Innovate2010
IBM開發者大會

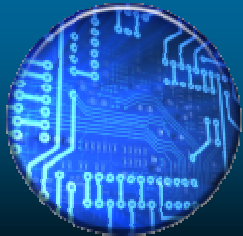# Smart Product Lifecycle Management

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Let's build a smarter planet.

August 31, 2010 台北喜來登

Competition and customer demand are driving increased product complexity and changes in product development and delivery

Electronics

Cell phones are completely instrumented, with GPS positioning software that helps the device know where you are

Need for product differentiation driving increasing amount of software into products

Automotive

In-vehicle electronics and software value will increase 35-40% by 2010

90% of innovation is based on electric / electronic systems - 80% of this is based on embedded software
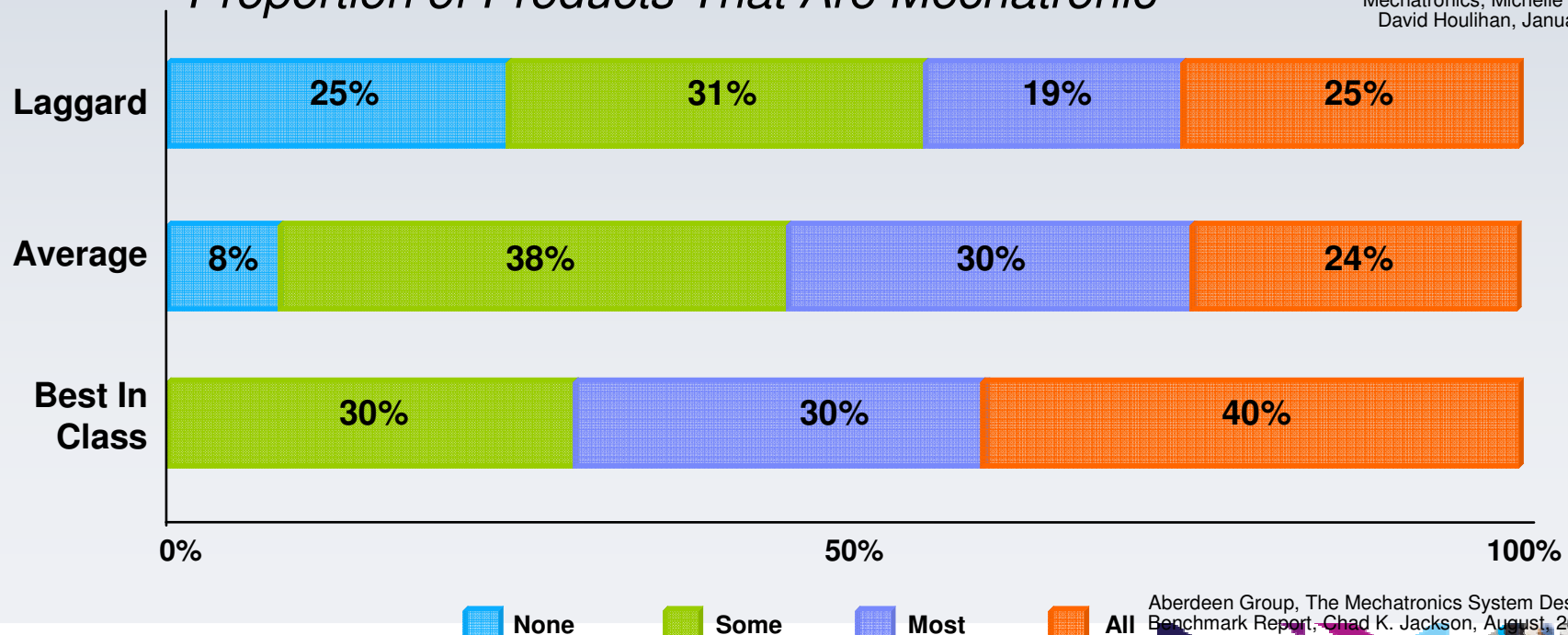
Aerospace & Defense

F-22 Raptor (2003) contains 1.7 million lines of code

F-35 Lightning II (scheduled for 2010) will have 5.7 million lines of code

Increased use of design partners across all disciplines

Product Innovation relies more on integration of mechanical, electrical and software components

Mechatronic product development has added a new level of complexity to product development as companies strive to integrate mechanical, electrical
and software components into their products.

Proportion of Products That Are Mechatronic

Aberdeen Group, System Design:
New Product Development for
Mechatronics, Michelle Boucher,
David Houlihan, January, 2008

	None	Some	Most	All
Laggard	25%	31%	19%	25%
Average	8%	38%	30%	24%
Best In Class		30%	30%	40%

0%   50%   100%

None   **Some**   **Most**   **All**

Aberdeen Group, The Mechatronics System Design
Benchmark Report, Chad K. Jackson, August, 2006

With increase in product complexity, the impact of software content may have dramatic results

Aerospace Agency

$1B prototype rocket self-destructs just 40 seconds after takeoff due to a software bug in the on-board guidance system
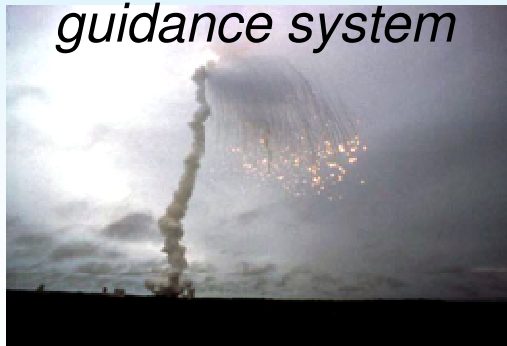
Microsoft Zune

1 million owners of the 30-gigabyte device woke up one morning to find their devices inoperable due to poor leap year handling

Ford Super Duty Pickup

Sales interrupted until engine control software could be updated to recognize improper levels of heat in the exhaust system

Market Leaders Are Responding To Pressures
By Implementing Solutions Organized Around Business Needs

Design Chain Management

Requirements Engineering and Management
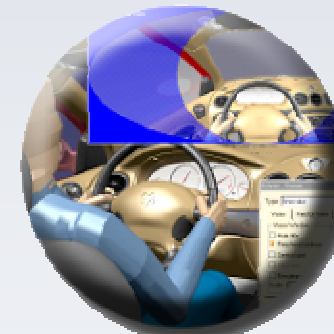
Software Development

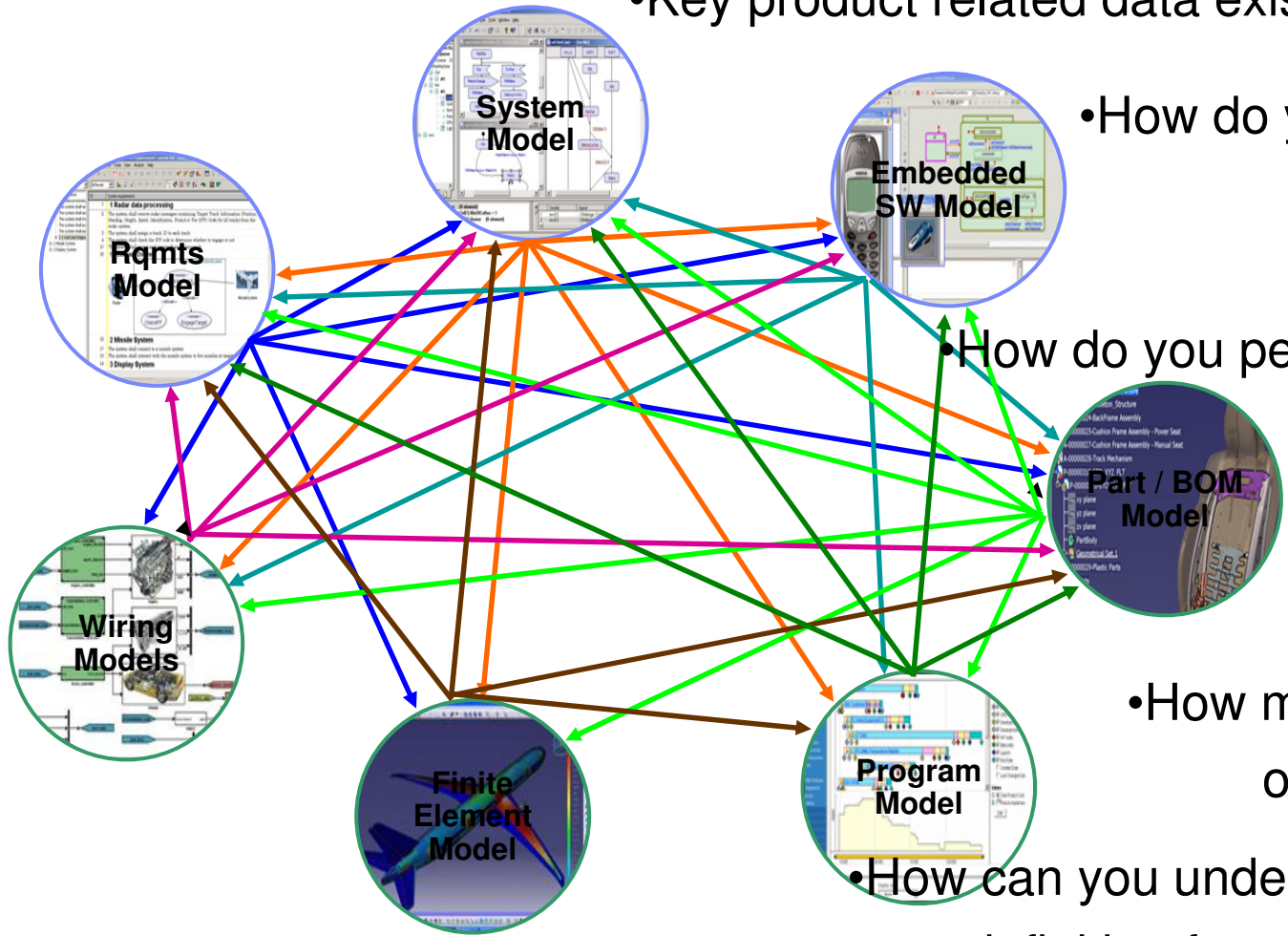**Electrical and Electronics Development**

Mechanical Development

Program and Portfolio Management

Systems Engineering

The Design Problem

- Key product related data exists in different systems

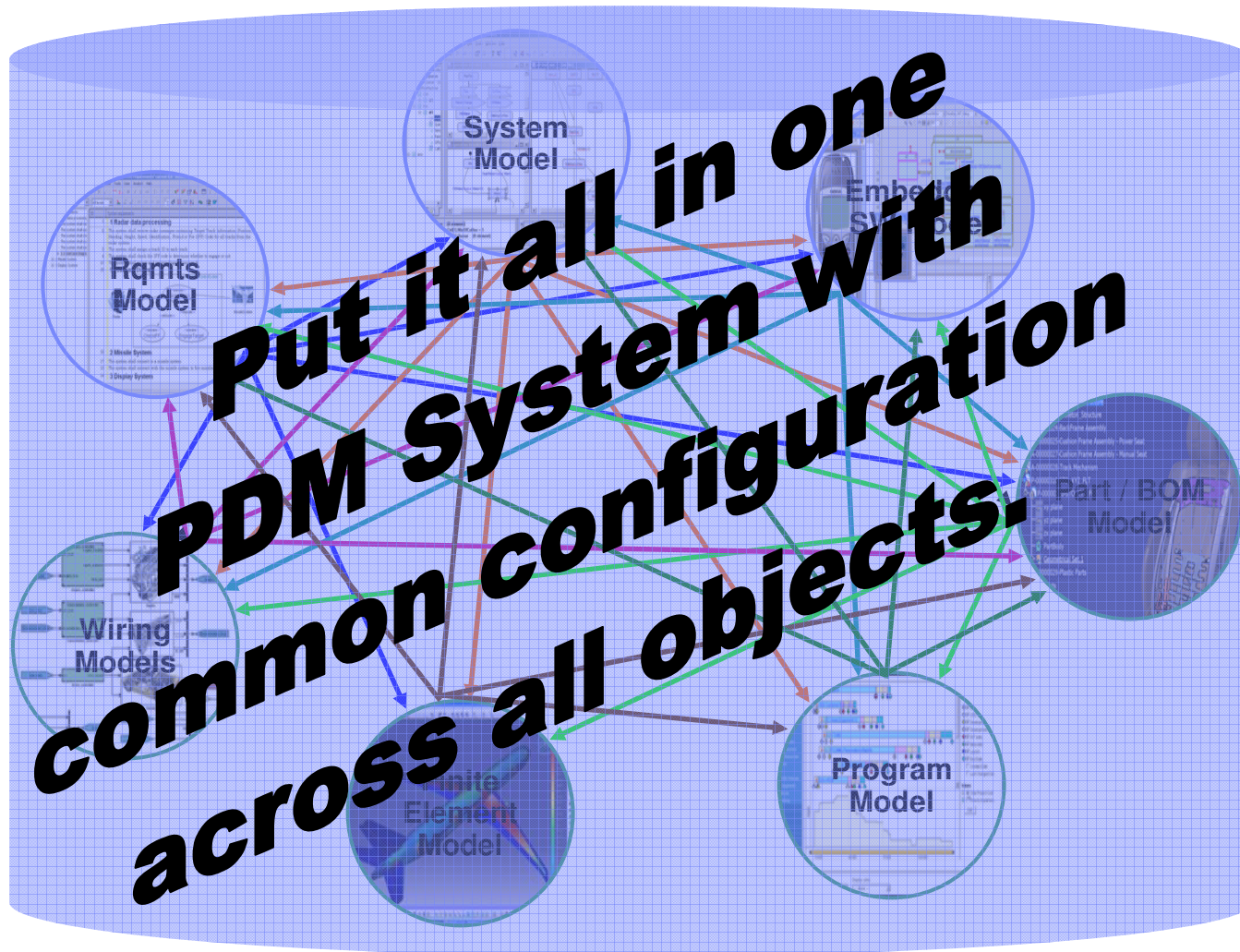- How do you do traceability?

- How do you perform impact analysis?

- How many times is the same object duplicated?

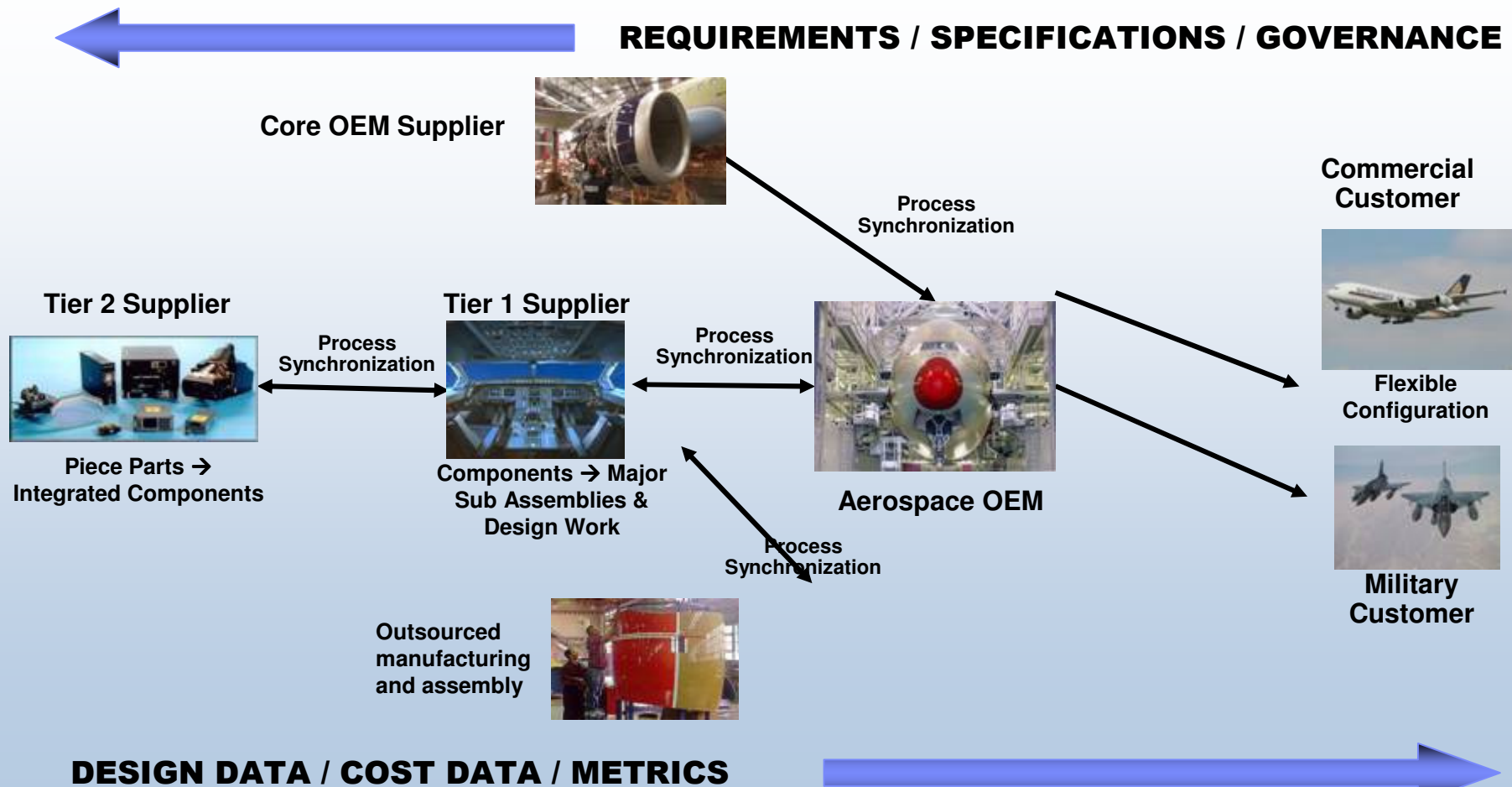- How can you understand the complete system definition for a specific configuration?

System Model

Embedded SW Model

Rqmts Model

Part / BOM Model

Wiring Models

Finite Element Model

Program Model

PLM ISV Approach

Need to Coordinate System Definition Up and Down the Collaborative Design Chain

Collaborative Product Design and Development

REQUIREMENTS / SPECIFICATIONS / GOVERNANCE

Core OEM Supplier

Process Synchronization

Commercial Customer

Flexible Configuration

Tier 2 Supplier

Process Synchronization

Tier 1 Supplier

Process Synchronization

Aerospace OEM

Piece Parts → Integrated Components

Components → Major Sub Assemblies & Design Work

Process Synchronization

Outsourced manufacturing and assembly

Military Customer

DESIGN DATA / COST DATA / METRICS

Challenges in Today's Global Development Environment

Resulting in:

Lack of mechanisms to express holistic system view

Poor link between requirements and design

Poor artefact management across engineering domains

Inability to trace product artefacts to processes

They each say they're 95% complete but we can't get the system to run in the lab. What is going on?
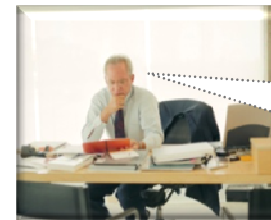
Why is the project over budget and behind schedule?

Engineering Manager

It must be a software problem

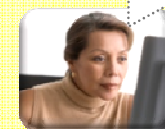The OEM changed the specs and forgot to tell us

Many different Roles

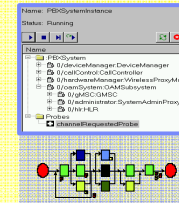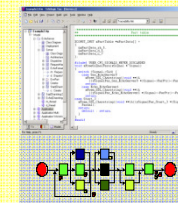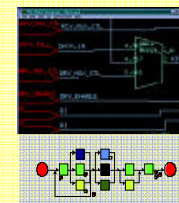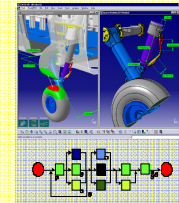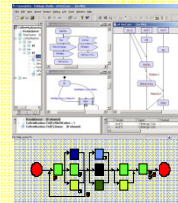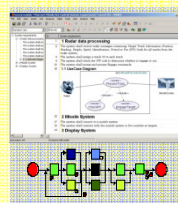| Req'ts Engineer | Systems Engineer | Hardware Engineer | Wiring Engineer | Software Supplier | Field Maintenance |

Best of Breed Applications with

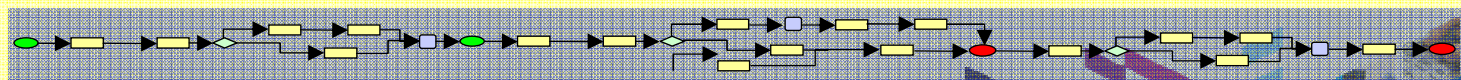Application Specific Processes

Domain Specific Program Assets

| Assets | Assets | Assets | Assets | Assets | Assets |

Enterprise Processes

New Product Development and Systems Engineering
Integrating Software, Mechanical and Electronics

Capability to manage product requirements
across stakeholders
- Improves ability to integrate products across multiple development environments leveraging a common view of requirements
- Facilitate trade-off decisions

Traceability of requirements to the rest of the development artifacts and design history
- Improving communication across teams
- Facilitating compliance and auditability

Propagate changes across multiple domains
- Shorten delivery times and lower product cost
- Continuous improvement and quality of products
- Helping integrate PLM processes across domains (and suppliers) using PDIF/SOA

Requirements engineering and integrated product change management

Process & product management

Requirements management | Architecture management | Quality management

Change & release management

SOFTWARE   **MECHANICAL**   **ELECTRONIC**
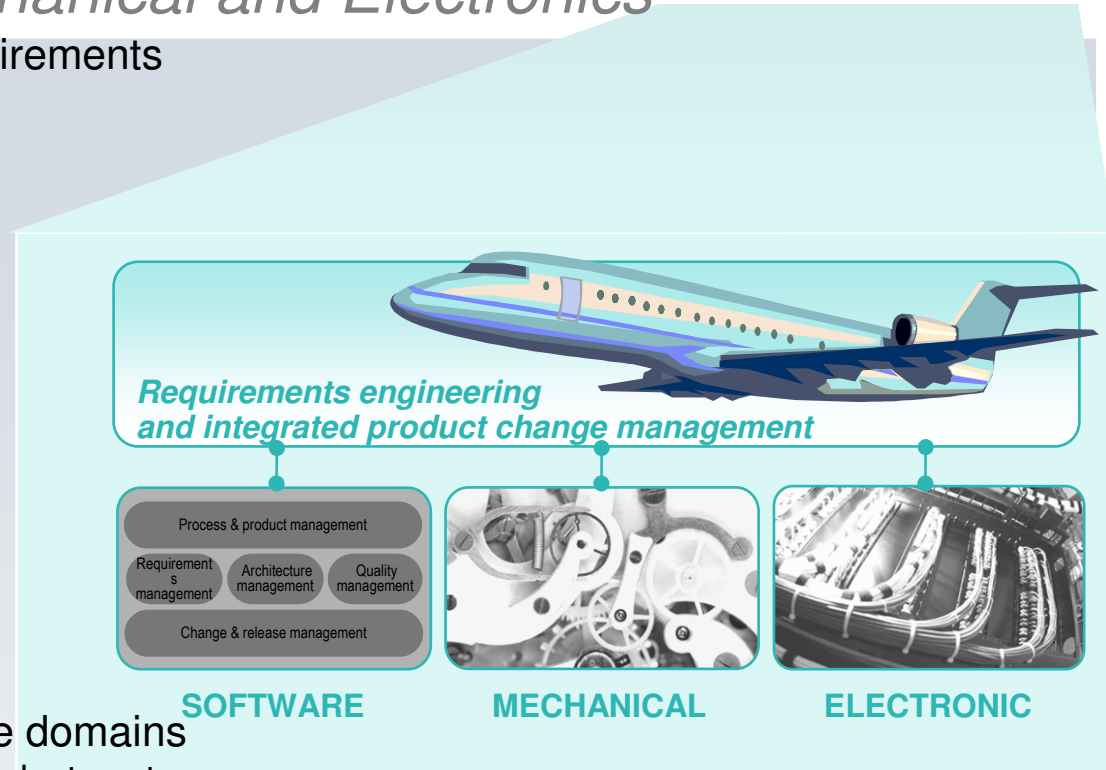
An enterprise-level solution is needed that supports real time cross domain collaboration throughout the product lifecycle.

Platform of tools for the full lifecycle of software development for systems

Integration of product development teams across all design domains and the enterprise

Tools that automate systems engineering best practices and industry-specific standards

Support for large scale and "teams of teams" development projects, including the extended team of contractors and suppliers

Manage all product requirements from customer needs through the full product lifecycle and end of life

Solutions that integrate with the IBM PDIF framework

What's Required - Adopt a Systems Engineering Approach

Systems Engineering is an **interdisciplinary** approach and means to enable the realization of successful systems. It focuses on defining **customer needs** and required **functionality** early in the development cycle, documenting **requirements**, then proceeding with **design** synthesis and system **validation** while considering the **complete problem**...."

International Council on Systems Engineering (INCOSE)

Enterprise Integrated Systems Engineering
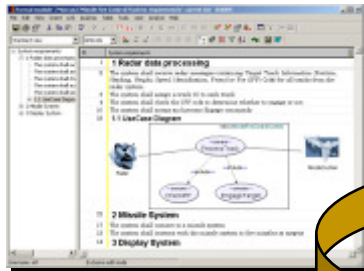
Req'ts Management

- Capture Requirements

- Link Requirements to the system model

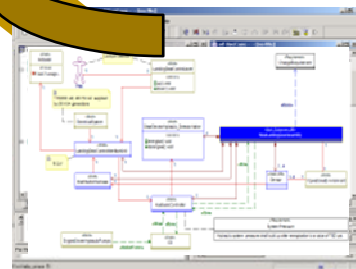- Refine model, simulate and verify architecture.

- Allocate functional architectural components to mechanical, electrical, and ESW dev. domains.

- Provide change management and traceability from requirements to all system artifacts.

System M...

Solution Atributes

- Dependencies and Relationships defined from requirements down to related artifacts in each system.

- Connectivity of related systems provided through SOA based integration architecture.

- Configuration control and tracability between systems provided as common SOA services .
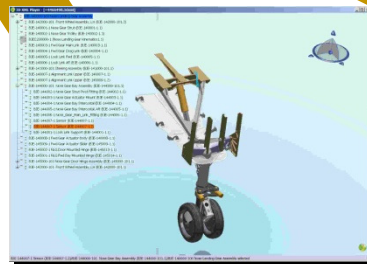
Mechanical Design
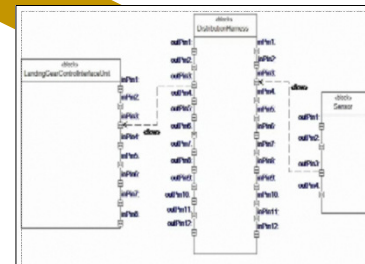
Electrical Design
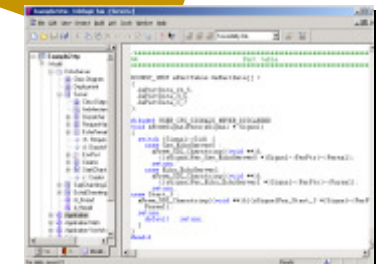
Embedded SW Design

Business Benefits of Enterprise Integrated Systems Engineering

Induced Errors

Costs of Design Change

Time

| Requirements | Design | Implementation | Test |

~$80/defect

During the requirements phase

~$240/defect

During the design & construction phase

~$960/defect

During the QA/Testing phase

~$7,600/defect

Once released as a product
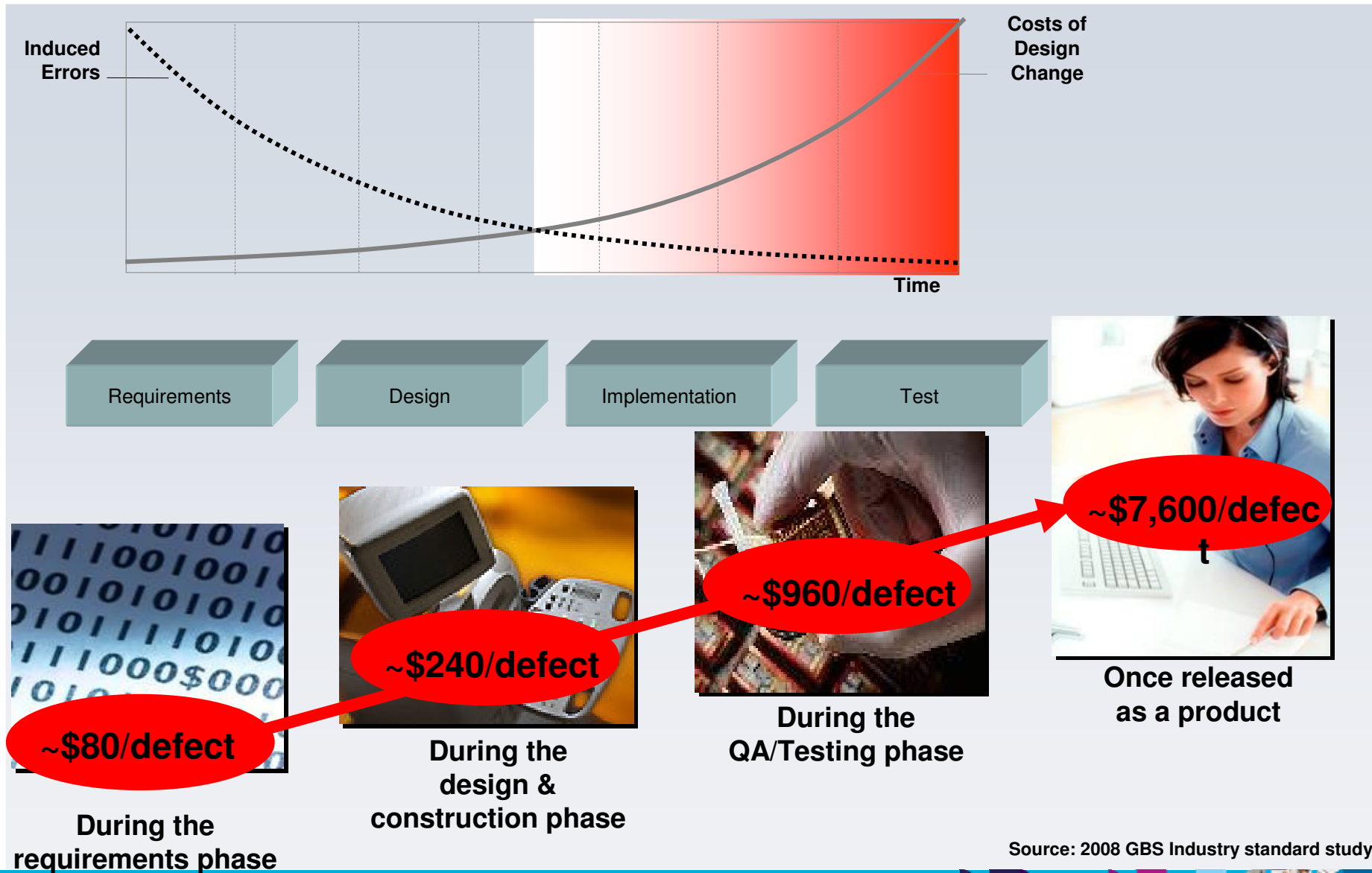
Source: 2008 GBS Industry standard study

Systems Engineering Enables Cross Domain Collaboration

So, why is Systems Engineering so critical to cross domain collaboration?

Systems Modeling is Key to Cross Domain Collaboration

Linkage of Requirements to Model Components

Allocation of Model Components to Detailed Design Domains

Constraints and Relationships Defined

Systems Model Simulation and Validation Supported

Roles

| Req'ts Engineer | Systems Engineer | Software Supplier | Wiring Engineer | Hardware Engineer | Field Maintenance |

Applications

Assets

Assets | Assets | Assets | Assets | Assets | Assets

Master Plan
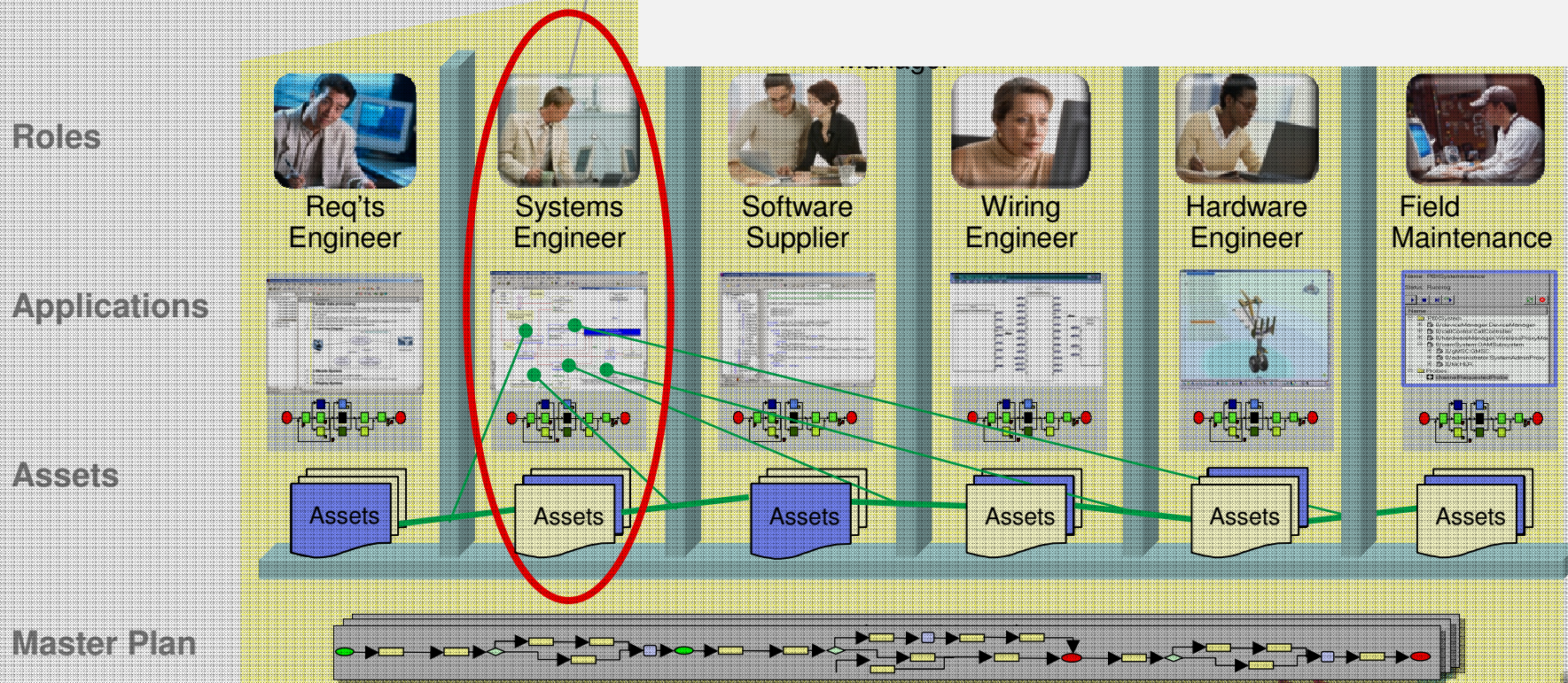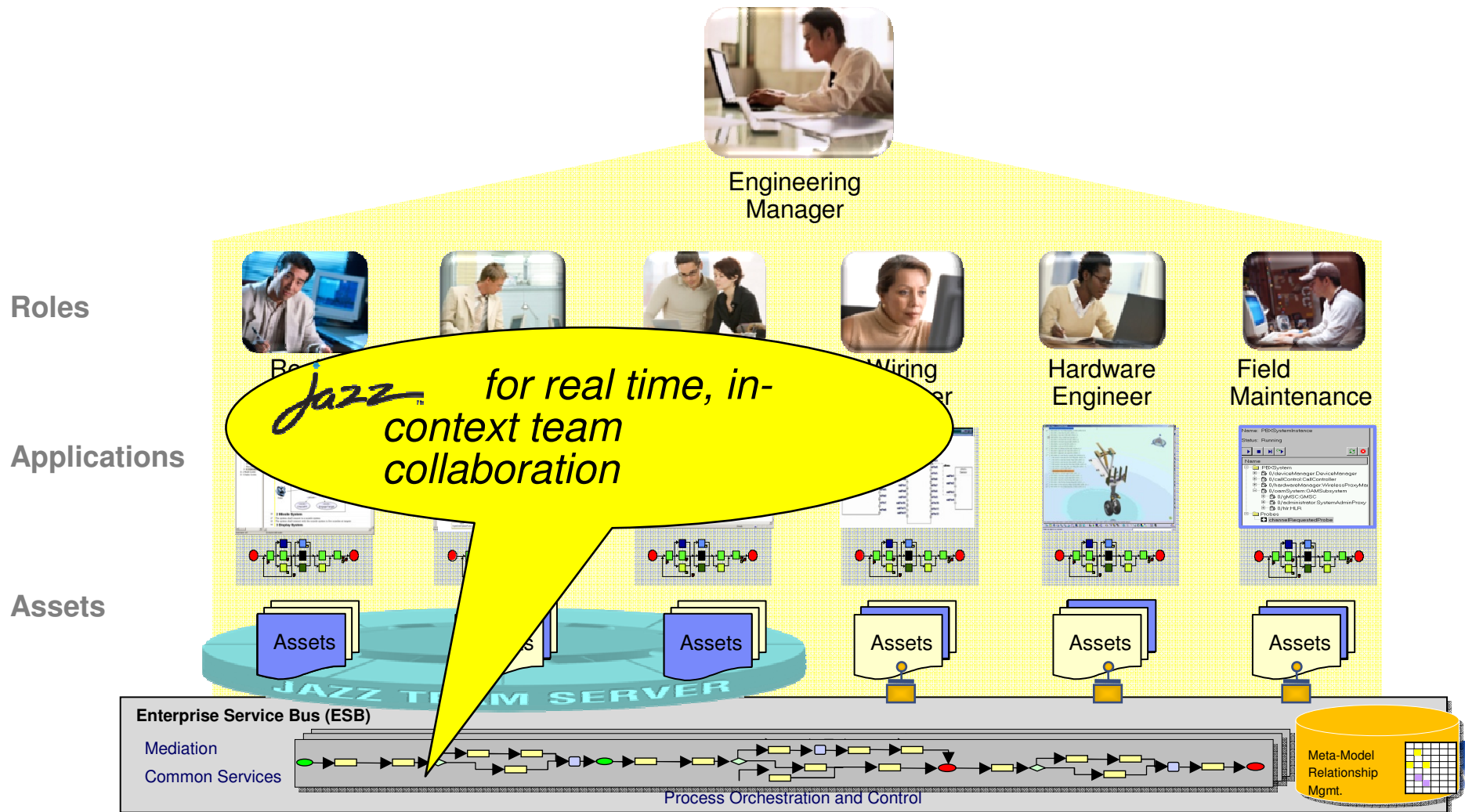
The Framework Supports Smart PLM Solutions
Delivered by IBM and its business partners

PLM Solutions

Requirements Engineering and Management

Mechanical Development

Design Change Management

Systems Engineering

Program and Portfolio Management
Electrical and Electronics Development
Software Development

Business Partners

PTC

DASSAULT SYSTEMES

CENTRIC

MSC Software

geometric

PROSTEP

ORACLE

SIEMENS

Product Development Integration Framework

Business Decision Support

Flexibility and Responsiveness

Smart SOA

Integration with the Value Chain

Collaboration

Infrastructure and Governance

IBM

Integrated Solution Architecture for PLM Systems Engineering

Requirements Planning,
Product Modeling

Project, Program Mgmt.

Role based, composite
view of PLM data
from multiple sources

Scorecarding
& Dashboarding

Planning, Budgeting
& Forecasting

Reporting, Analysis

Enterprise Service Bus (WPS)

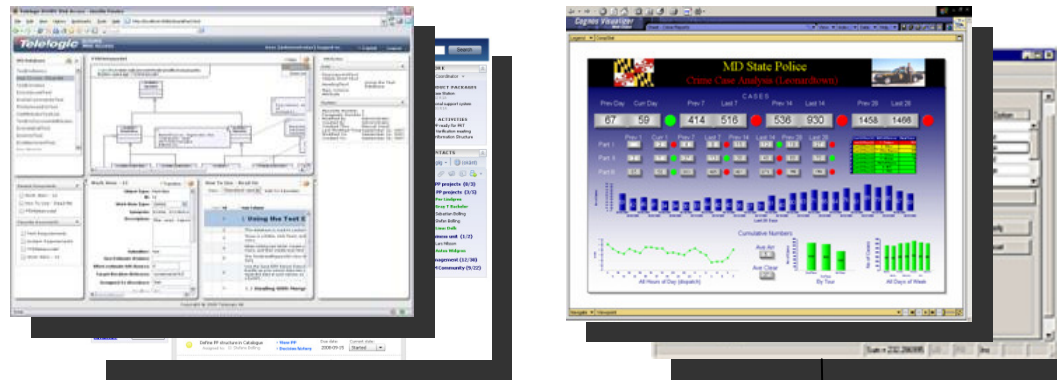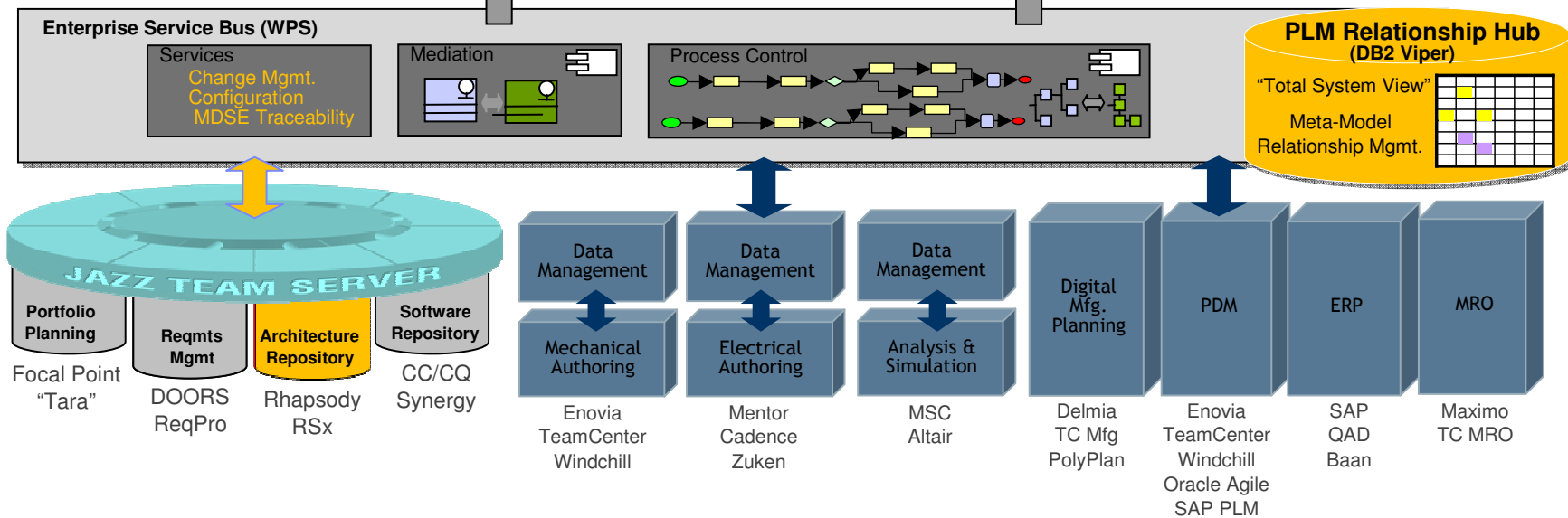| Services	Mediation	Process Control
Change Mgmt. Configuration MDSE Traceability		

PLM Relationship Hub
(DB2 Viper)

"Total System View"

Meta-Model
Relationship Mgmt.

JAZZ TEAM SERVER

Portfolio Planning	Reqmts Mgmt	Architecture Repository	Software Repository
Focal Point "Tara"	DOORS ReqPro	Rhapsody RSx	CC/CQ Synergy

Data Management	Data Management	Data Management	Digital Mfg. Planning	PDM	ERP	MRO
Mechanical Authoring	Electrical Authoring	Analysis & Simulation				
Enovia TeamCenter Windchill	Mentor Cadence Zuken	MSC Altair	Delmia TC Mfg PolyPlan	Enovia TeamCenter Windchill Oracle Agile SAP PLM	SAP QAD Baan	Maximo TC MRO

Solution Benefits

Reduce the time to propagate changes throughout the entire design team

- Reduce turn-around-time in design & defect resolution
- Reduce discovering 'missed' changes late in the project

Improve management of multiple engineering disciplines

- Increase visibility of schedules, including impact of requirements & product changes
- Enhance the ability to manage project costs

Leverage existing investment in Product Lifecycle Management (PLM), Product Data Management (PDM), and Software development platforms

Thank You

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