A Global PLM strategy in Ford Motor Company

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Office of the Technical Fellow
Ford Motor Company

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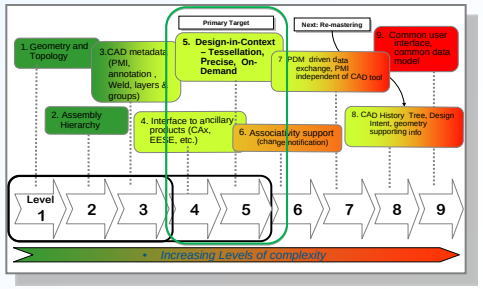
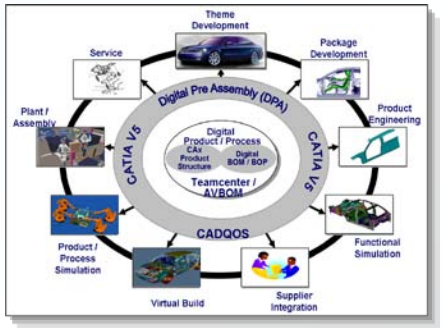
Overview

- A Global product strategy relies on a global PLM strategy
- A global PLM strategy is enabled by interoperability
- Interoperability must be achieved at all levels:



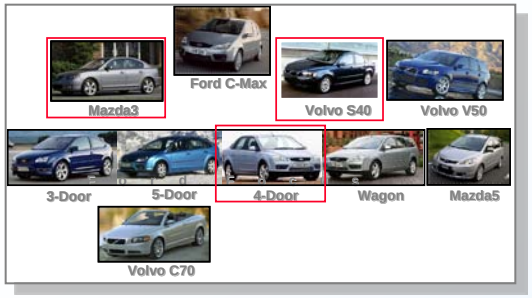
Level-1
Data & Tools Interoperability across core design and engineering activities

- **Product Definition (Geometry)**
- **PMI & Metadata**
- **Analysis and Attributes**
- **PDM-Enabled**



Level-2
Interoperability across PLM Processes and Components

- **PDM**
- **BOM**
- **MFG Systems and Processes**
- **Requirements& Assumptions**



Level-3
Interoperability across global vehicle programs

- **Global Platform**
- **Global Commodities**
- **Global Release & Change Management**
- **Enabled by Standard Information Model**

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Interoperability – Level 1
Product Creation Core Tools

- CAD Interoperability
  - Working with geometry in one CAD tool with reference geometry from another CAD tool
- PDM Interoperability
  - Product Data is shared and exchanged between multiple purpose product data management centers.
- Visualization-based Interoperability
  - Product Data Pipeline
  - Data sharing and collaboration across multiple design and engineering disciplines using efficient product data representation.

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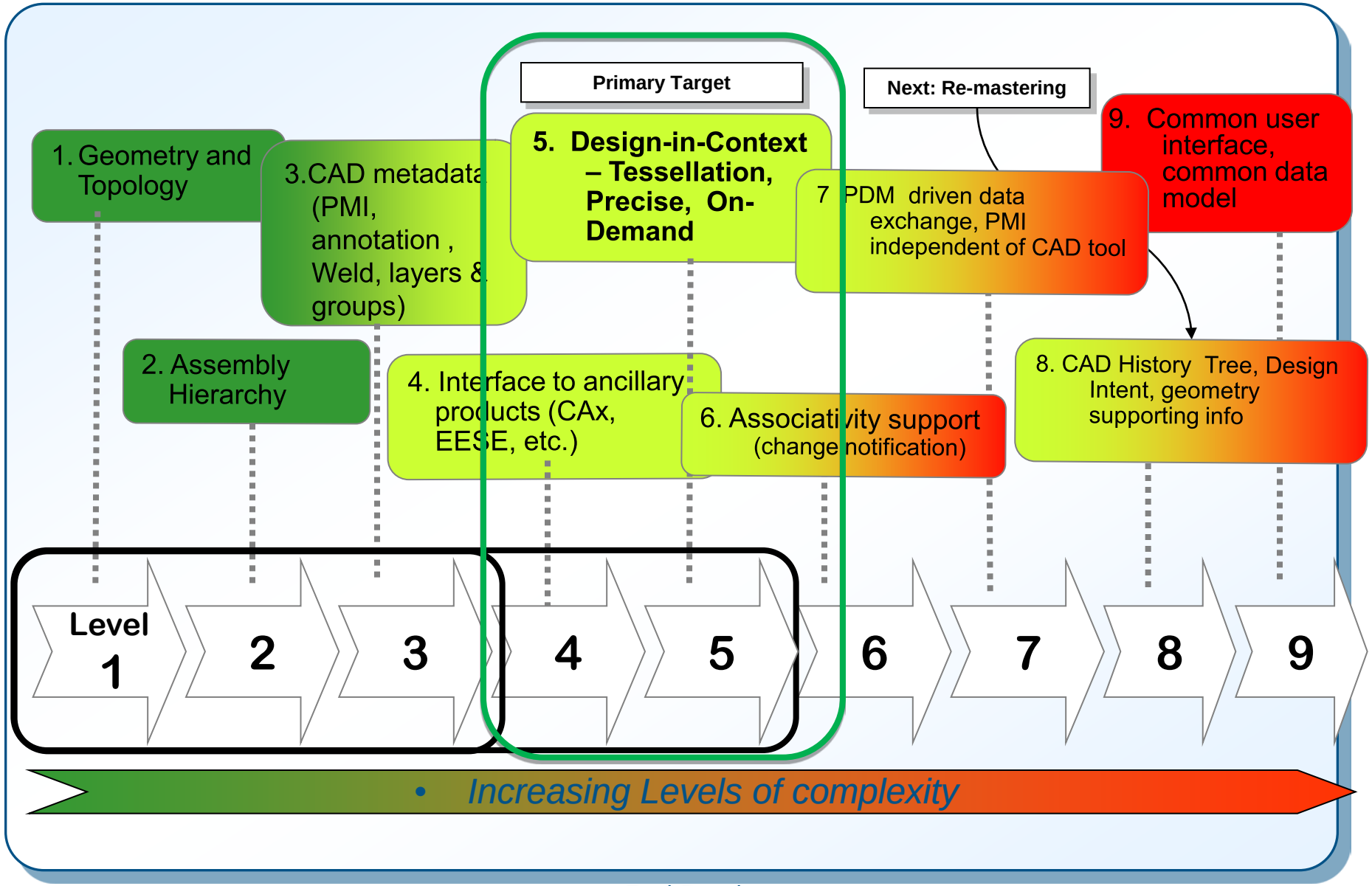
C3PNG Levels of CAD Interoperability



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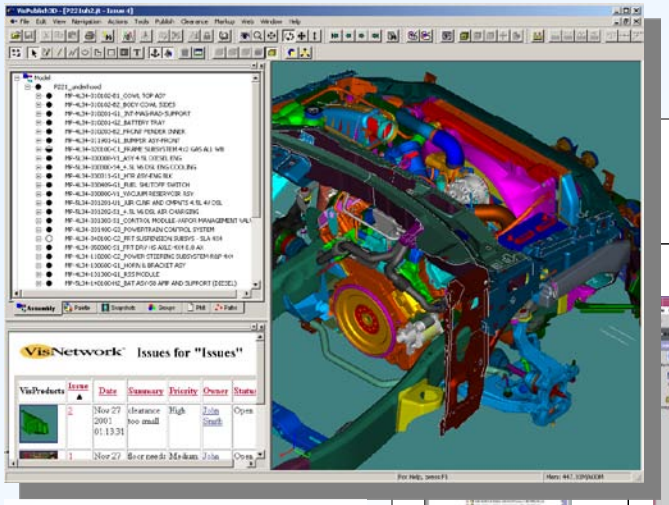
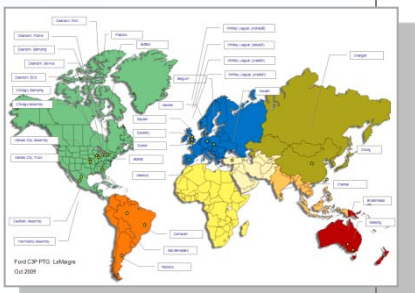
Product Creation Systems
A Global PDM - Teamcenter Centric

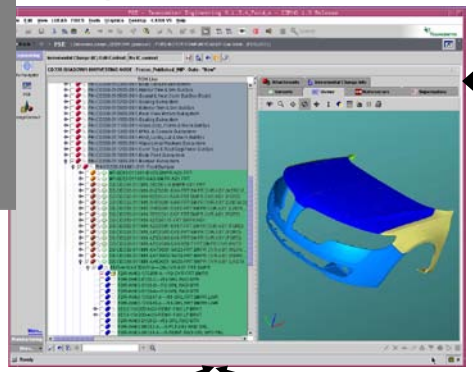
Integrated CAD/CAM/CAE/PIM and Visualization Platform



- ✓ Over 16,000 Users
- ✓ Over 100 Vehicle Programs
- ✓ 74 Data Distribution Servers



Digital Product Structure

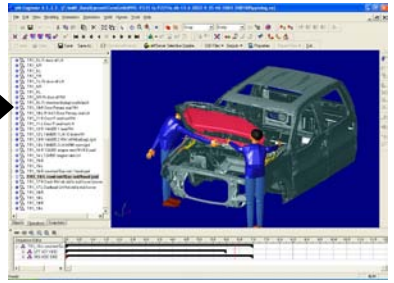


IDEAS **CATIA V4 / V5**

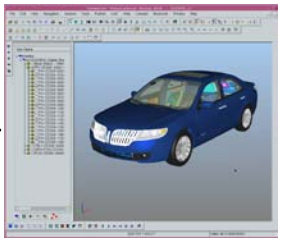
Teamcenter Engineering with Multi -Site

CC to EMS

Digital Factory (EMS)

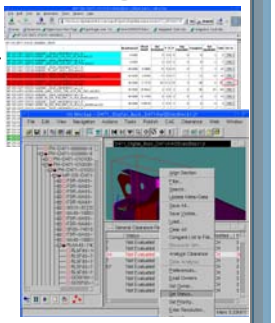


Distributed Digital Vehicle



PDV **Issue Management**

Integrated Clash Management



Metaphase

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JT-Based Interoperability: Multi-CAD Design in Context

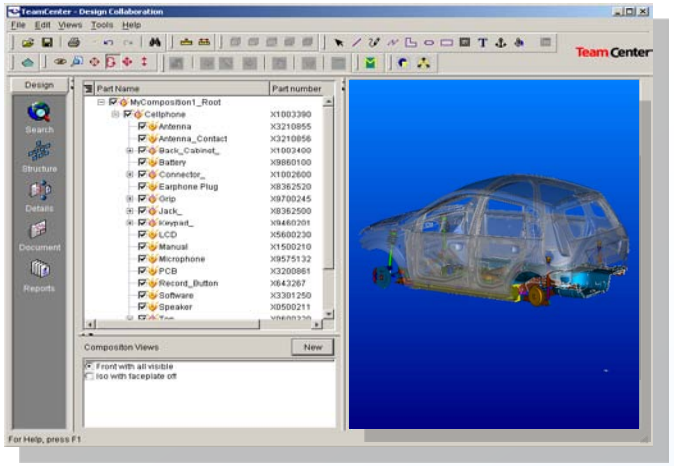
Benefits:

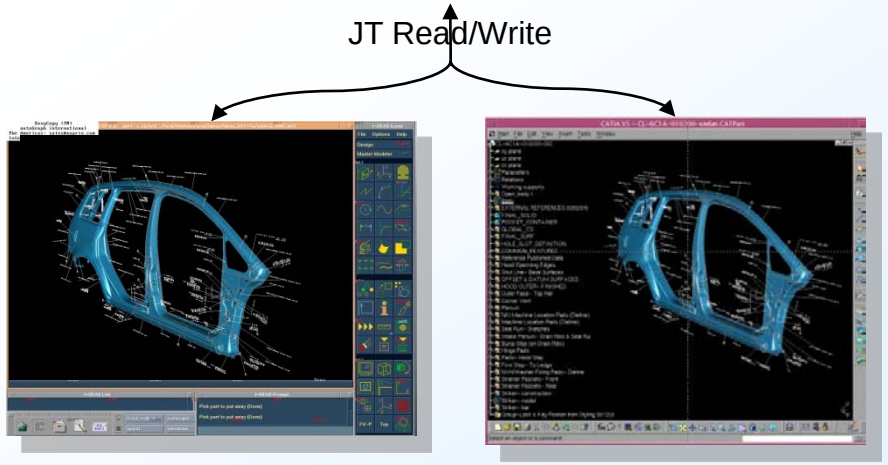
- Multi-CAD / Single PDM Environment
- JT Generation via Engineering Translation Services
- JT Read Capabilities in CATIA V5 and IDEAS
- Seamless Integration. No manual translation/exchange is necessary

History:

- Began Development in 2001
- Initial Production in 2003
- Currently Deployed World-wide

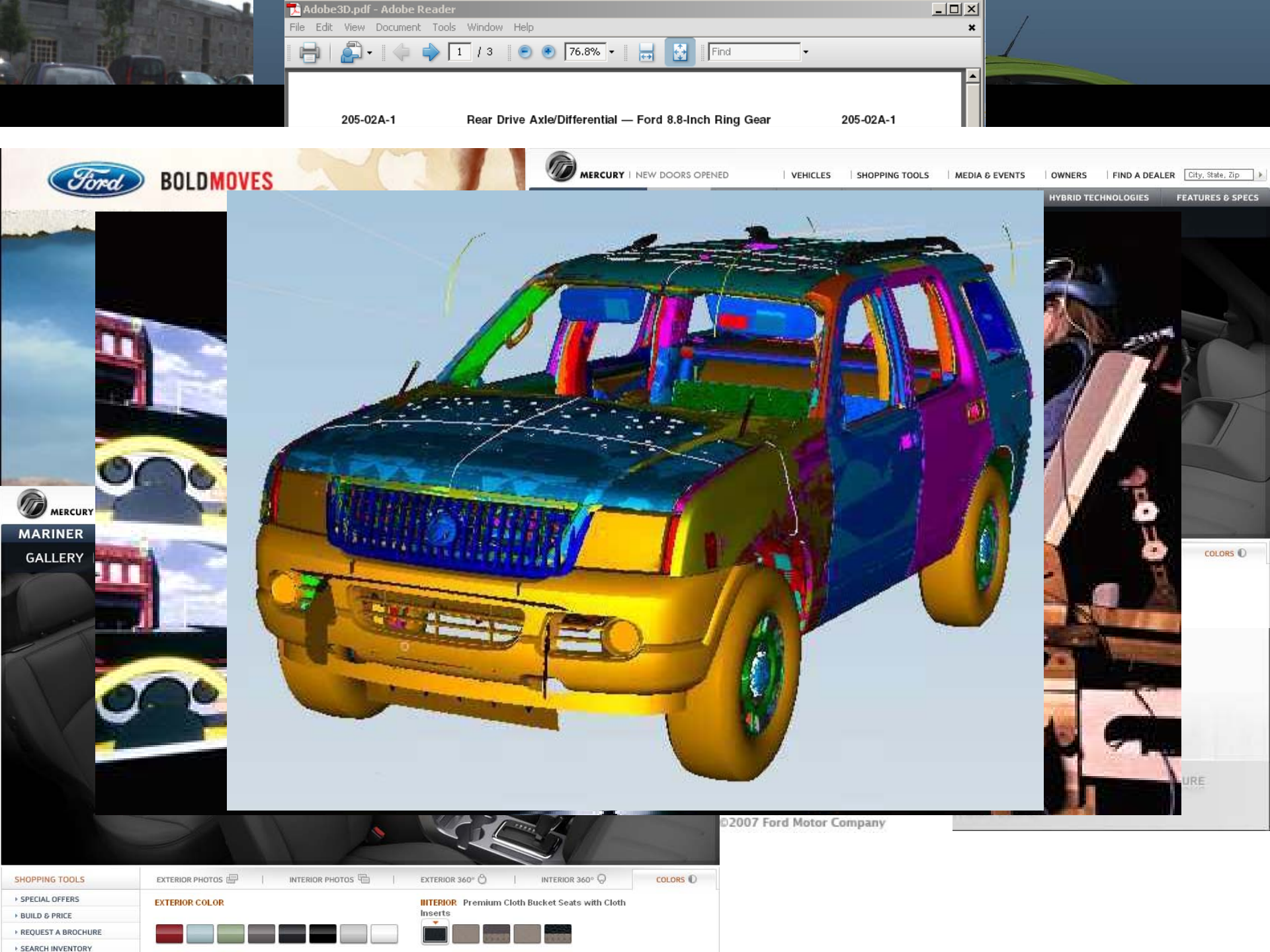
Teamcenter Engineering





IDEAS

CATIA V5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Ford BOLDMOVES
MERCURY | NEW DOORS OPENED
VEHICLES
SHOPPING TOOLS
MEDIA & EVENTS
OWNERS
FIND A DEALER
City, State, Zip
HYBRID TECHNOLOGIES
FEATURES & SPECS
MERCURY
MARINER
GALLERY
COLORS
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EXTERIOR PHOTOS
INTERIOR PHOTOS
EXTERIOR 360°
INTERIOR 360°
COLORS
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BUILD & PRICE
REQUEST A BROCHURE
SEARCH INVENTORY
EXTERIOR COLOR
INTERIOR Premium Cloth Bucket Seats with Cloth Inserts

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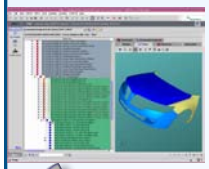
JT Pipeline

JT Enabled Interoperability across core PD tools



PD/KBE

PDV
PDV
Jack
TCe
D Buck
VVT

Indirect
PDV
Jack

Services

IooDraw
IooDraw
Adobe Illustr
PDV
3DsMax
AutoTrol
TCViTransCabels

TCVis
VisJack
VSP

JT Pipeline

Mfg

TCM
eMS
Jack
FIDES
PartViewer
EMS Planner

PTO

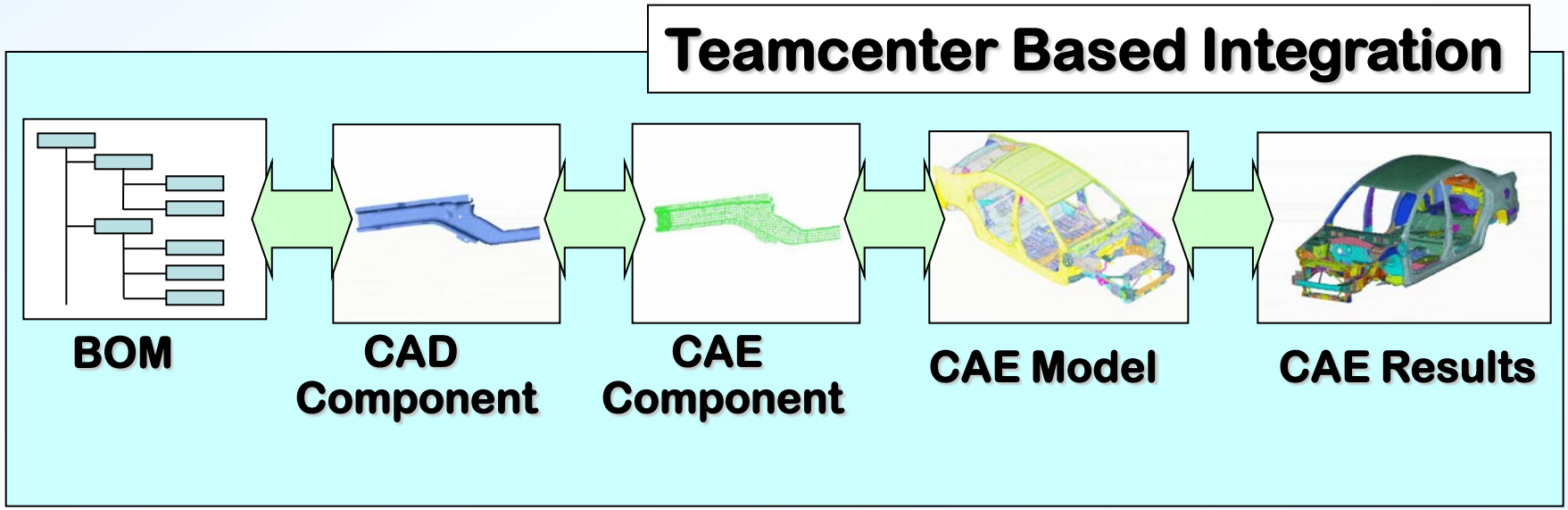
CAE Mashing
TessOnDemand
ePEds
PTO Buck

Corp Design

ICIDO
Opticore
Bunkspeed

Global CAE Strategy

- BOA – Bill of Analysis
- Clear link between CAD and CAE



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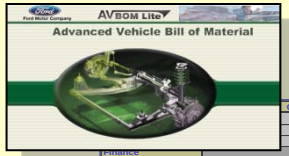
Achieving Geometric Compatibility

Requires Aligned BOM, CAD and DPA Processes

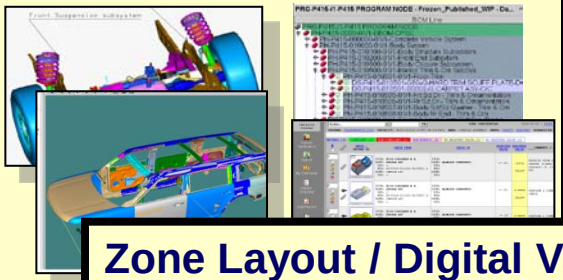
BOM Authoring



			C170	D385/6	P415	D471	S197
			Yes	Yes	Yes	Yes	Yes
			Yes	Yes	Yes	Yes	Yes
			Yes	Yes	Yes	Yes	Yes
Finance				Yes	Yes	Yes	Yes
Primary Designer	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Digital Buck	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IPS			Yes	Yes	Yes	Yes	Yes
PPM			Yes	Yes	Yes	Yes	Yes
Vehicle Operations		Yes	Yes	Yes	Yes	Yes	Yes
Package			Yes	Yes	Yes	Yes	Yes
Service			Yes	Yes	Yes	Yes	Yes
Recyclability		Yes	Yes	Yes	Yes	Yes	Yes

Single Bill of Material with a Defined Maturity and Freeze Cadence

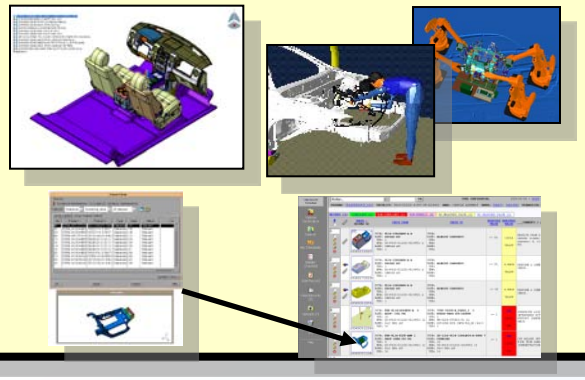
CAD Authoring / Config



Configured CAD Data Aligned to BOM

- Production End Item Based Design Solutions
- Collaboration Structure for Layouts and Studies
- Manufacturing Structures aligned to BOP

Zone Layout / Digital Validation



Management and Delivery of Geometric Compatibility

- Cascade System and Comp Design Requirements
- Validates Digital Control Models
- Manages Geometric Issues and Resolution

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Digital Pre-Assembly

Geometric Verification, Compliance to Standards

DPA Assessments — Verification — Requirements

DPA 0	DPA 1	DPA 2	DPA 3	DPA 4	DPA 5	DPA 6
Function	**Static Nominal Taisen**	**Craftsmanship**	**Tolerance**	**Service**	**Mfg/ Assembly**	**Package/ Ergo**
• Dynamic displacement • Movement • Heat Clearances • Variation	• Clearances • Positional correctness • Interface completeness	• Design Appearance • Margins/ Flushness • Grains / Gloss	• VSA Focus studies agreed by Design, Program & VO	• Removal • Access • Damageability	• Formability • Assembly Process • Plant Floor Ergonomics	• Ingress/egress • Reach • Vision • Accessibility • Spatial Relationships
DPA Owner: Block Leaders	DPA Owner: Block Leaders	DPA Owner: Craftsmanship	DPA Owner: Craftsmanship	DPA Owner: FCSD	DPA Owner: VO & SBU ME	DPA Owner: Basic Design Package
UN & UP	UN & UP	UP	UP	UN & UP	UN & UP	UN & UP

Functional Specifications	Nominal Taisen	Craftsmanship Specifications	Appearance Tolerance	Service Specification	Mfg/Assembly	Package/Ergo
• Material • Key Life • Component	• Component System & interface requirements.	• Exterior • Interior • Under Hood	• Acceptance Criteria for Component Variation	• Component Standards for Service	• Component Mfg Standards • Control specs • DFA Req	• Component Ergo Req • Component Package Standards

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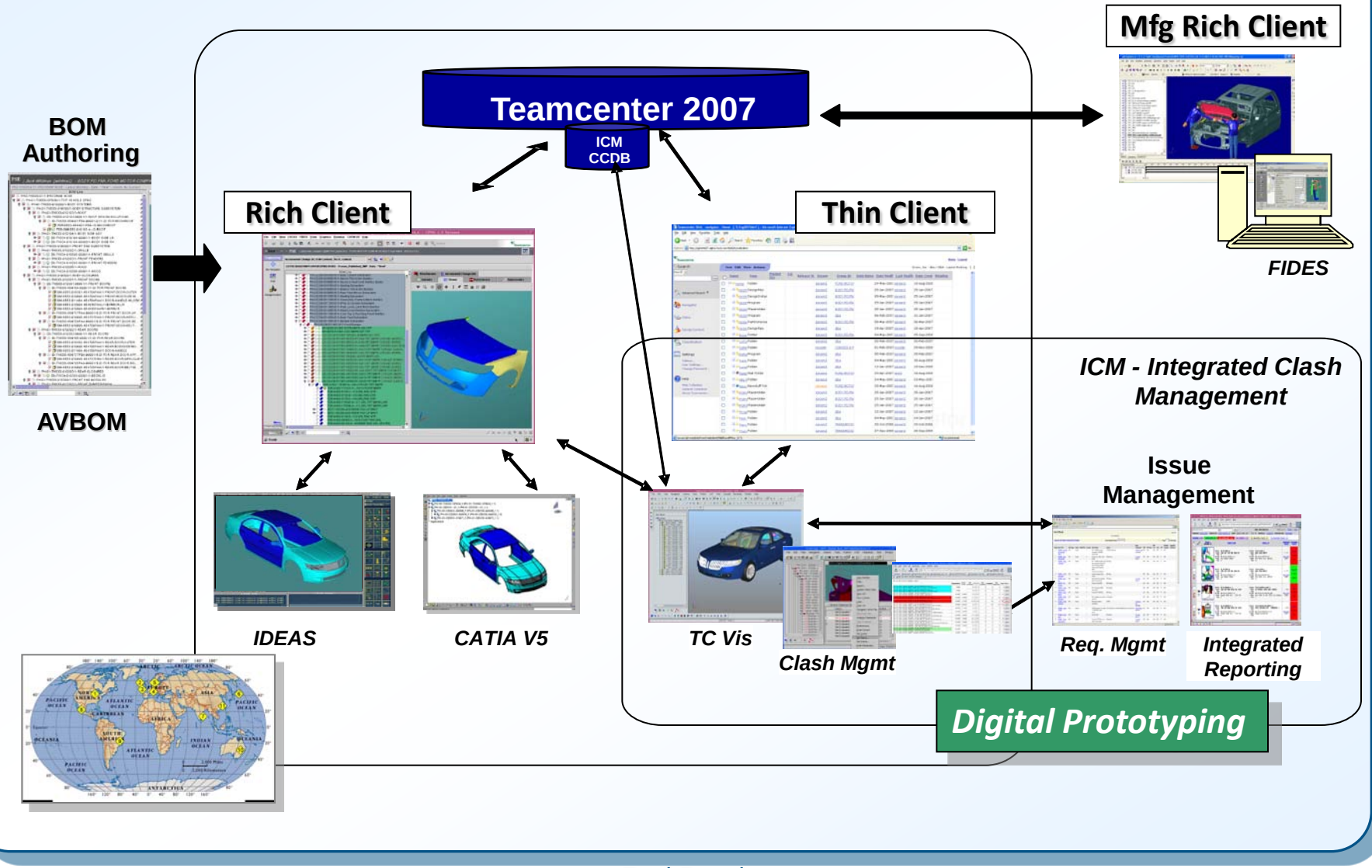
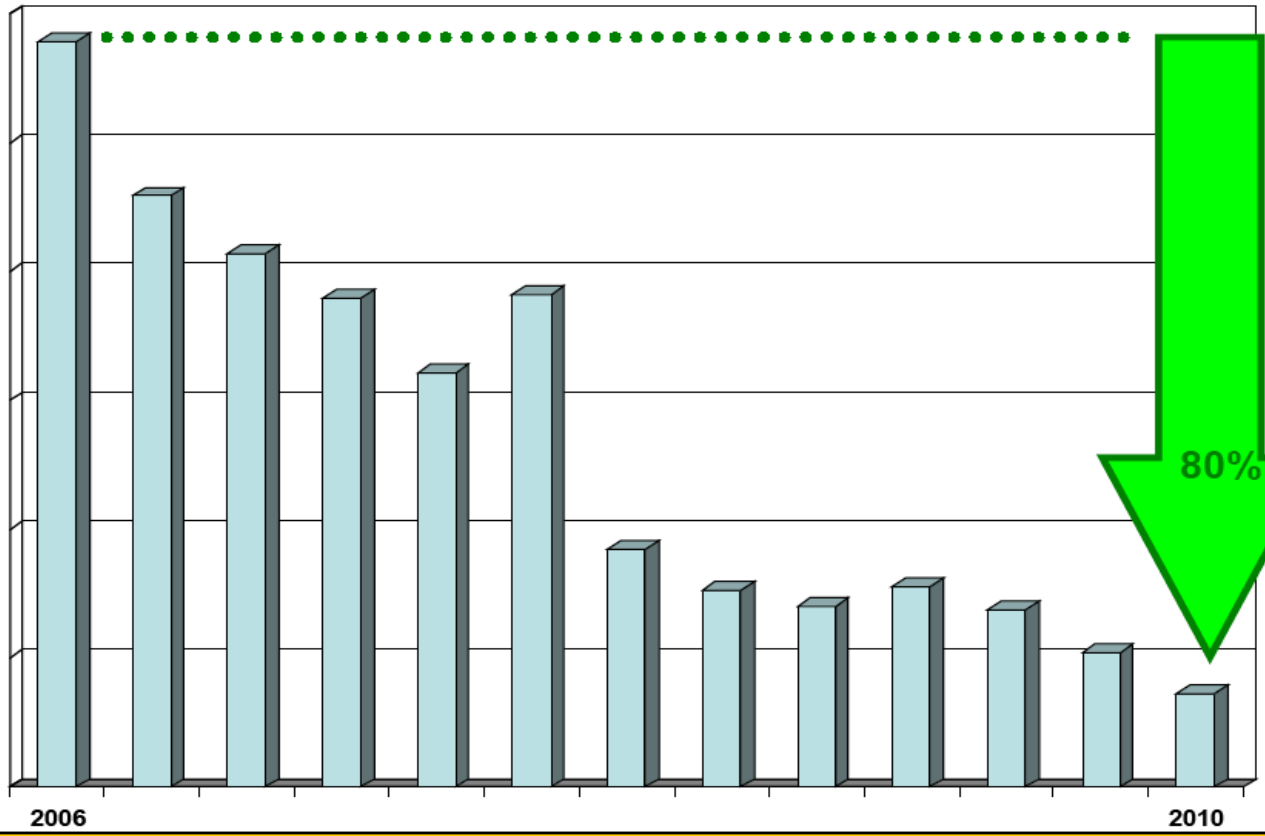
Fully Integrated Digital Prototyping Environment



Significant impact on the Results

Launch Issues Reduction



- ✓ On-going, year over year reduction in Manufacturing issues – 5 years running
- ✓ Overall 80% reduction in issues at the first physical build

Continuous improvement in digital pre-assembly process yields ongoing reduction of launch issues.

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MANAGEMENT BRIEFING SEMINARS
August 4, 2009

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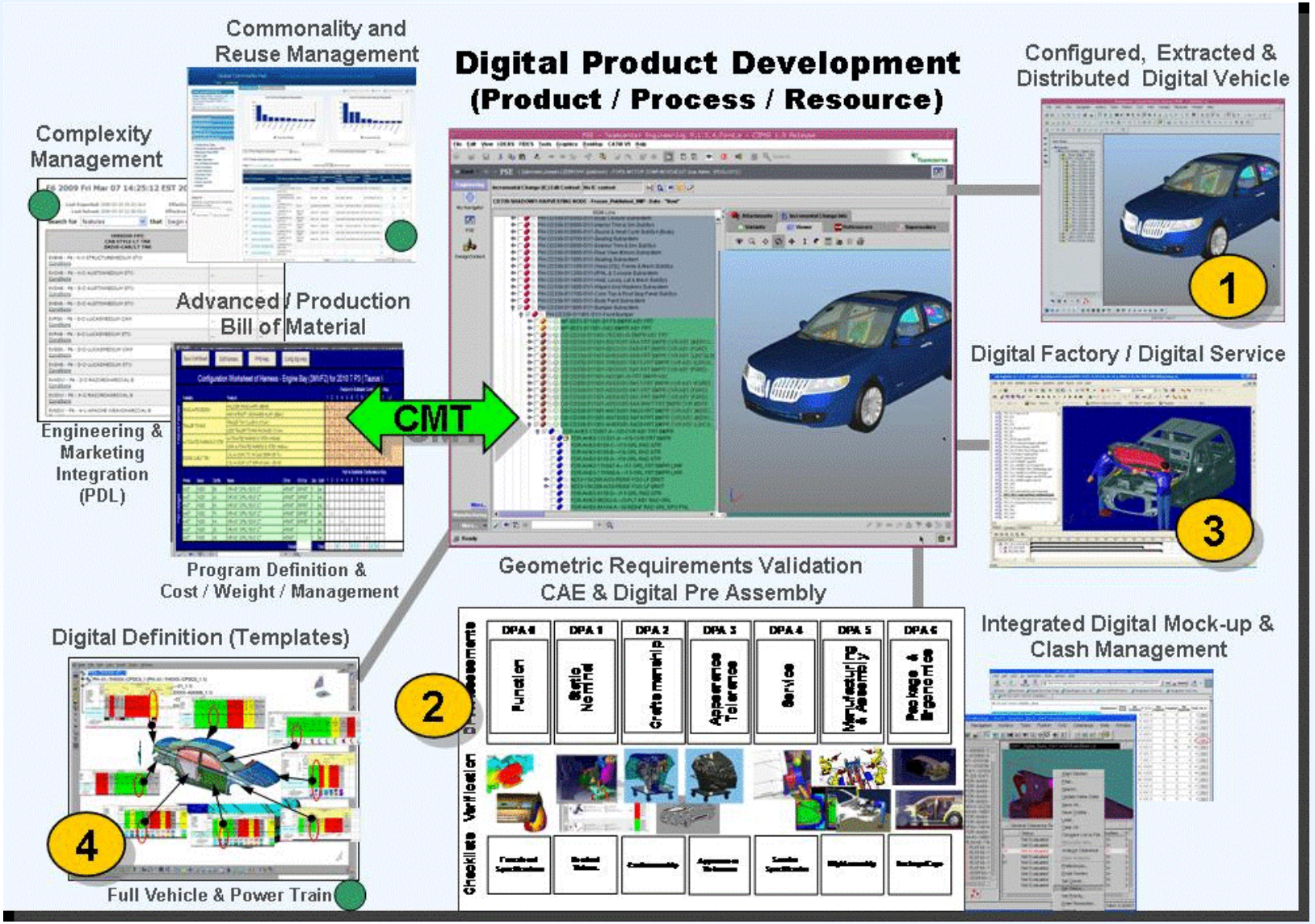
Interoperability Level-2
Current Ford PLM Environment



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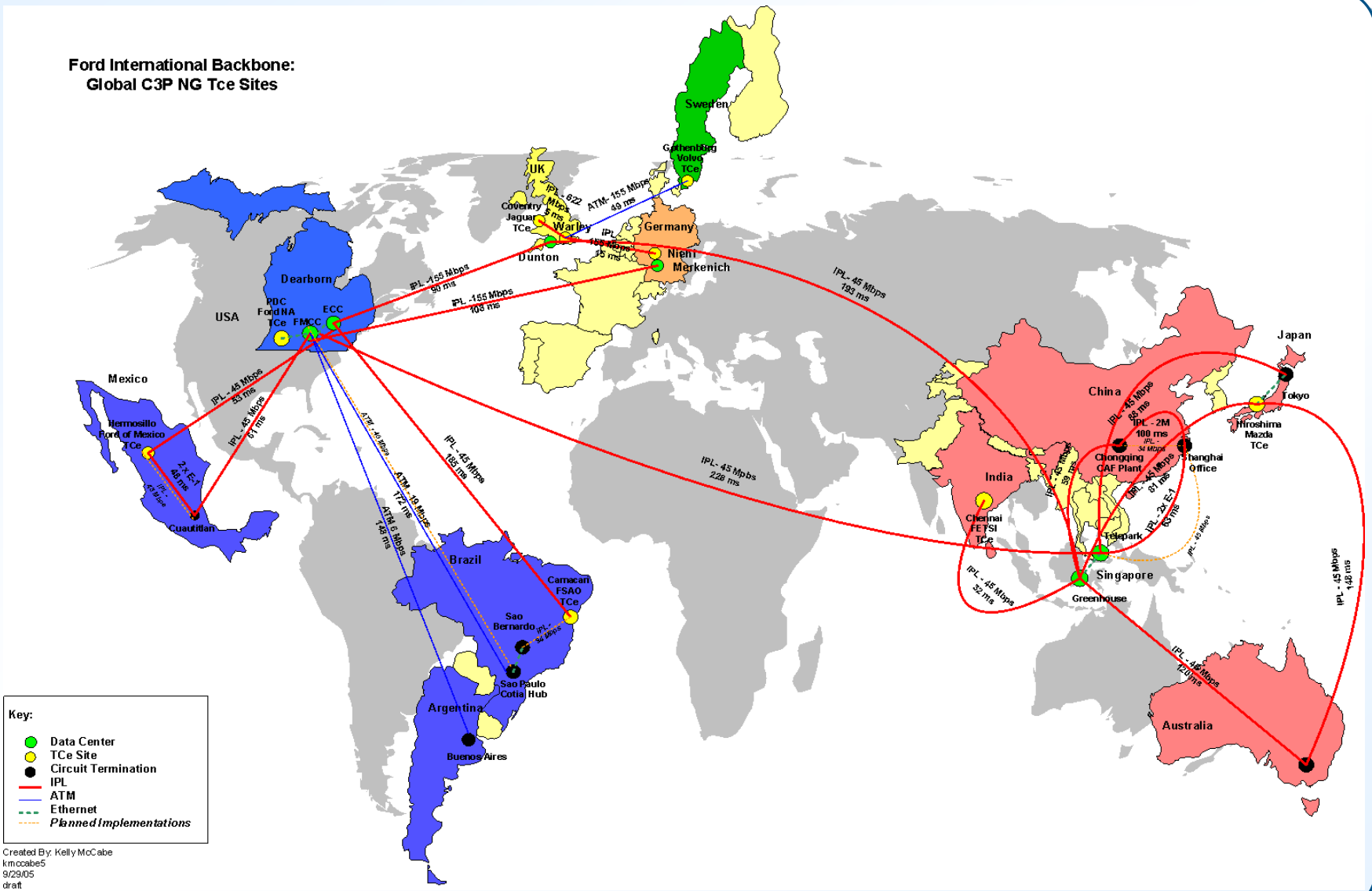
Current Ford Network Landscape



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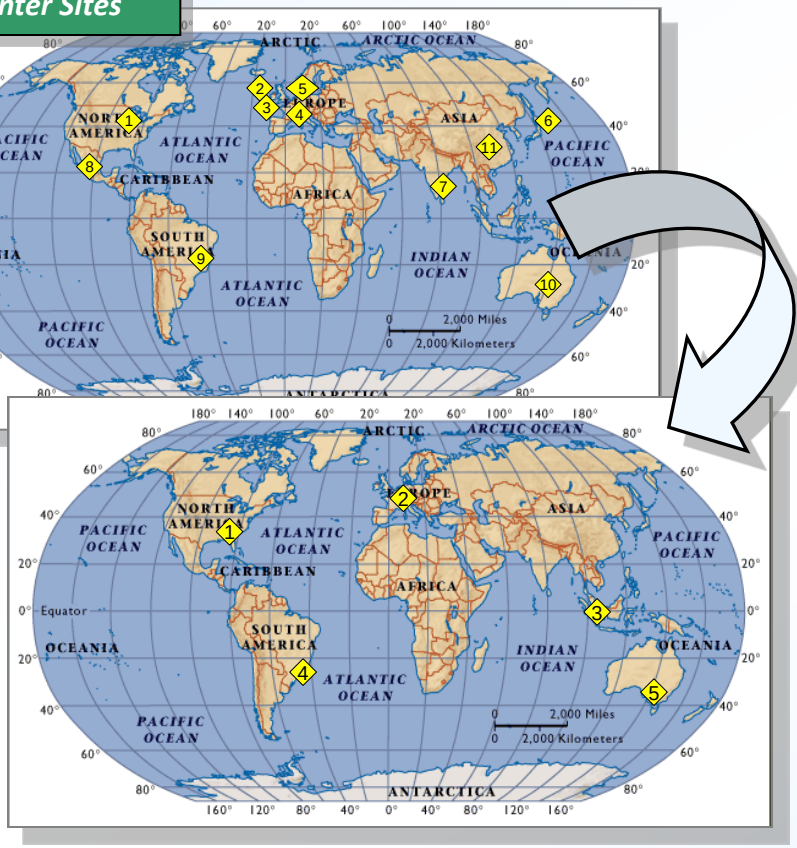
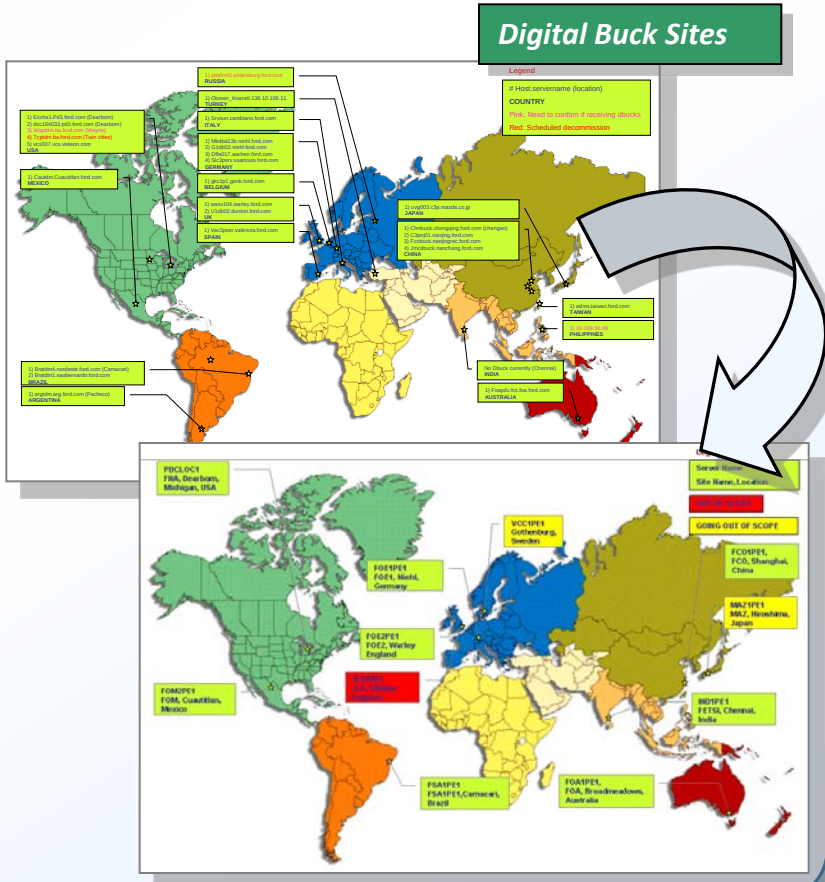
C3P NG Deployment Landscape

- Multi-Site data sharing established across all sites
- Each site can exchange data with any other site
- Consolidation effort is currently under way

Teamcenter Sites



Digital Buck Sites



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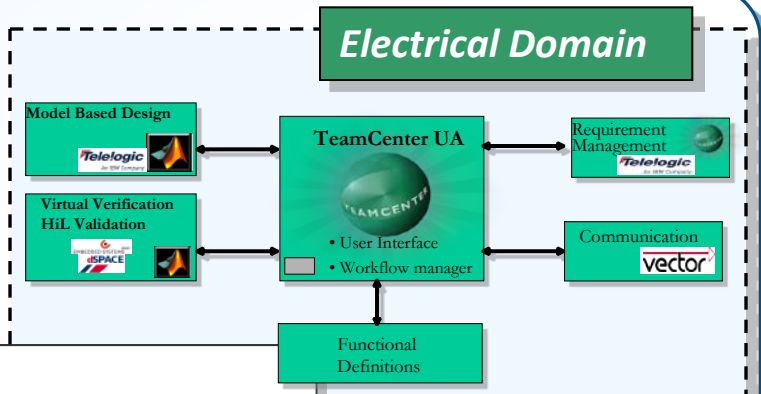
Sharing information across all PLM systems and tools

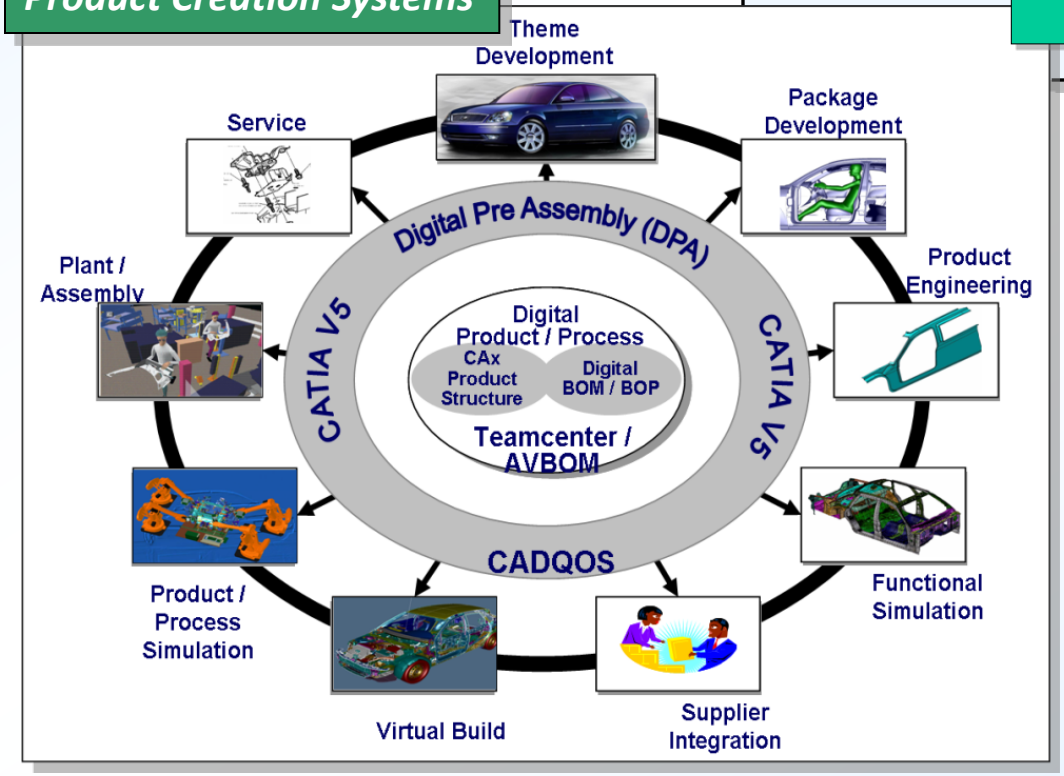
Business Systems

- Issue MGR
- WERS
- AIMS
- MPNR
- Parts Lib
- CCAS
- AVBOM

Electrical Domain



Product Creation Systems



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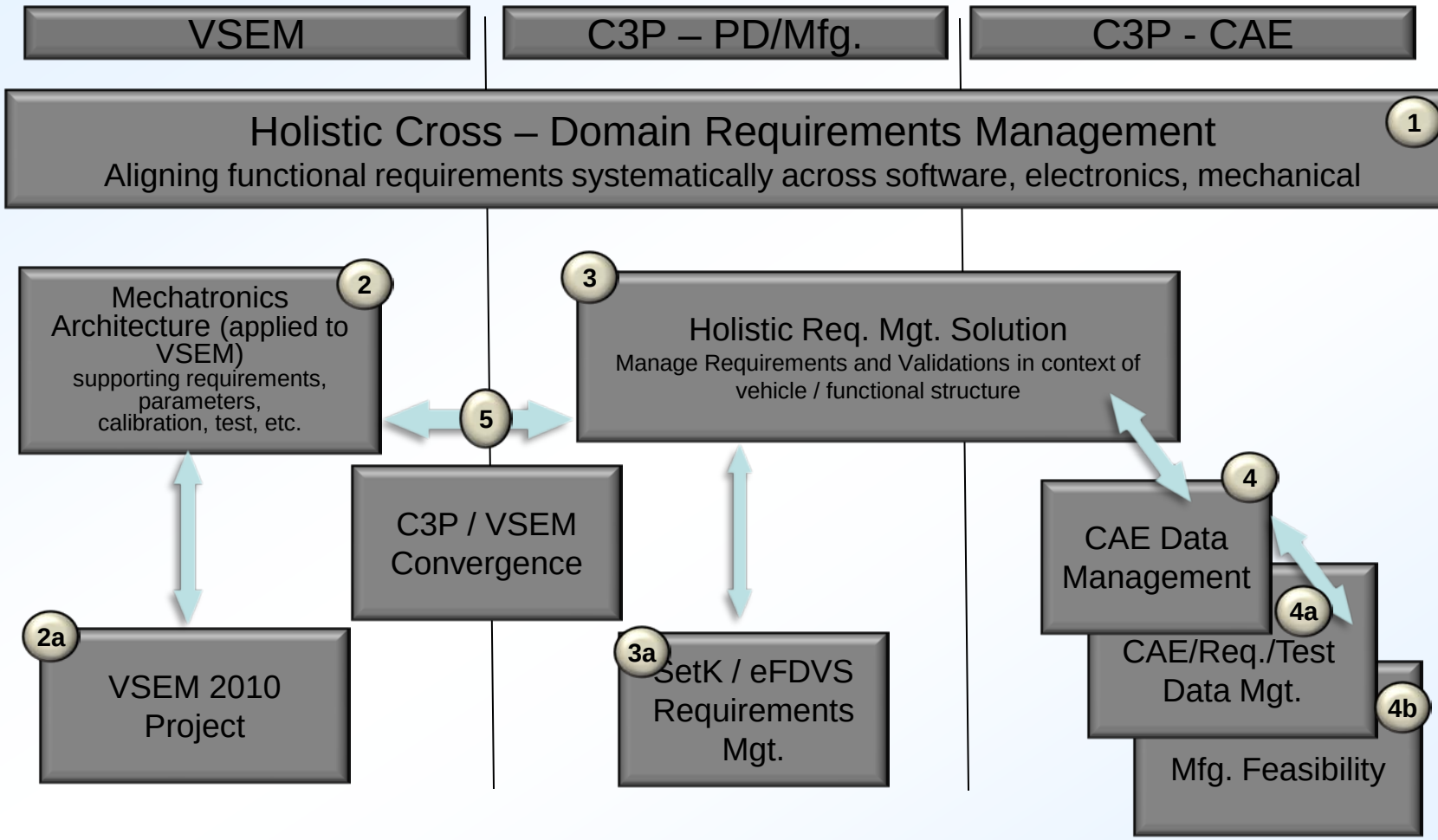
Systems Engineering Framework
Integrating CAD/CAE and VSEM



VSEM Infrastructure: *Information Architecture*

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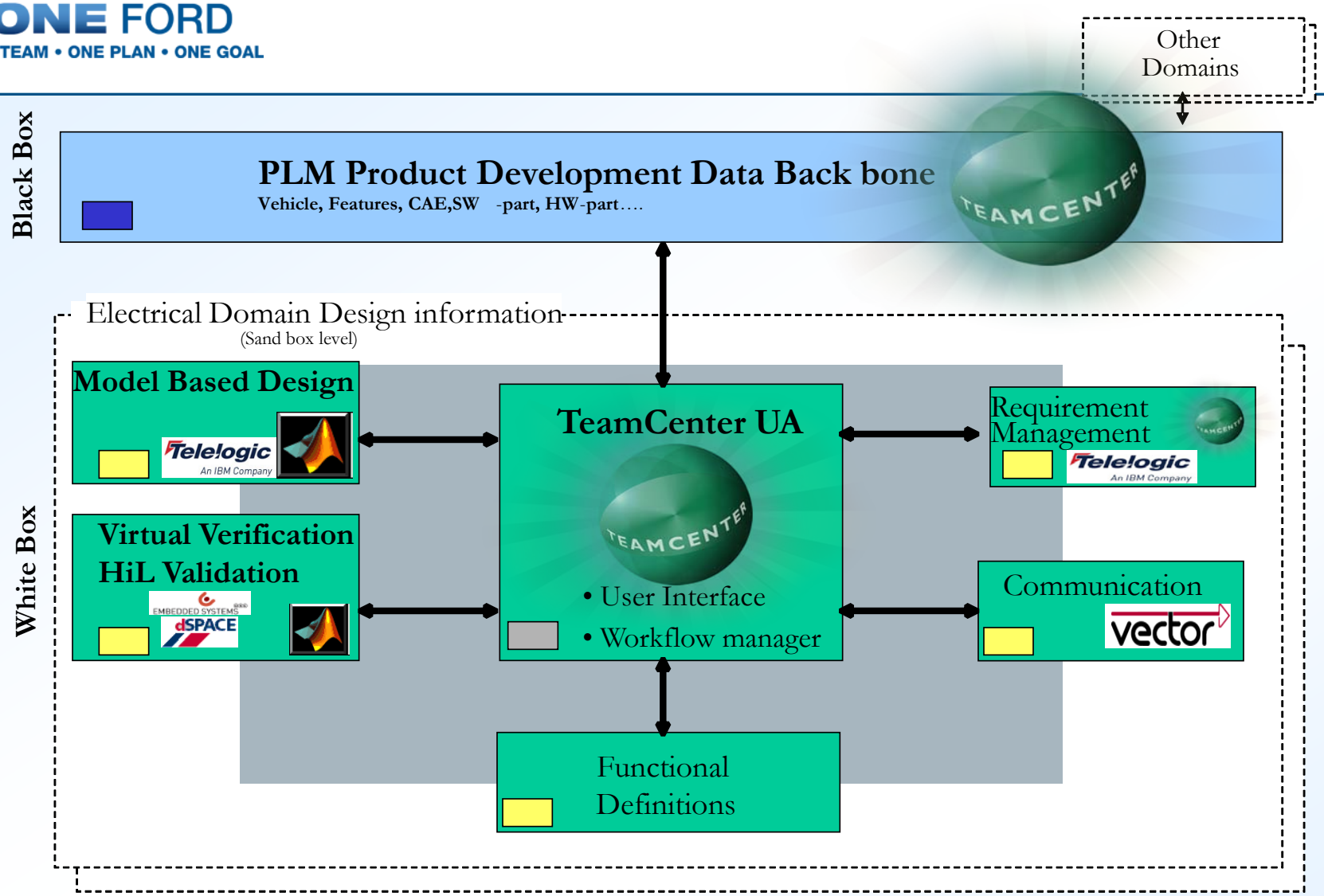

Global Enterprise information | Electrical domain information | Local information in point tools | ↔ Defined Exchange formats

- **Leveraging standard data exchange formats**
- **Minimize the number of E/E development tools**

- **Leverage existing Corporate infrastructure**
- **Global data replication supporting LCC development**
- **Allow best-in-class design tool usage**

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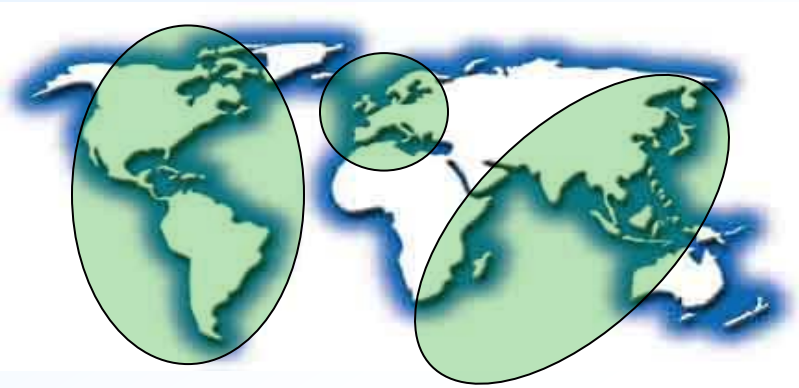
Interoperability – Level 3
Business Transformation

Old Way



Program Centric

New Way

Global Platforms

Global Commodities

Differentiated Top Hats

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C1 TECHNOLOGIES BEGAN THE PROCESS

Mazda3

Ford C-Max

Volvo S40

Volvo V50

3-Door

5-Door

4-Door

Wagon

Mazda5

Volvo C70

"If you look at C1, it's almost a microcosm of what we're trying to do in the enterprise as a whole," "Having a very strong and capable platform - and on top of that you put very unique products that are unique not just in how they look but are very consistent with the individual brand DNA." - Derrick Kuzak

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Key Business Drivers Summary

Key Business Drivers:

- ✓ **Capability**
  - **Provide an integrated Process/Methods/Tools Solution set with improved capabilities versus today**
  - **Improve Vertical integration <u>within</u> Brands**
  - **Required to provide BIC capability for Product Creation (Time to Market, Efficiency, Quality)**

- ✓ **Commonality**
  - **Enable product commonality cross brand (Platform, Commodities, etc.)**
  - **Improve Horizontal integration <u>across</u> Brands**
  - **Required to support increased cross brand technology sharing (e.g. CD3s, C1, EU-CD, B2e, etc.)**

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Global Product Creation Hierarchy of Enablers

Business Priorities

Reduce Time to Market

Reduce Cost | **Increase Profitability**

Capability & Commonality

Key Business Strategies

Commonality

- Distributed Engineering (LPEA, Commodities, PTO)
- Cross-brand Manufacturing
- Cross-brand Purchasing
- Platform Consolidation & Part Commonality

Cross Brand Efficiencies in Product Creation

Commonality Governance

Major Process/ Data / IT Enablers*

- GPDS and common Processes
- C3P-NG
- Single Product Definition
- Common BOM (Eng, Purch, and Manuf)*
- Transparent part number structure

Other Key enablers include: Engineering & Manufacturing Standards, Systems Library

Proposed Framework for prioritizing Process/ Methods/ IT Enablers

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Release Management Current Capabilities

- **Automated processes exist mostly within given toolsets and functions**
  - CAD Change Management Workflows (TeamCenter Engineering)
  - Worldwide Engineering Release System (Home-grown)
- **Hybrid Solutions exist at key functional or organizational touch-points within the Product Lifecycle**
  - CAD & Engineering (CAD / BOM Reconciliation)
  - Engineering & Purchasing (Part / Supplier Sourcing)
- **Non-Automated workflow processes tend to be found at soft-points within our processes.**
  - Time based triggers (BOM Scrub to meet milestones)
  - Less Formal Approval Required (Early Vehicle Program Changes)
- **Wide variation in CAD release methods cross functions**
  - Powertrain, Chassis, Body and across Vehicle/PT Development Centers
- **Overall loss of business efficiency due to:**
  - Variation in methods on global programs - vehicle teams follow different process based upon localized methods
  - Audit-based process adds unnecessary time and complexity to release/change process, and false sense of integrity of release/change event

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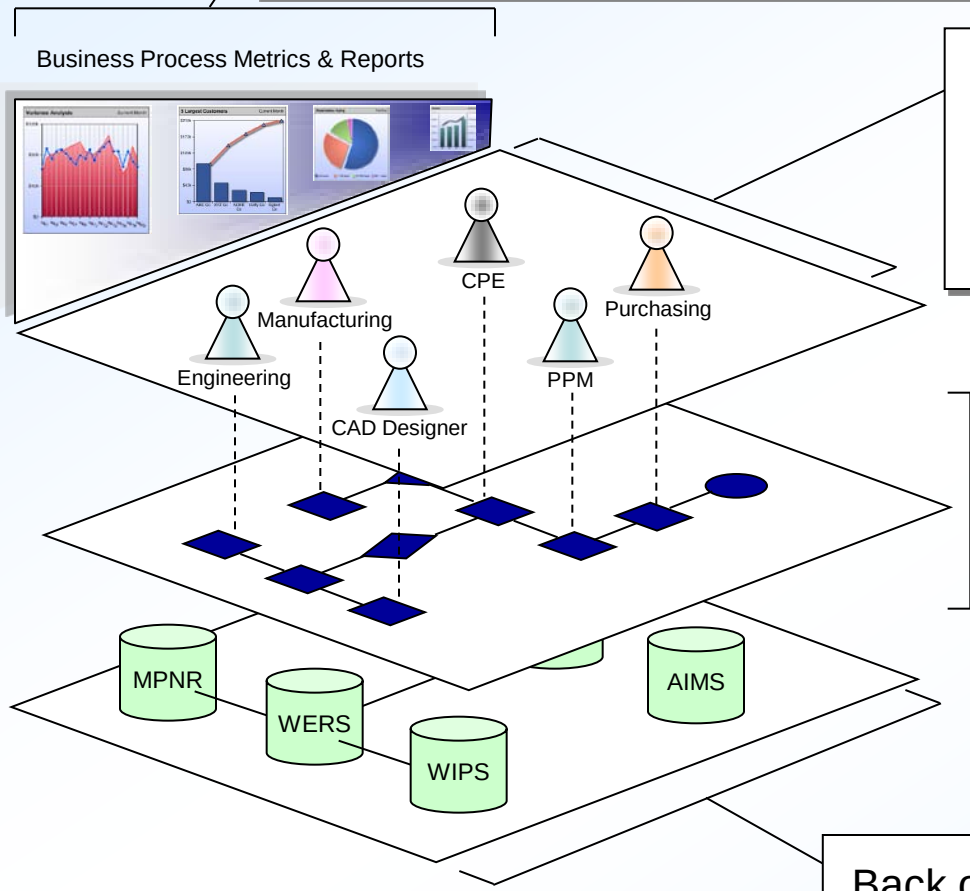
Strategic Workflow Direction

Metrics produced directly from the process



Users interact with a single process
- Removes complexity
- Users don't have to know the whole process

Process is mapped and codified:
- Scaleable
- Captures intellectual property

Back office environment is hidden from users

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Global P-Release and Change Management

Objective:

- Deliver streamlined global Process for P-Release and Change Management built upon the principle of ensuring BOM and supporting virtual data accurate and validated prior to P-Release and all production changes by:
  - Use of common global process across all functions and supporting global supplier business environment: **eliminates process variation across CBG and/or Engineering Functions.**
  - Bundling virtual data into a single Teamcenter object to support virtual review, validation and signoff in Teamcenter: **eliminates data re-entry, elimination of CAD information in WERS, eliminates use of review and signoff functionality in PPM Audit.**
  - Providing pre-validation tools to ensure that all of the data in the virtual environment supporting the release/change is aligned to the BOM (production drawings/CCTM, in-context DPA validation): **eliminates need for PPM Audit validation checks.**

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Example: New Global Purchasing Strategy

- Global supply base - “Aligned Business Framework”
- Reduce key supplier base 50%,
  - Mutual profitability and improving quality
  - Two or three global suppliers per commodity
    - Regional suppliers on an exception basis
- Develop “Commodity Business Plan”
  - 100+ sets of components
  - Reduce complexity and what is the
  - Migration plan with suppliers
  - Technology
  - Manufacturing footprint

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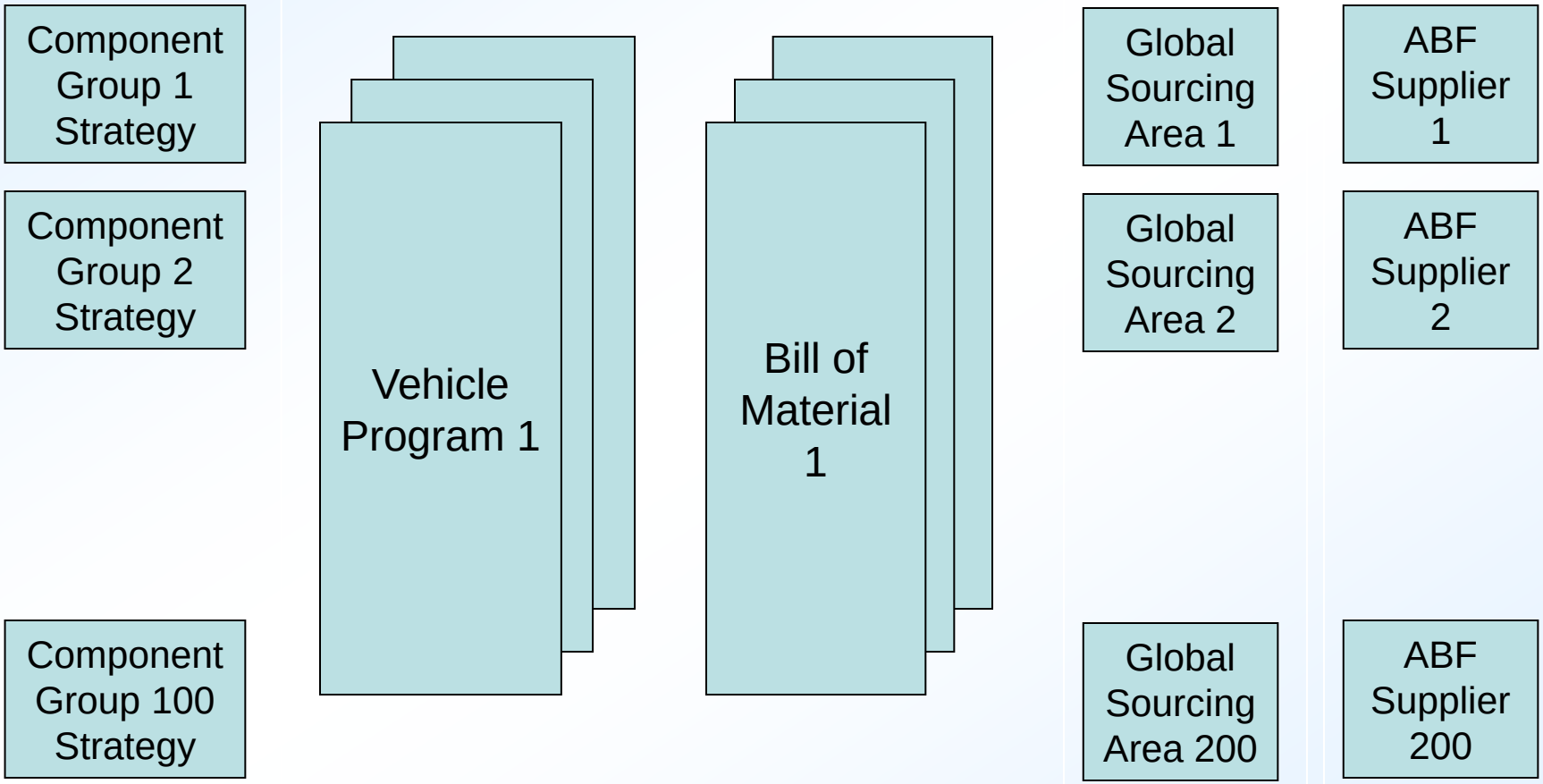
New Global Purchasing Strategy ➔ New Information and Interfaces



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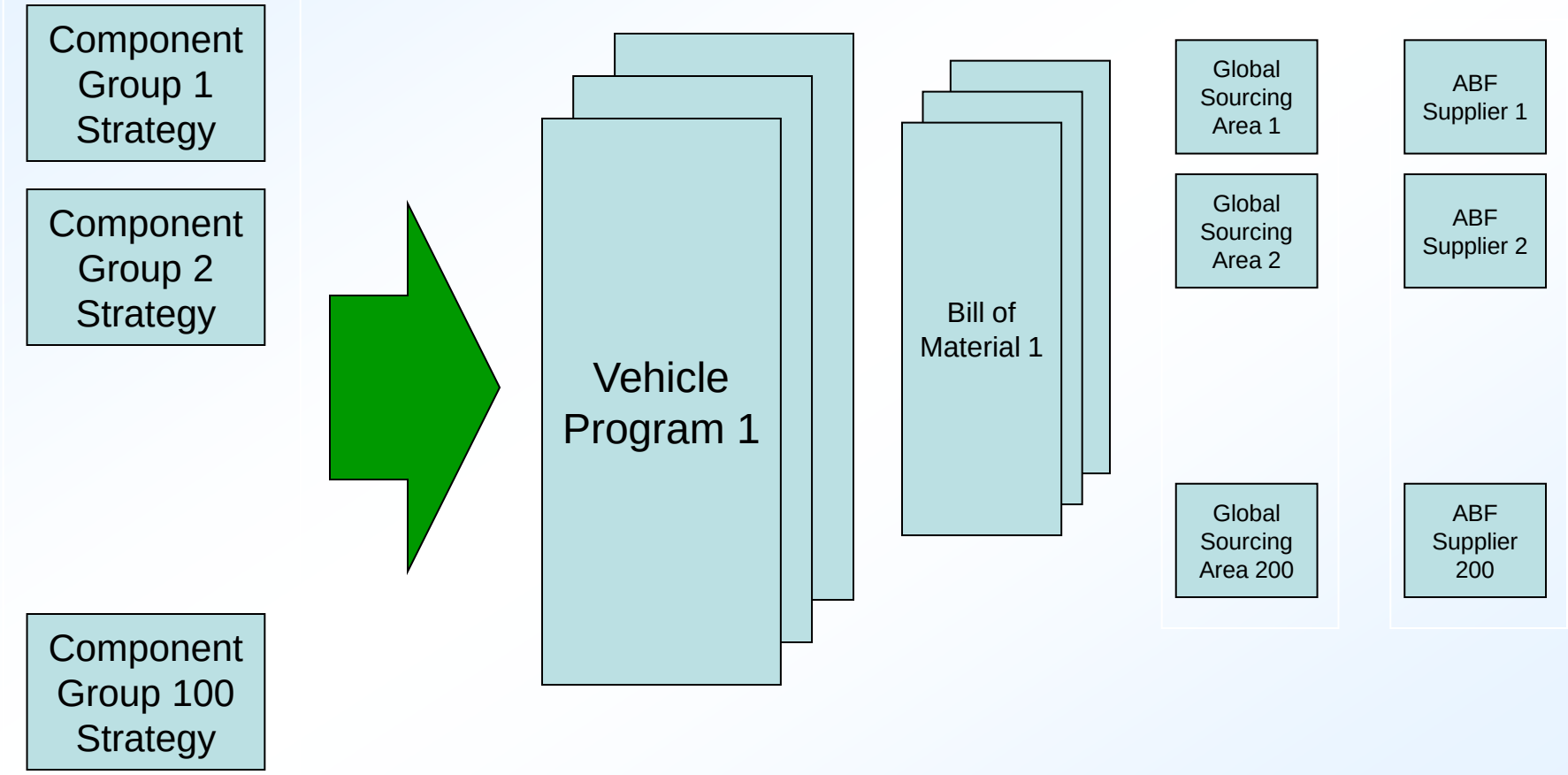

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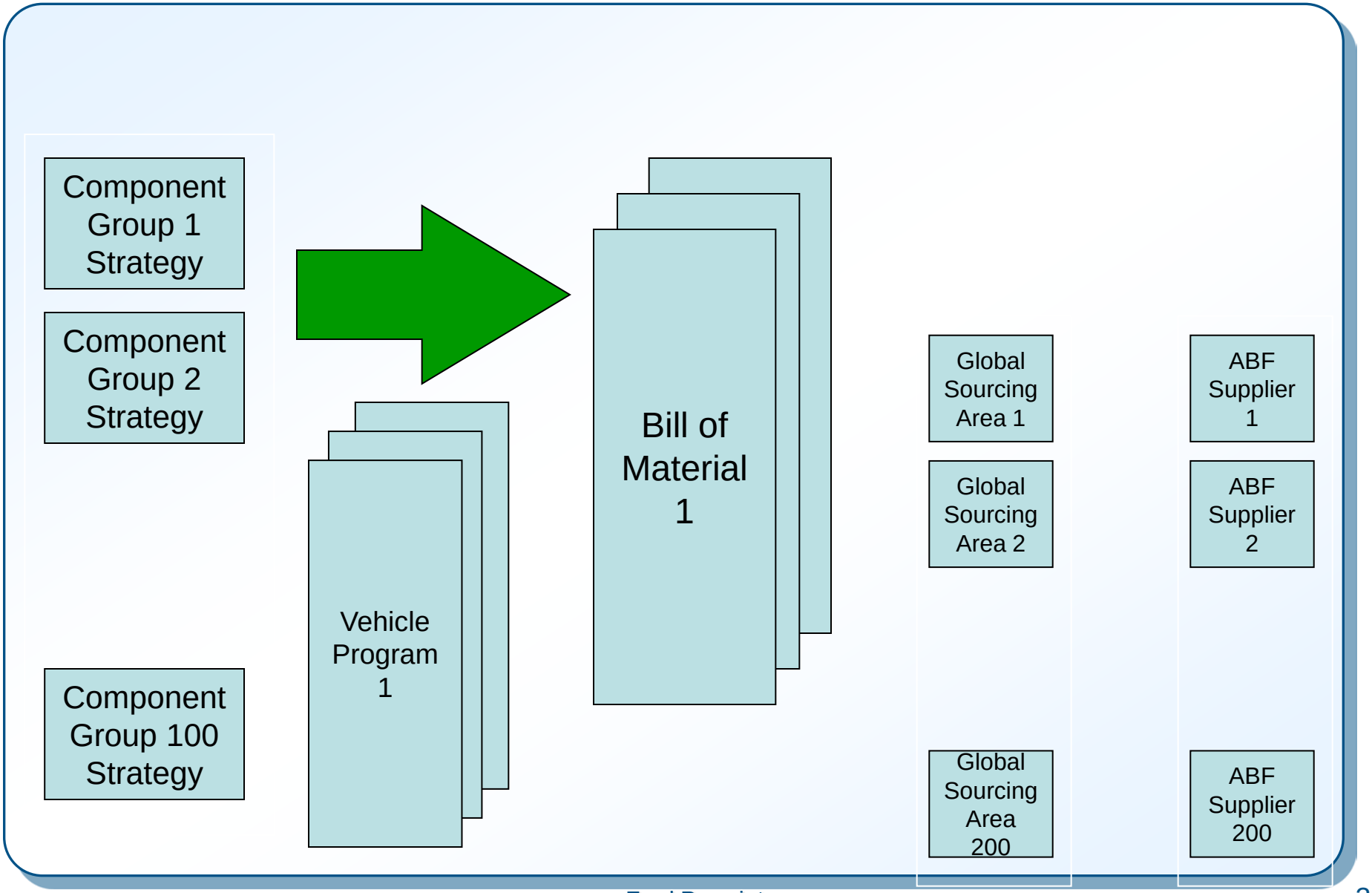
New Global Purchasing Strategy ➔ New Information and Interfaces



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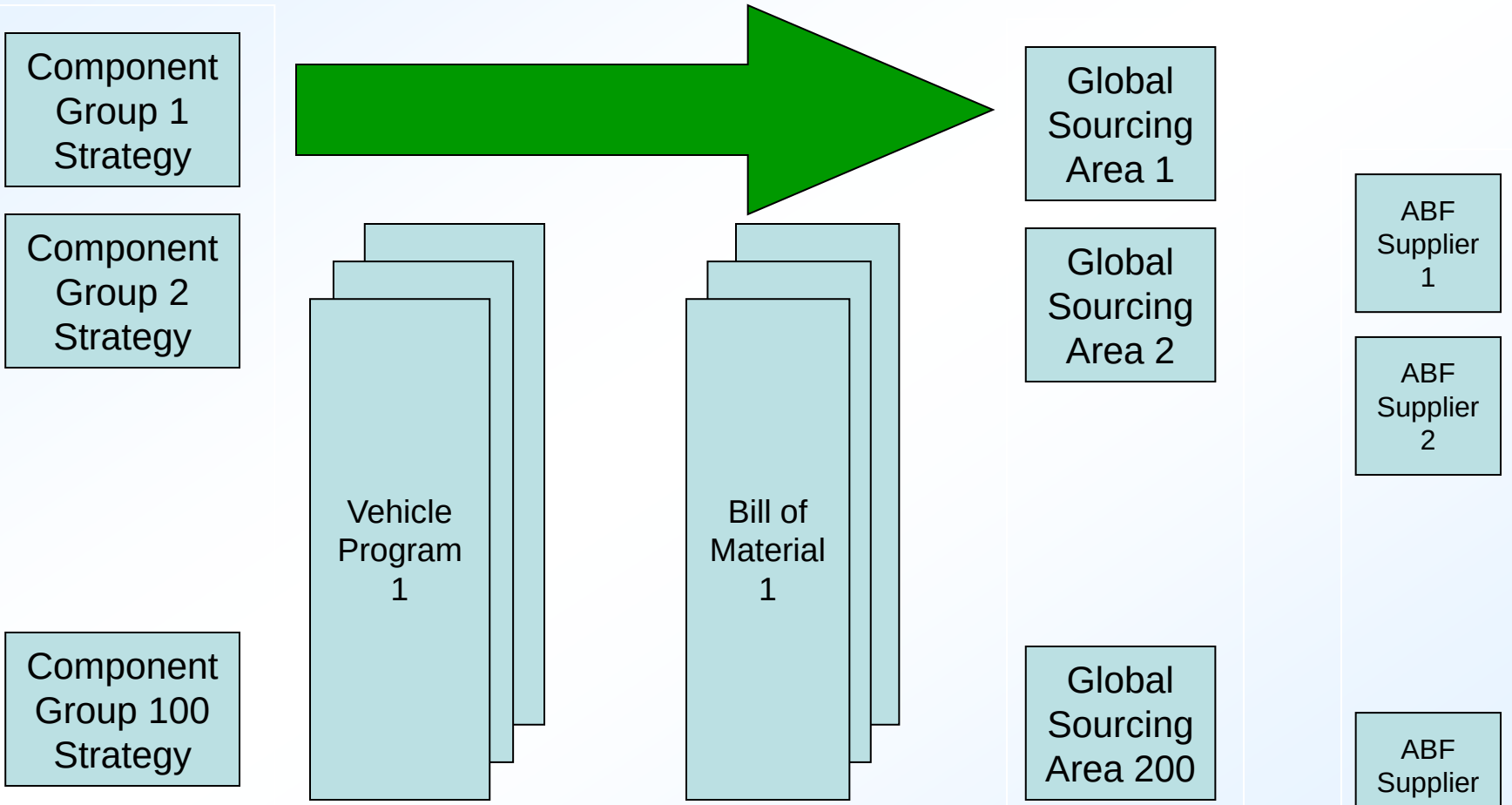
New Global Purchasing Strategy ➔ New Information and Interfaces



ONE FORD
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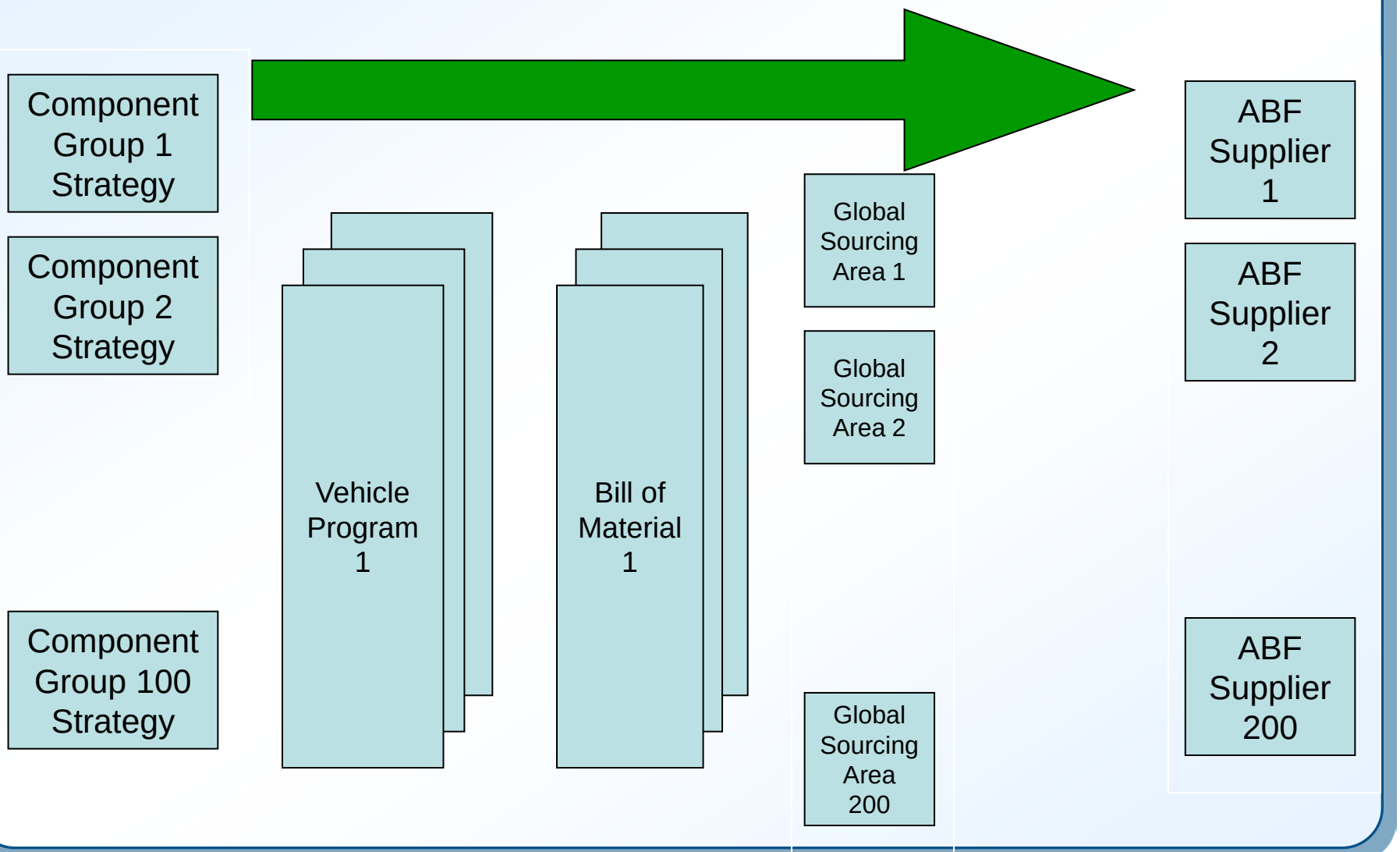
New Global Purchasing Strategy ➔ New Information and Interfaces



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Business Information Standards and Integration Enable Cross Functional Collaboration

Process – What work needs to be done when
(e.g. GPDS process specifies timing and deliverables of gateways)

Methods – How to do the work
(e.g. business rules and workflow to complete process deliverables)

Information
Data at the point of decision
(e.g. What does "Fuel System" mean? Does "Fuel System" mean the same thing to an engineer in Europe and an engineer in FNA?)

Tools

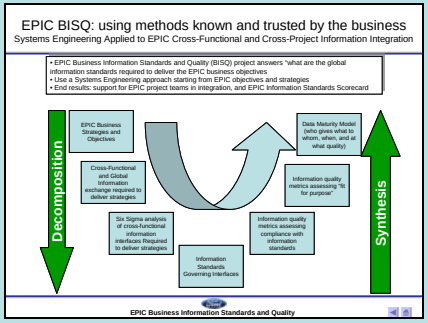
Applications – software customized to Ford's needs
(e.g. PeopleSoft, WERS, CMMS, ACM, SOE/SOF, etc.)

Infrastructure – network, computers, operating system, DB

To deliver the collaboration required for Ford's global transformation information needs to have the same meaning to all stakeholders globally. Information needs to comply with documented and accessible standards

Information Standards for the Industrial Backbone: Driving Efficiencies and Integration

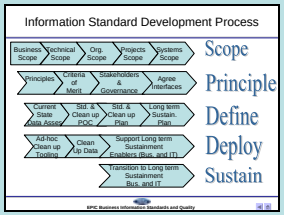
Defining the information landscape required to deliver EPIC and OneFord

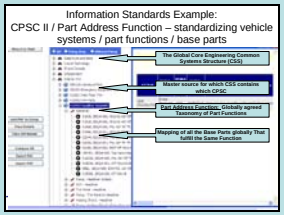


Systems Engineering and Lean Six Sigma Approach

Revolutionary ➔ New info. Req.
Evolutionary ➔ Clean up existing
Governance ➔ Info. Scorecard

Creating robust global information standards for the industrial backbone





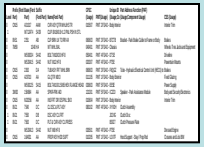
New process for creating information standards ➔ sustainable standards and quality

- **Part Address Func. (PAF)**
- CPSC II
- Base Part to Commodity
- BOM file scope (**PT/VL**)
- **Engineering Modules**
- **Features, and PAF rel.**

Working with "left hand side" organizations to deploy standards – PAF example

PAF in EIC CAD.

PAF in BOM

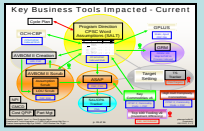


PAF in DPA

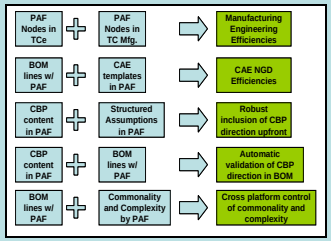
PAF in Mfg. Eng.

PAF in CBP

PAF in Assump.



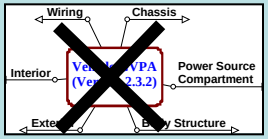
Working with Global Platform Programs and Process Owners to leverage standardized information to deliver GPDS efficiencies and cross-functional integration



Platform Deployments:
- B
- CD
- C

Results: increased business satisfaction from IT delivery, defragmentation of IT landscape

Examples:
- PAF enables Global Commodity Hub effectiveness



- Sunsetting of GPA simplifies IT deliverables

Business Results:

Manufacturing Engineering: Without PAF we can't contain the requirements of a global Manufacturing Engineering process

Digital Innovation: PAF based reporting drives CAD-BOM alignment, and the CAD structure

Attributes (NVH): It's going to greatly improve the process for engineers, enable identifying issues early, and constantly staying on the status of the CAD

Global Material Cost: Detailed BOM comparisons that took weeks can be done in minutes, it's a major enabler for us

Program Management: prior solutions addressed multiple symptoms, they never provided a platform the business can cross functionally converge, I feel [with PAF] we now have the critical mass

Thank You