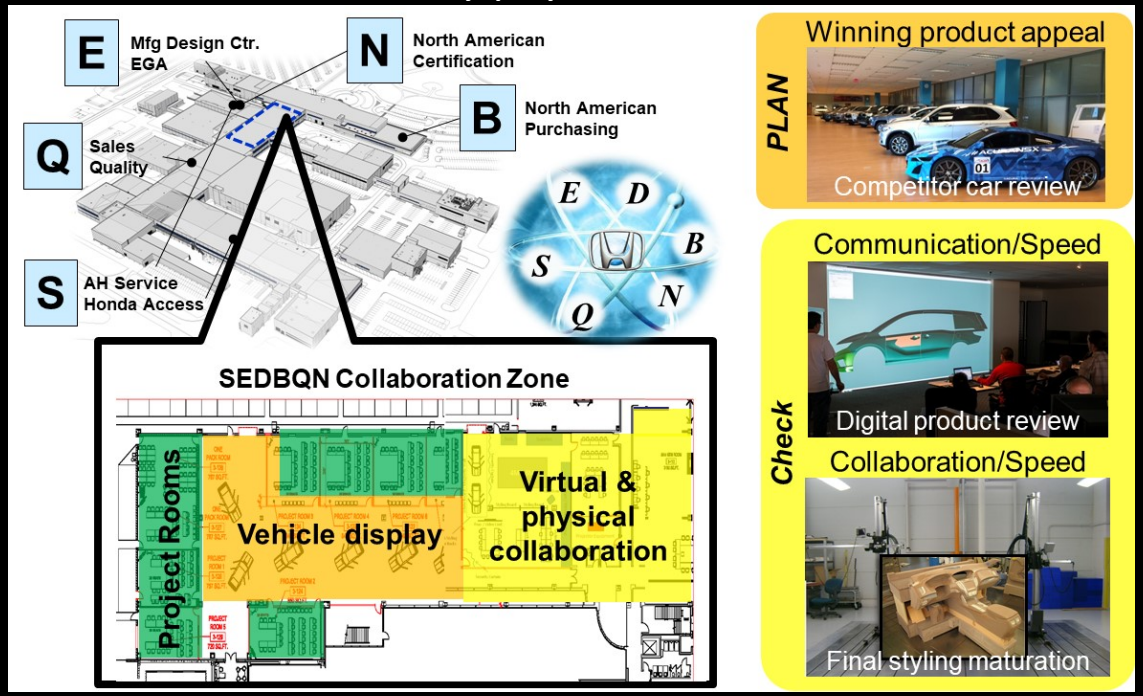
R&D influence;



SEDBQ collaboration by physical location:



Simplify product development:

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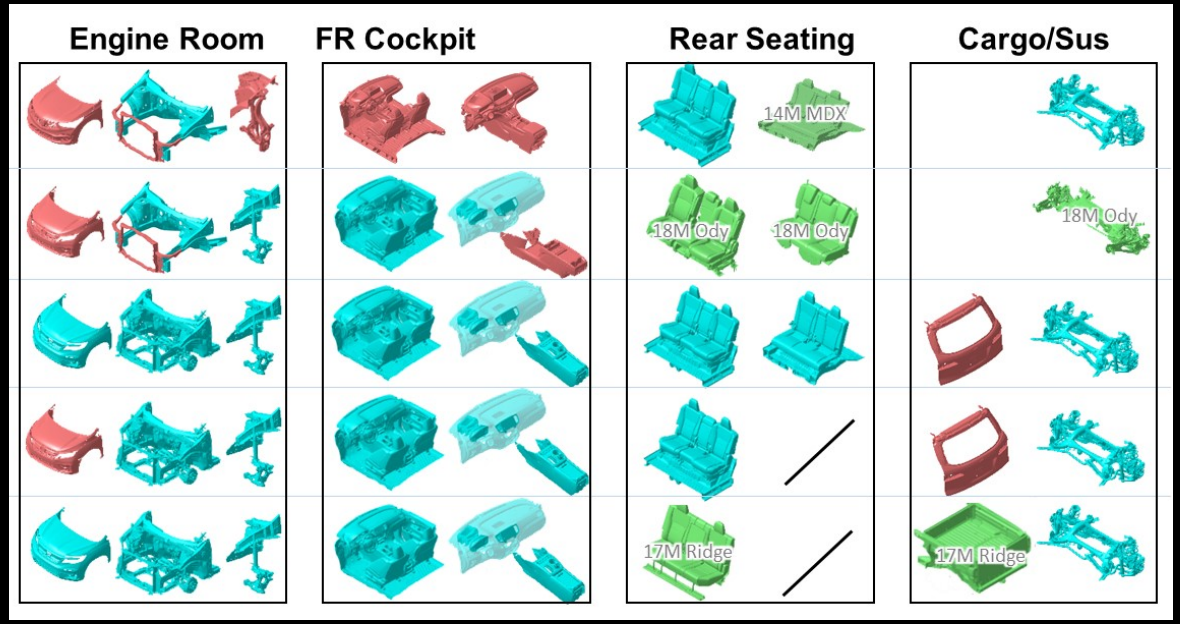
Core Module strategy



stable platform /part commonality/ time and resources /unique innovation
Purchasing power by volume/ factory characteristics improvement

Simplify Product sharing

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JAPAN

NORTH AMERICA

EUROPE/AFRICA/MIDDLE EAST

ASIA & OCEANIA

SOUTH AMERICA

Inter Regional
Coordination

Simplify MTOC

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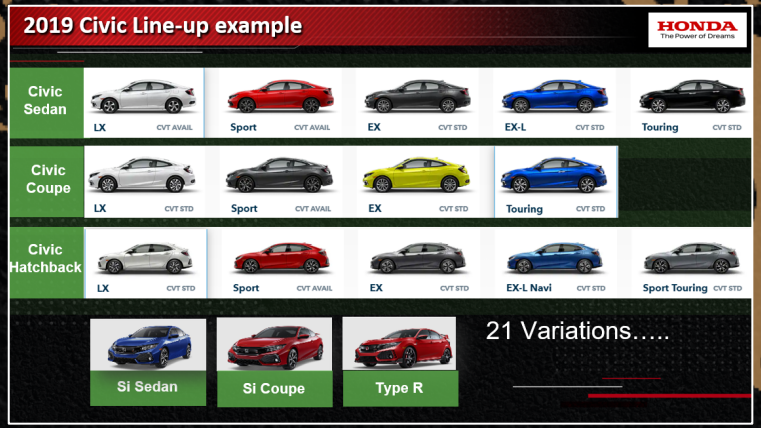
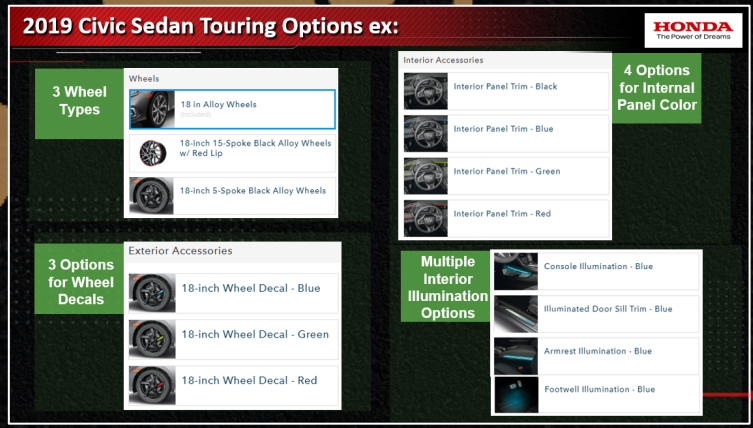
Globally, Honda will reduce the number of trim & option variations





Simplify manufacturing:

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Factory Monozukuri Grand Design

Simplify process:

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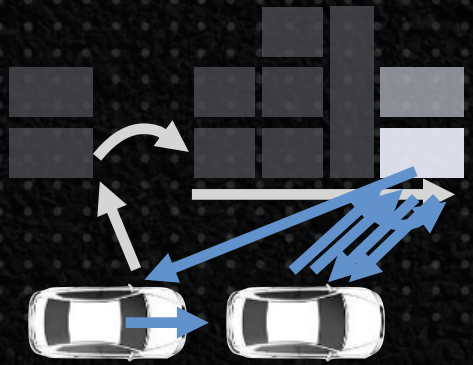
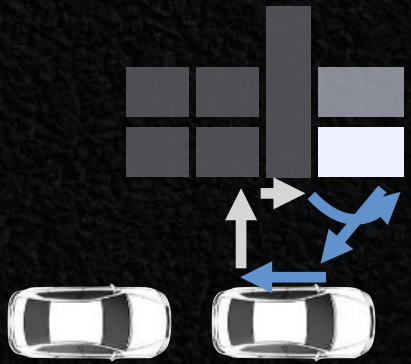
Continue optimization:

Wasted Movement



Loss Reduction



Loss from part layout & sequence of processes

Target at least 70% installation & & 30% Movement

Loss elimination improvement supports adding electrification processes

Simplify message to suppliers:

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Stabilize Today	Make honest assessment of delivery management, quality & talent
Eliminate Loss	Ensure your processes and workforce are aligned with your future business
Prepare For The Future	Optimize manufacturing specifications today for future technology

Next Steps

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CREATE **NA DEBQ OBEYA**

- ❑ Visualize R&D status
- ❑ Visualize factory status
- ❑ Visualize supplier status

MOVE FROM NPD TO **SPD**

- ❑ Optimize Tooling Go timing
- ❑ Maximize early verification opportunities
- ❑ Minimize Late design change to MP tools

DEB **“ONE-FLOOR” DEVELOPMENT**

- ❑ Design for manufacturing
- ❑ Control Tooling release
- ❑ Minimize changes
- ❑ Value stream map + PSR

Conclusion → LEAN is never ending...

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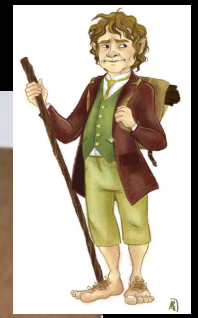
1) Crisis and leadership is very important to change & inspire… get rid of waste



2) Quality organizations can always get better with LEAN principles
3) R&D efficiency has drastic impact on total organization → start there
4) Never underestimate the power of visualization to improve QCD
5) Start simple.. With simple KPI's (objective and subjective)
6) Digital & LEAN: Cannot go fast unless you can grasp the data

LEAN Journey is never ending… always evolving with technology but the principles of LEAN are timeless and transferrable to any business