IBM Software Group

Turning Product Development Into Competitive Advantage:

IBM Rational Solutions for Systems and Software Engineering in Aerospace & Defence

Reduce the Time, Cost and Risk of Developing Profitable Products and Systems

Go to IBM

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A&D today

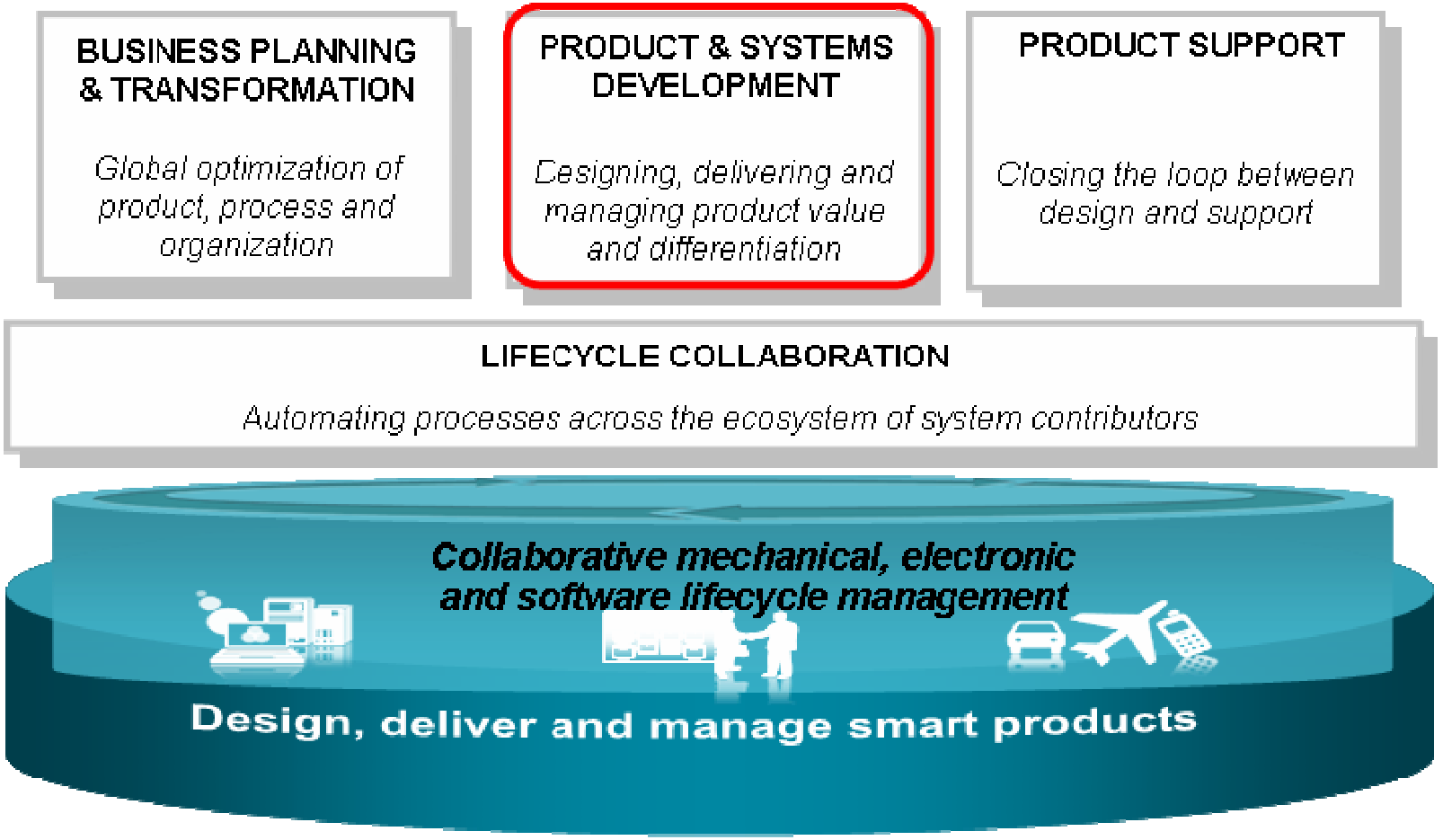
- Shrinking budgets
- Increased demands
- Do more for less

Agenda

- Collaborative product development platform
- Accelerated paths to value

Introduction to IBM Innovation Strategy

Integrated Product Management



Complexity Creates Development Challenges

Leading to cost overruns, schedule slips and quality issues

Poor requirements engineering = failed projects

Paper-based and manual processes hinder efficiency

Complex architecture is difficult to textually explain

Functionality is poorly distributed across components

Hardware/software integration is often late

Many organizations lack formalized practices

Silos of people, process, and projects

Geographic Barriers

- Poor communication
- Language, culture, time
- Process gaps resulting in rework

Organizational Barriers

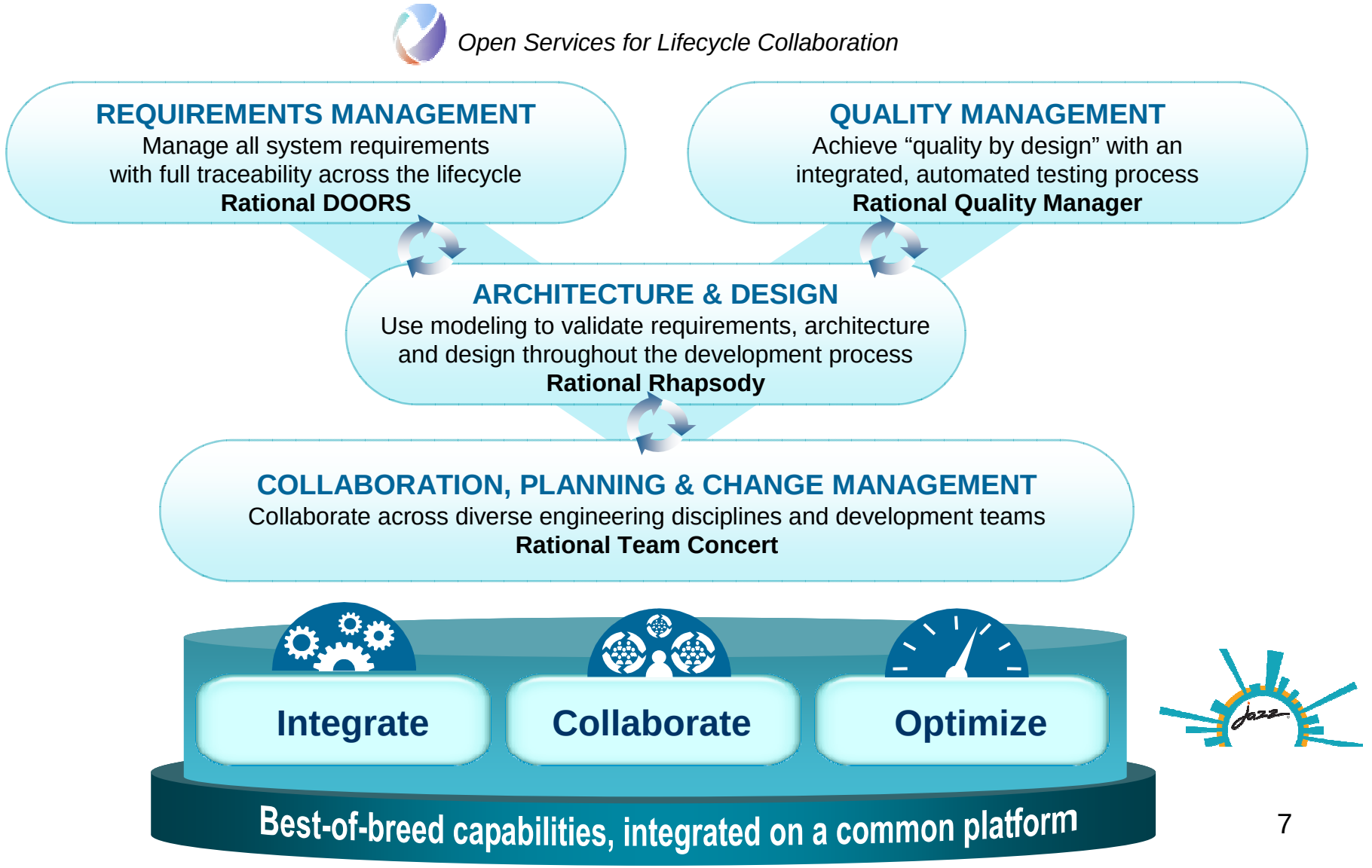
- Weak collaboration
- Poor project governance and LOB oversight
- Security of IP

Infrastructure Barriers

- Incompatible tools
- Unreliable access
- Lengthy on-boarding
- Inflexible integration

Rational Solutions for Systems and Software Engineering

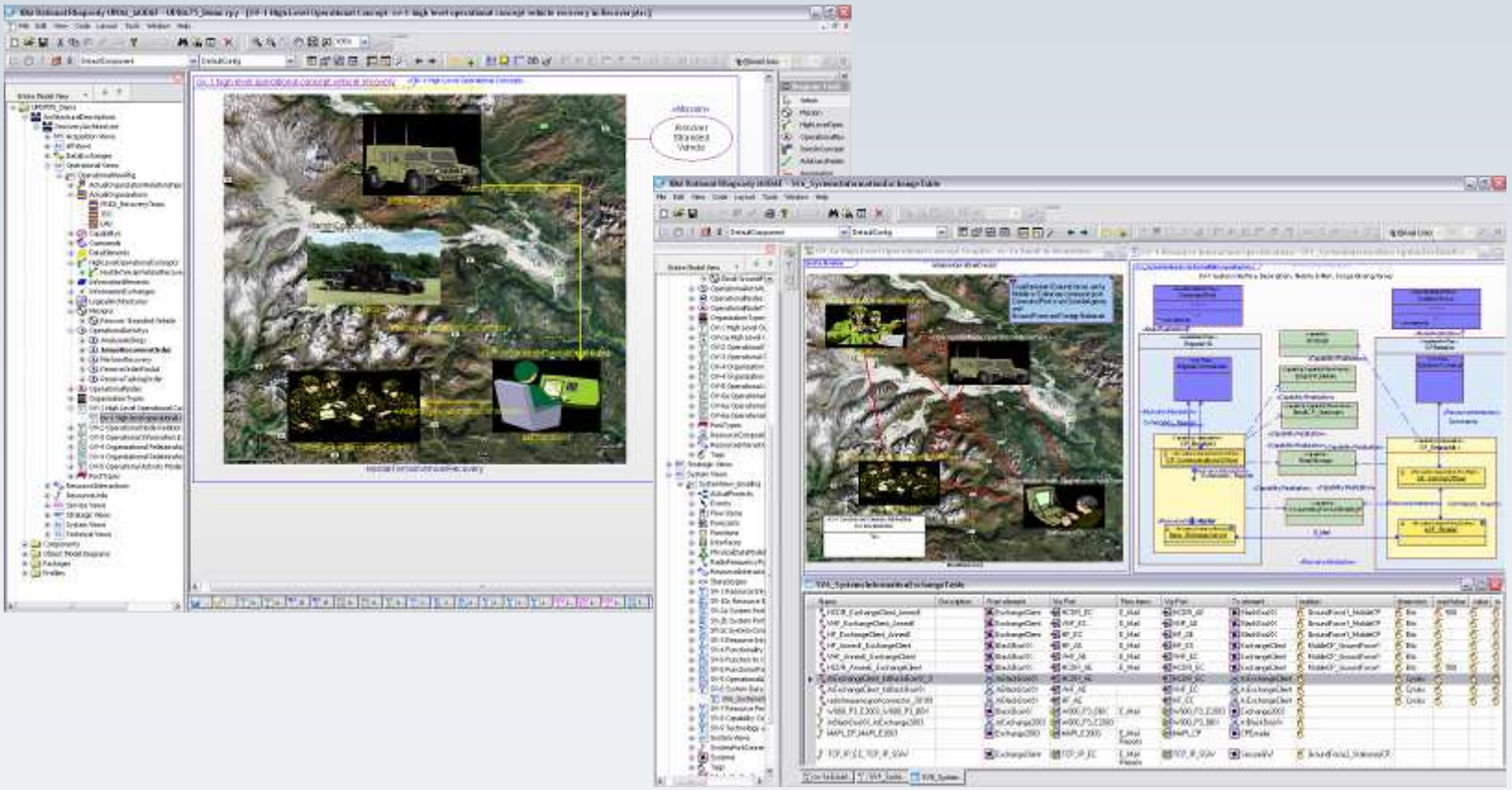
Built on a core product set



Rational Solutions for Systems and Software Engineering

Collaboratively refine requirements into a robust system

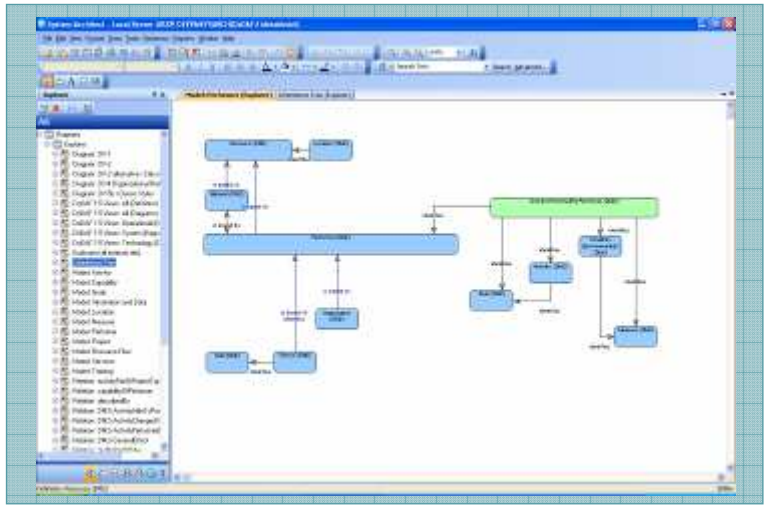
A standards-based practice for the development of complex systems across the mechanical, electronic and software disciplines



Architecture First

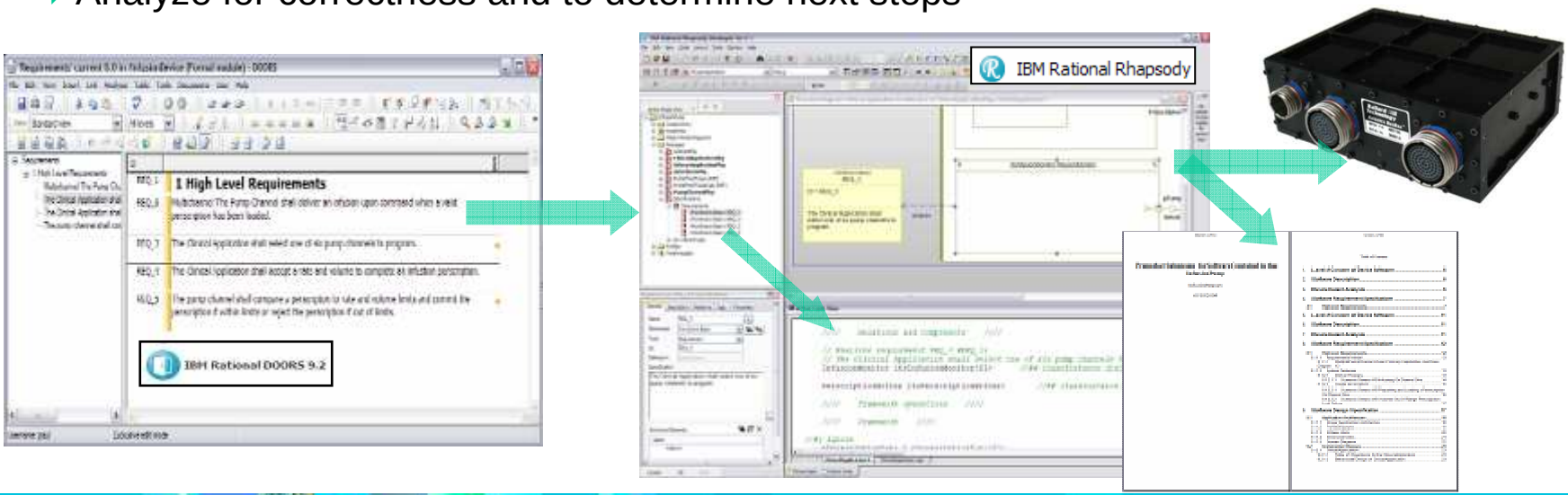
Specify Operational Capabilities, Enterprise Architectures, and Systems

- Specify operational capabilities needed for:
  - Warfighters
  - Network centric operation
- Analyze complex systems of systems
- Comply with DoDAF, MoDAF, FSAM architectural framework requirements

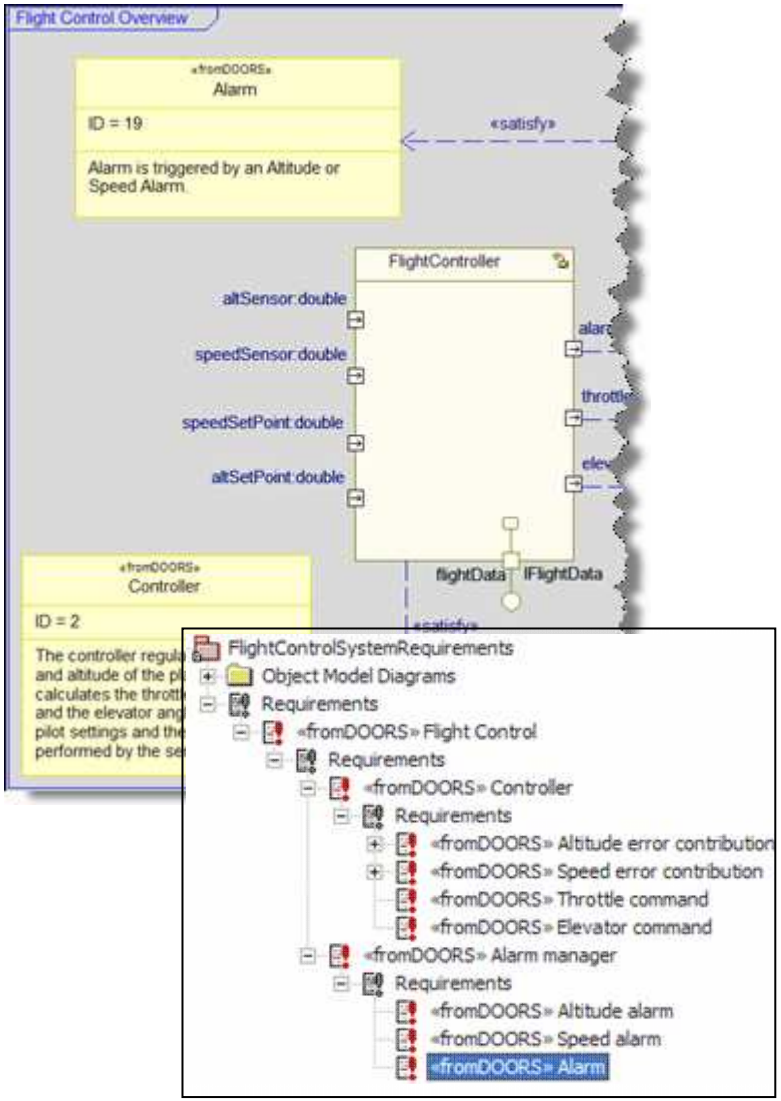


Manage Requirements across Lifecycle and Disciplines

- *Build the right product* because the requirements are visible at all times
  - Prove that all agency requirements (user, safety, regulatory, etc.) were fully satisfied
- Understand the requirements
  - Analyze stakeholder needs
  - Evaluate coverage and impact analysis
- Validate the requirements
  - Analyze for correctness and to determine next steps



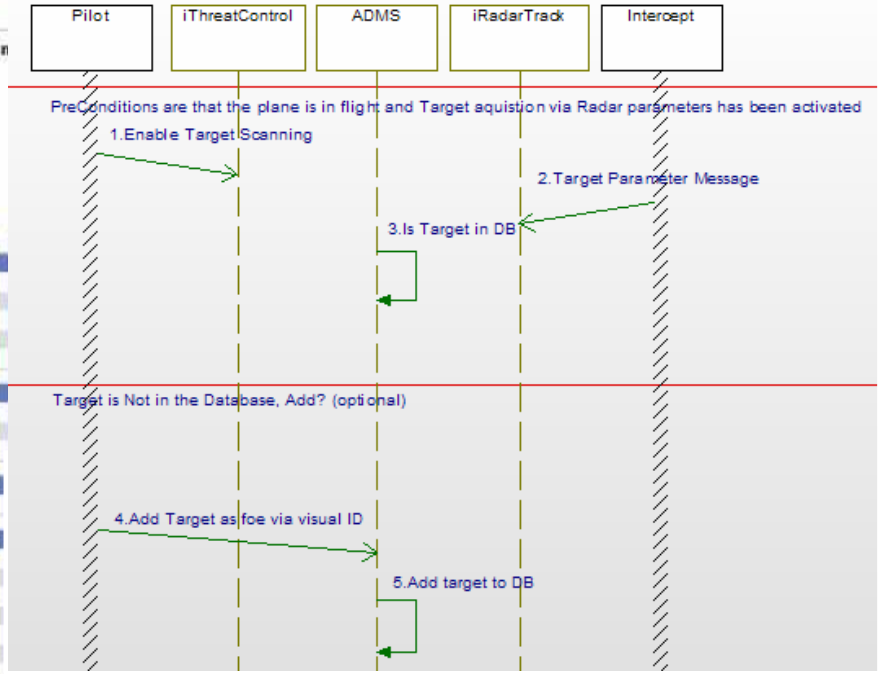
Translate Requirements into a System Design



- *Build the product right* with structural and behavioral analysis and design
- Visualize the system
  - Reduce confusion over requirements
  - Specify system functionality
  - Simulate to confirm functionality
- Analyze impact of changes
  - Whether in requirements or design
- Trace requirements in either direction
  - Provide full accountability and understanding
  - Comply with DO178B traceability
- Specify and develop software
  - Monitor and control the system

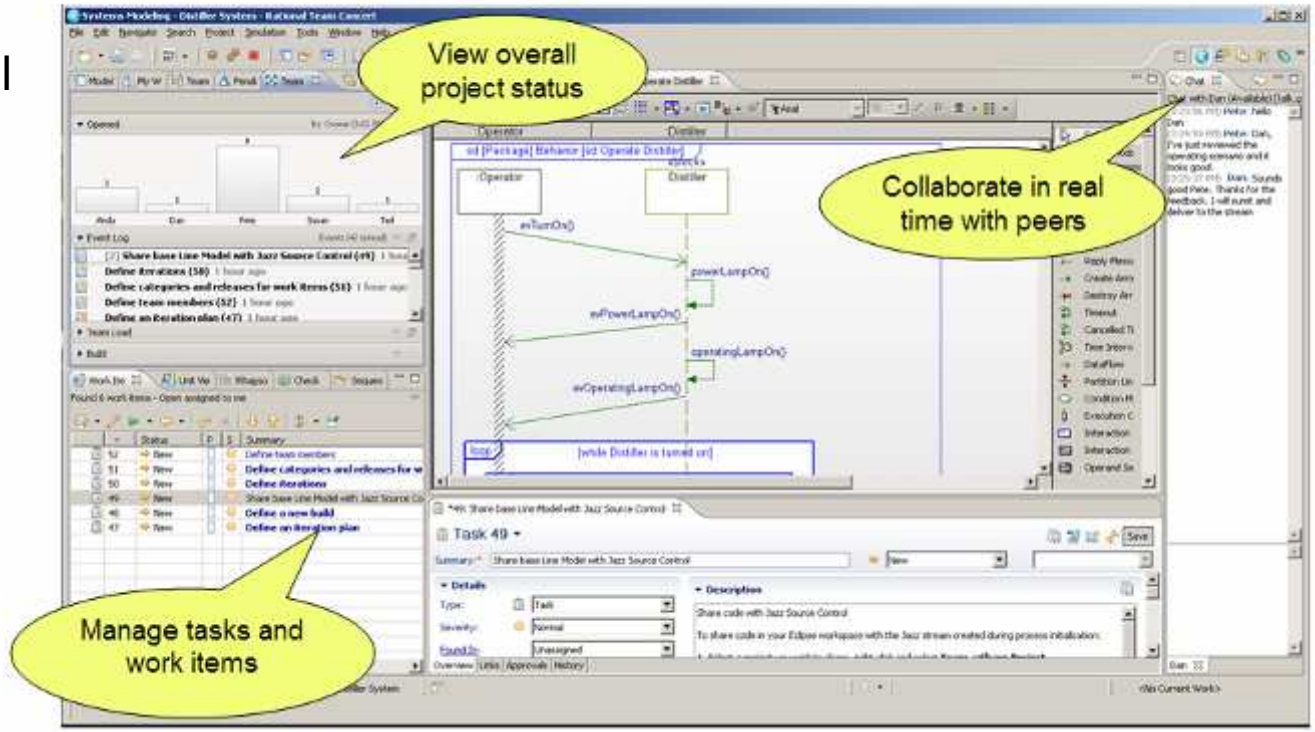
Build in Quality from Concept to Launch

- Simulate often to validate functionality and verify correctness
- Automatically create and execute tests from the design model or target platform
- Manage test cases, while prioritizing the features and functions to be tested



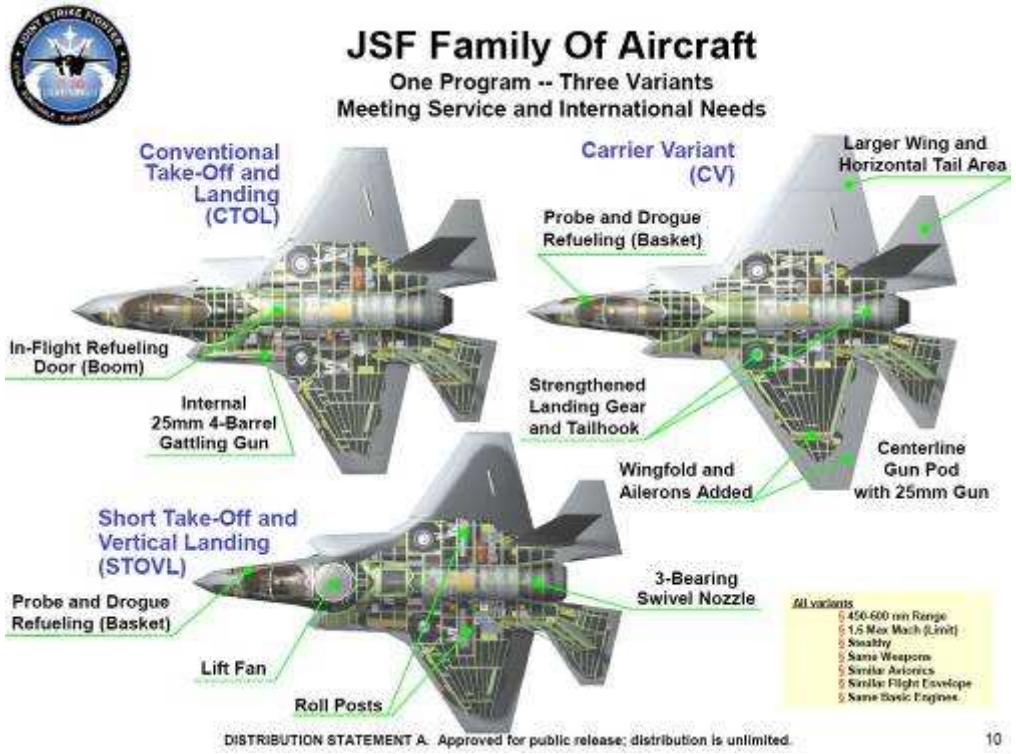
Collaborate and Communicate throughout Development

- Collaborate across teams and geographies
  - Reduce time and risk associated with parallel development
  - Enable integrated design, sharing and review across diverse engineering teams
- Enhance productivity
  - Share views
  - Collaboratively debug
  - Link work items
- Automatically generate reports and documentation directly from the design



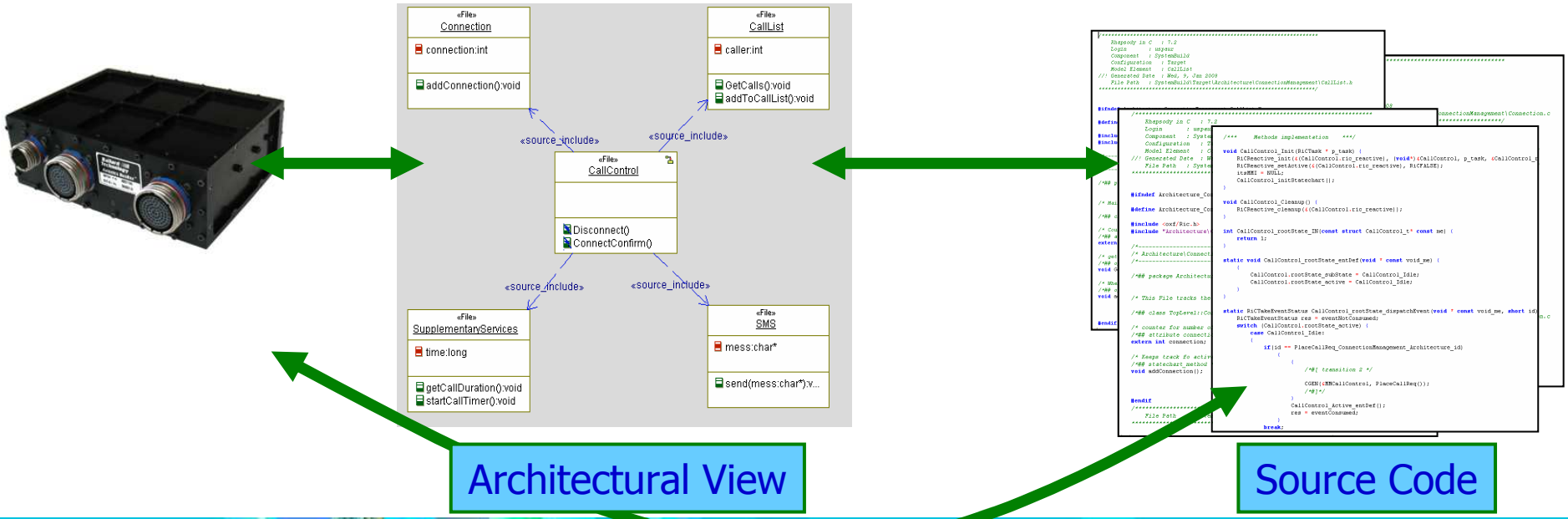
Recapture Intellectual Property

- Preserve and reuse designs and design data
  - Visualize and reverse-engineering existing software
  - Create a library of design assets
  - Analyze to best meet requirements
- Work with product lines
  - Expand product offerings
  - Exploit commonality across products
  - Focus efforts on unique product variants



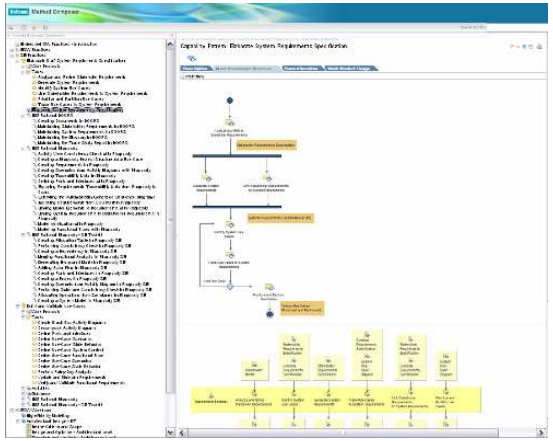
Control the System with Optimized Software

- Design efficient embedded source code
  - Specify and create from the system requirements
  - Generate complete C, C++, Java, and Ada applications
- Unite the architecture and code
  - Simultaneously work with the system design, software and target platform
  - View how a change in any one area is reflected in the others

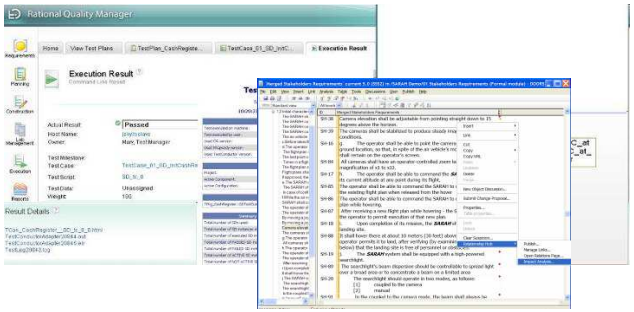


Technology, Tools, Best Practices, Services

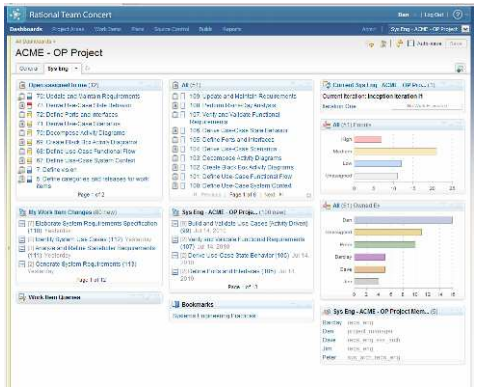
Practice library



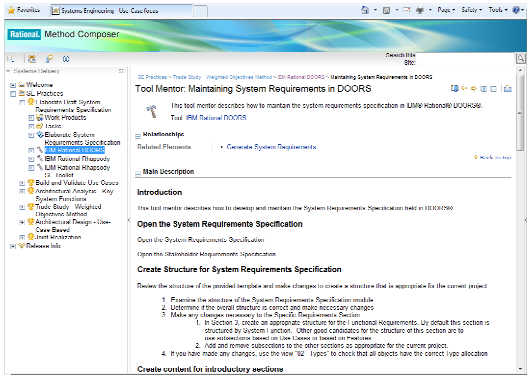
Starting templates



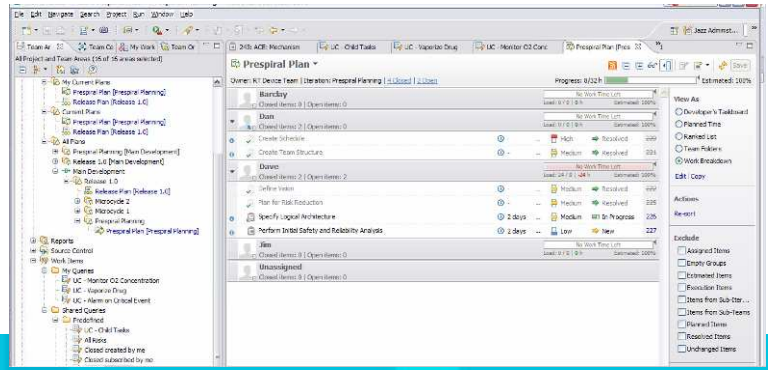
Dashboards



Tool mentors



Auto generation of practice work items



Collaborative Design Management

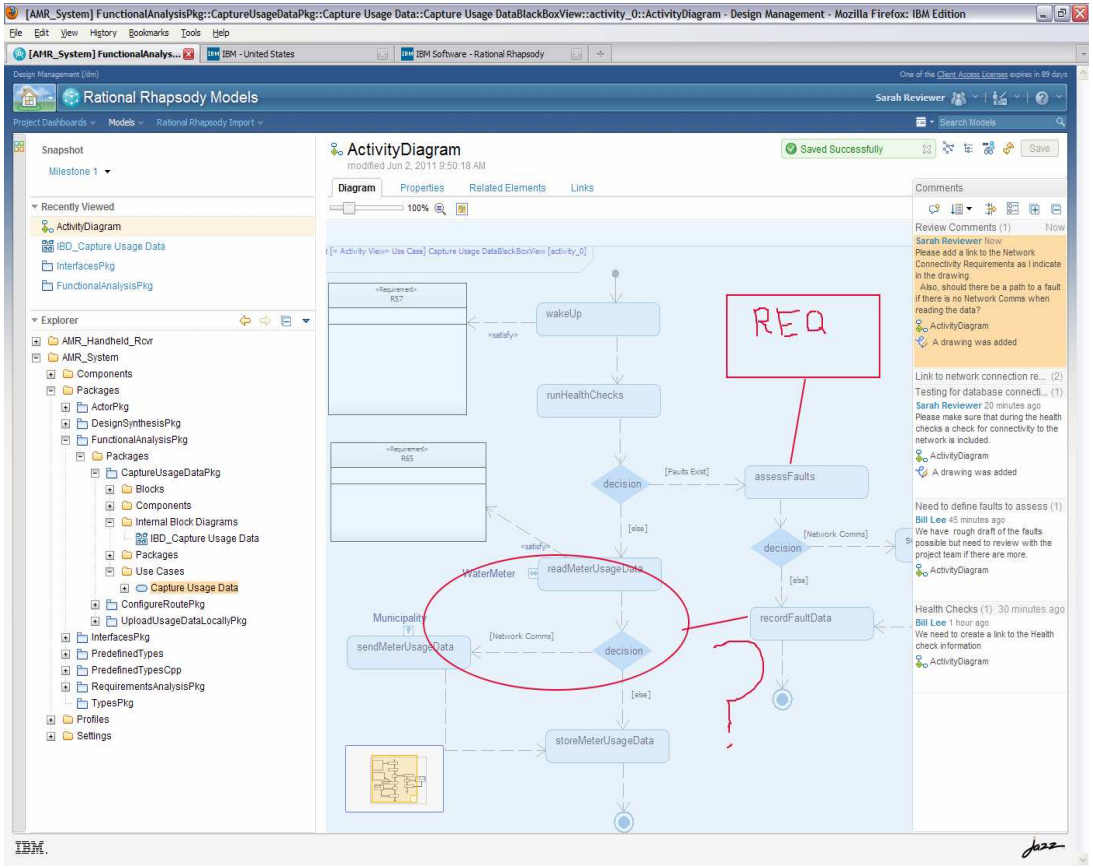
Enhance cross-team collaboration in systems & software design

Central Design Hub

- Enterprise-wide search, review, analyze, and reuse
- Links elements to artifacts
- Navigate and visualize relationships

Stakeholder Collaboration

- Mark-up diagrams
- Discussion thread
- Web client



New Release in June 2011

Agenda

- **The Systems Engineering Challenge – Rational Perspective**
- Engineering Lifecycle Management needs
- Tool integration patterns for Engineering
- Summary

Challenges in Complex Products Development

Collaboration between domains is still manual.

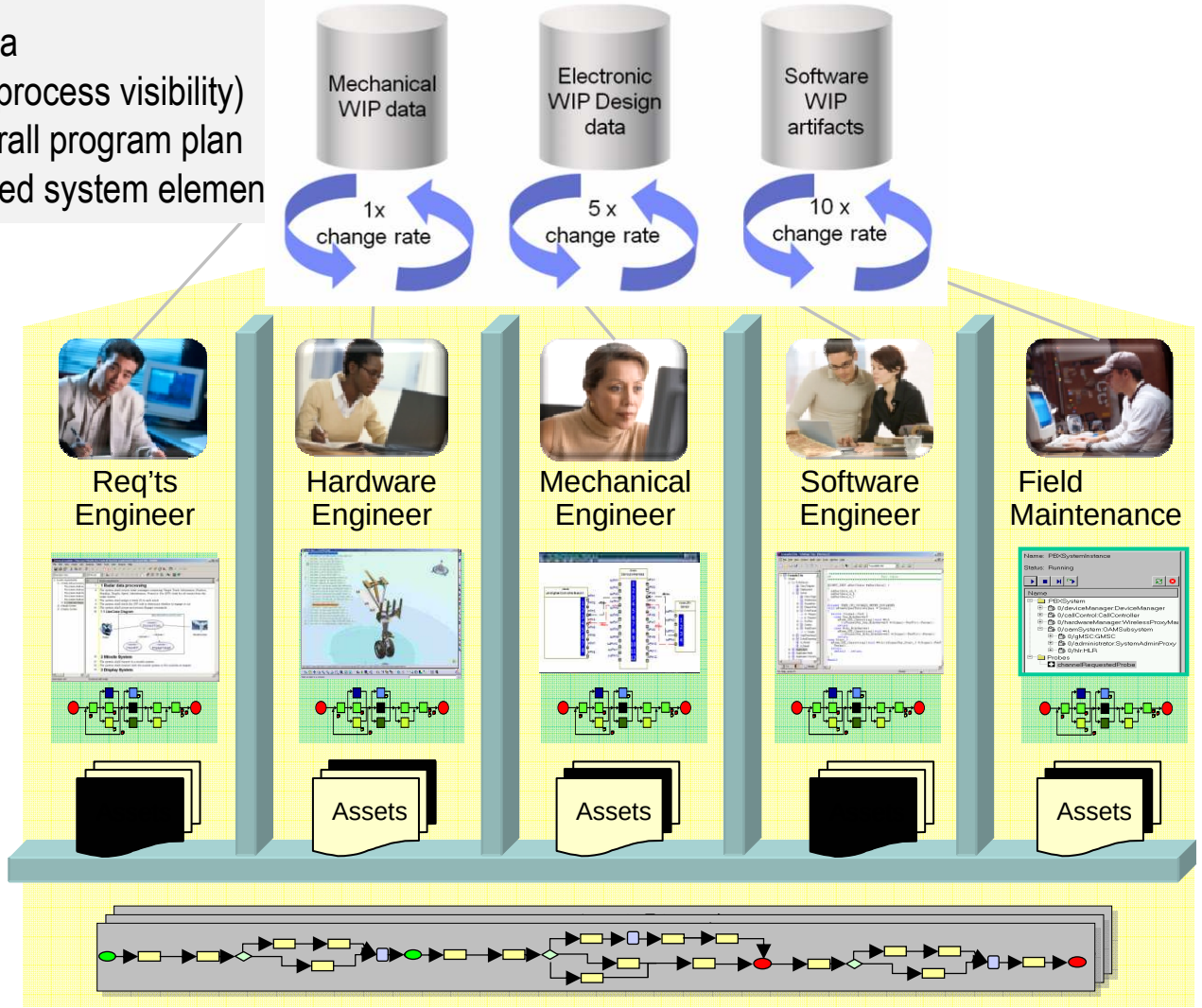
- ✓ Related and dependent data
- ✓ Progress on related tasks (process visibility)
- ✓ Progress related to the overall program plan
- ✓ Visibility to changes in related system elemen

Many Different Roles

Best of Breed Applications, Domain Specific Processes

Domain Specific Program Assets

Program Master Plan



Business results of increased product complexity driving critical imperatives for product development and delivery

Business View

Product missed customer needs	46%
Late to market/missed demand	33%
Poor commercialization / promotion	26%
Product quality	24%
Pricing	23%
No clear product differentiation	19%

The CIO's Guide to the PERFECT Launch: Translating Innovation to Business Benefit, AMR Research, 2005

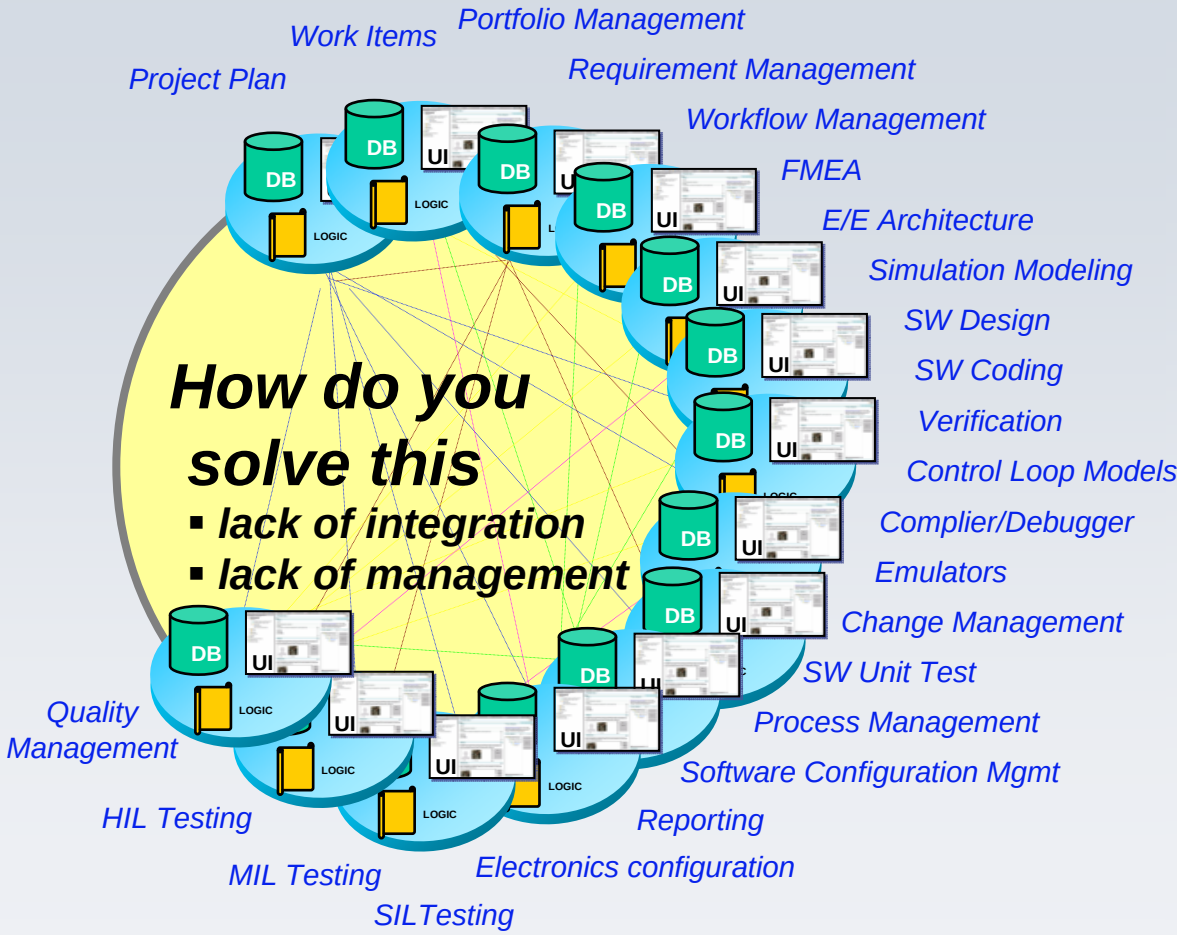
Engineering Opportunity

Improve communication and collaboration across disciplines	**71%**
Increase visibility into status of requirements	49%
Increase ability to predict system behavior prior to testing	46%
Implement or alter new product development processes for a multi-disciplinary approach	43%
Increase real time visibility of product Bill of Materials (BOM) throughout the development process	39%

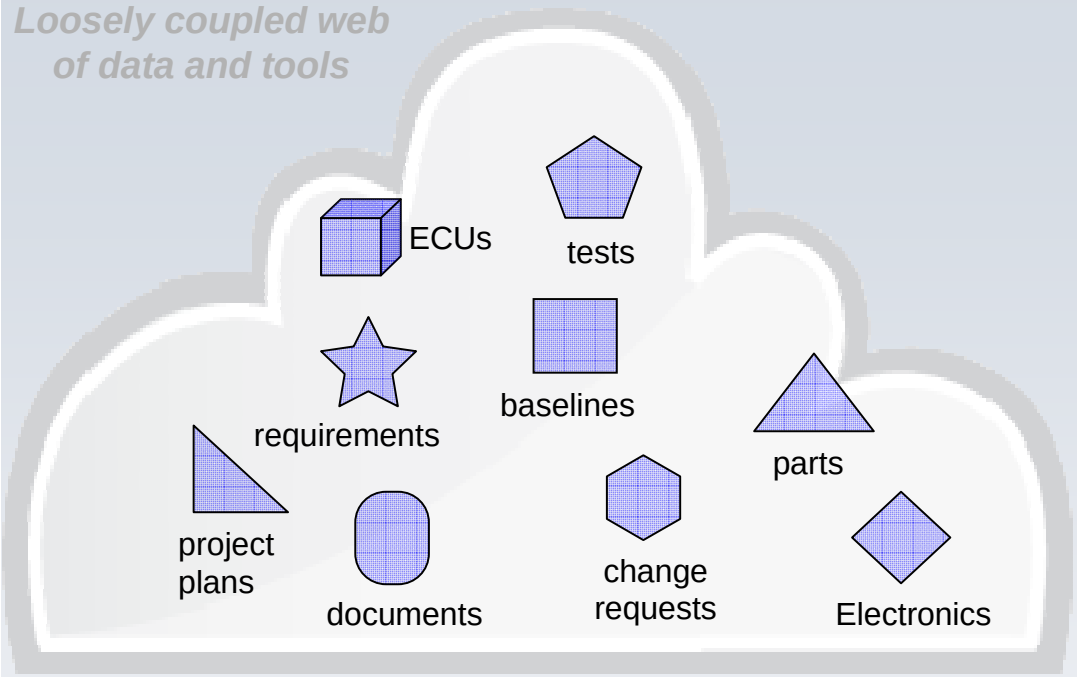
Aberdeen Group, System Design: New Product Development for Mechatronics, Michelle Boucher, David Houlihan, January, 2008

Engineering environments are highly fragmented -
the challenge to connect them is increasing exponentially

- **Traditionally, each tool came with its own**
  - **UI** - Web and desktop presentations of views and tasks
  - **Logic** – Workflow, process, search, query, scale, security and collaboration
  - **Storage** – individual files on workstation or servers: how to ensure availability and traceability?
- **Resulting in...**
  - Brittle/poor integrations
  - Silos everywhere
  - High cost to maintain and administer
  - Low re-use



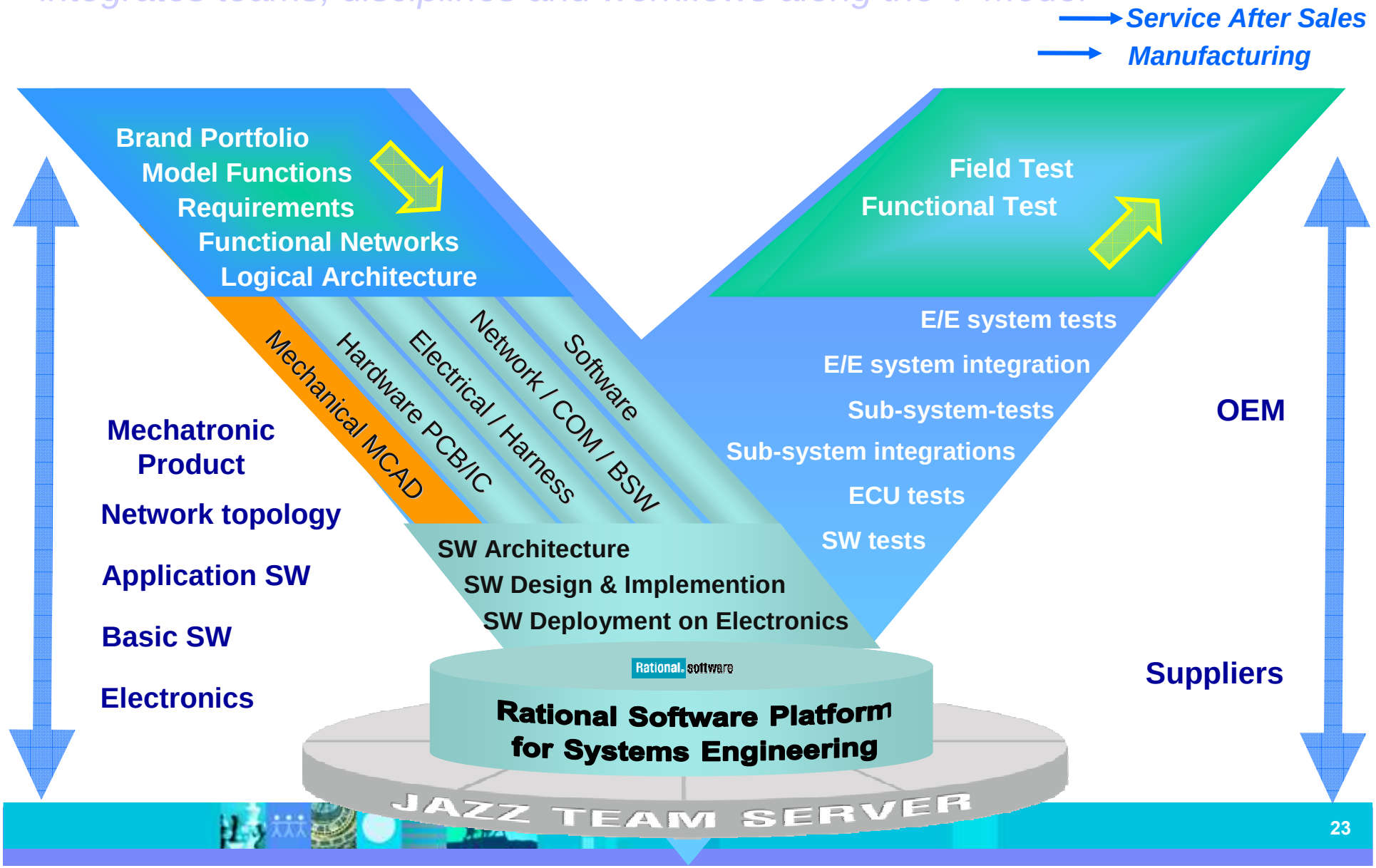
Jazz Integration Architecture enables a loosely coupled “web” of engineering data



- Federated integration architecture
- Provides common, cross-product capabilities (search, query, report, process, etc.)
- Integrate tools multi-vendor and in-house tools
- No duplication/synchronization of data
- Incrementally add tools and capabilities
- Leverage existing tool investments and best of breed capabilities
- Upgrade parts individually

Integrating Engineering Disciplines with IBM Rational Platform

integrates teams, disciplines and workflows along the V-Model



Goals

- Practical
  - Improve user experience of team members trying to discover, understand and reuse engineering artifacts
  - Bridge semantic gap between domain and tool terminology
  - Improve collaboration and communication across disciplines
  - Reduce redundant information entry/copying
  - Reduce integration cost and complexity
  - Improve and automate processes (find the “gaps”)
- Aspriational
  - Advance key architectural tool integration patterns
    - Configuration management and versioning
    - Product line engineering and variability
    - Multi-model integration
  - Foundation for analytics and discovery
    - Watson for engineering?

Agenda

- The Systems Engineering Challenge – Rational Perspective
- **Engineering Lifecycle Management needs**
- Tool integration patterns for Engineering
- Summary

Each tool domain has its own organizational structure

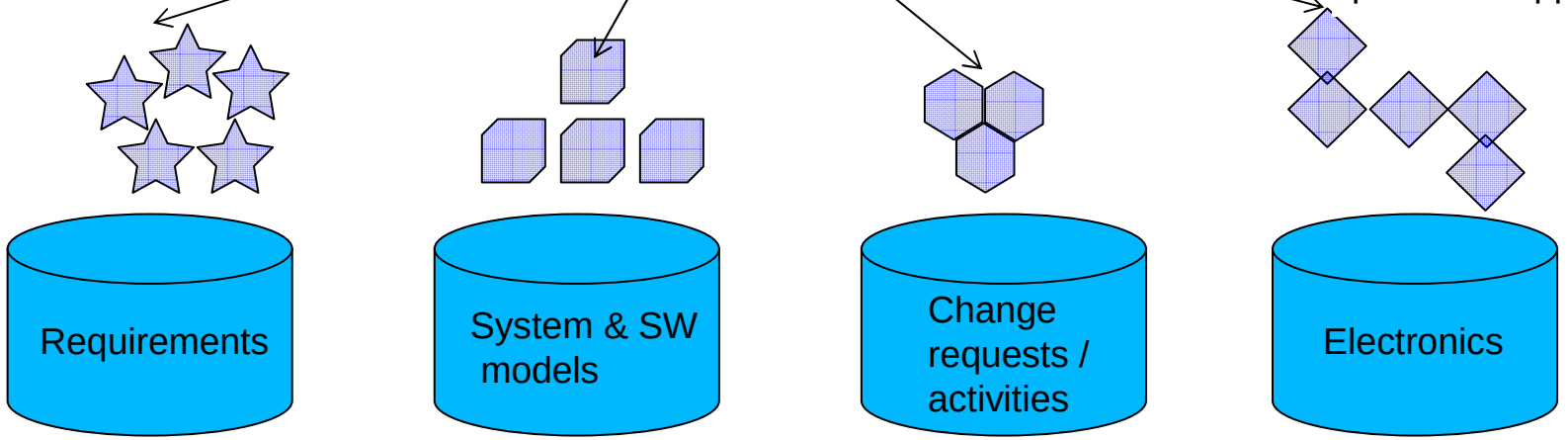
How do I find out who is dependent on this interface?

Which artifacts are used in Product X?

Who is working on the product use case 'foo'?

each tool domain organizes artifacts in a different way

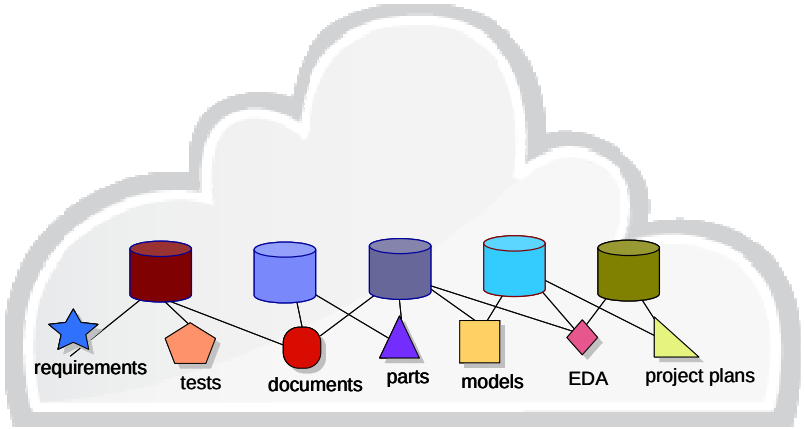
each discipline may structure projects and artifacts in their particular approach



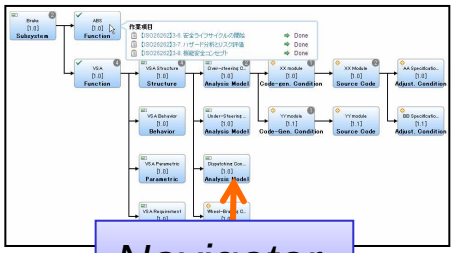
No shared view of project/product configuration
No single point of access or integrated view/perspective

Integration Architecture Challenges

- Challenges for a federated integration architecture
  - Integrated views of data without data copying or export
  - Distributed configurations and baselines
  - Rich model integration
  - Reporting and document publishing
  - Security
  - Performance



Proposed Rational Engineering Lifecycle Management solution



RTC

RQM

Navigator

An “Engineering Integration Hub”

Rhapsody or RSA Design Management:
jazz-based storage and collaboration for models (new)

DOORS

Integrates with existing Rational data sources: e.g., DOORS, RTC, RQM, Rhapsody as well as 3rd party tools such as Mathworks Simulink

RDM

RPE

Insight

RPE and Insight integration for publishing and reporting

3rd party tools

Rational solution for Collaborative Engineering Lifecycle Management

Capability to support effective teams – enhanced by central index and product "context" visibility

- Real time planning
- *Lifecycle traceability*
- *In-Context collaboration*
- *Development intelligence*
- Continuous process improvement

Connected data and tools

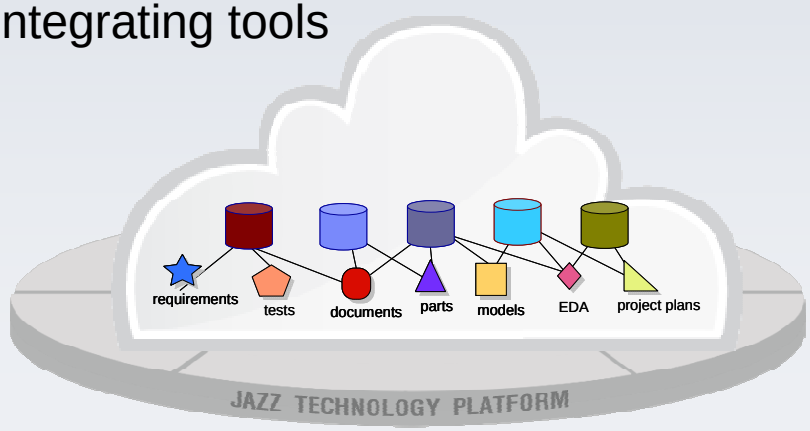
on a truly extensible, scalable and open platform

Key Directions

- Index of artifacts and relationships
- Resource navigation and query
- Cross-tool configuration management
- Cross-tool baselining
- Integrated multi-tool processes
- Open integration standards (OSLC) for integrating tools

jazz

**„open community.
open interfaces.
open possibilities.“**



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Turning Product Development Into Competitive Advantage:

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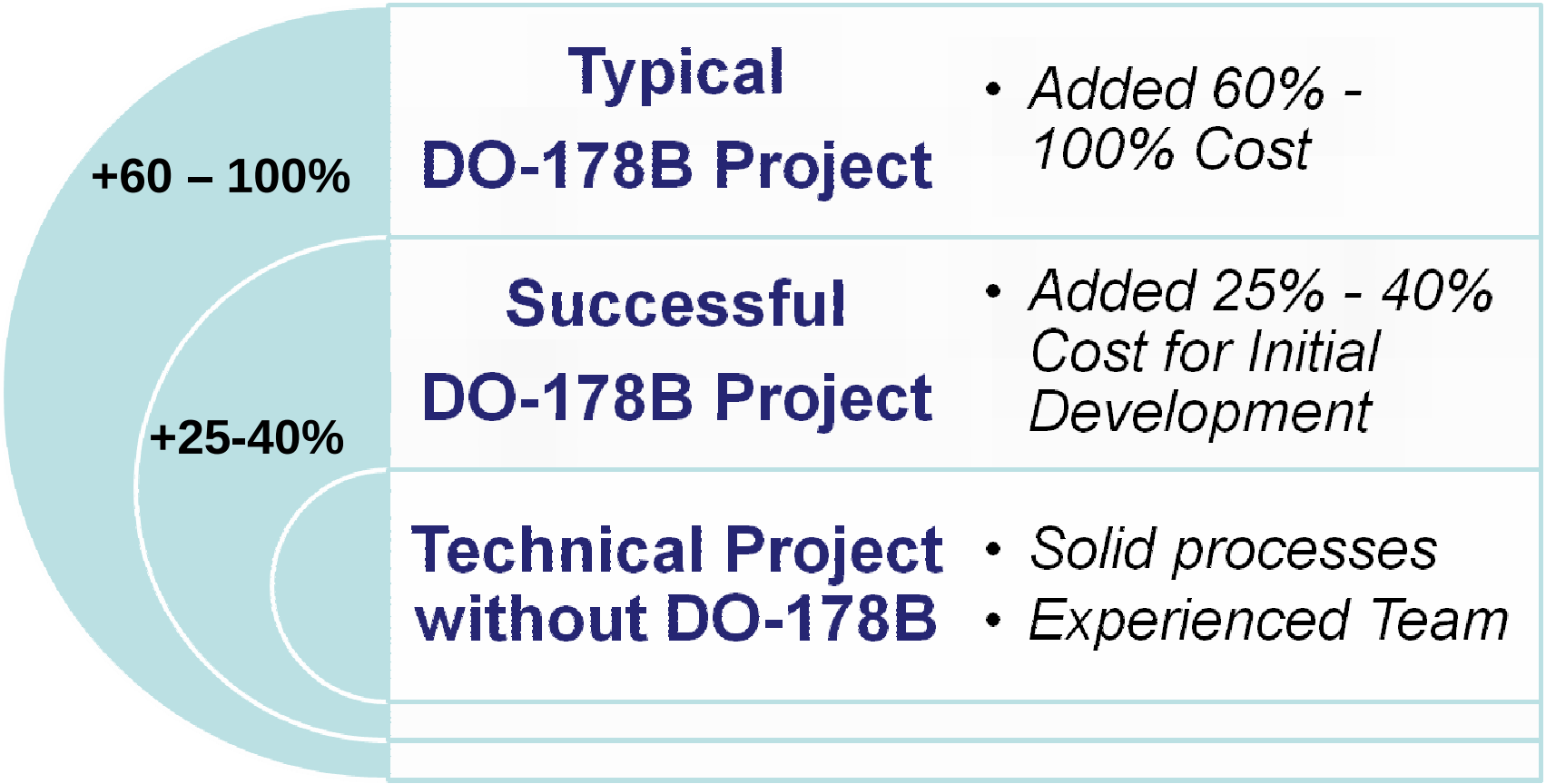
Standards intended to prevent failures often initially increase project costs--Example: DO-178B



Source: Avionics Certification – Vance Hilderman and Tony Baghai (avionics publications)

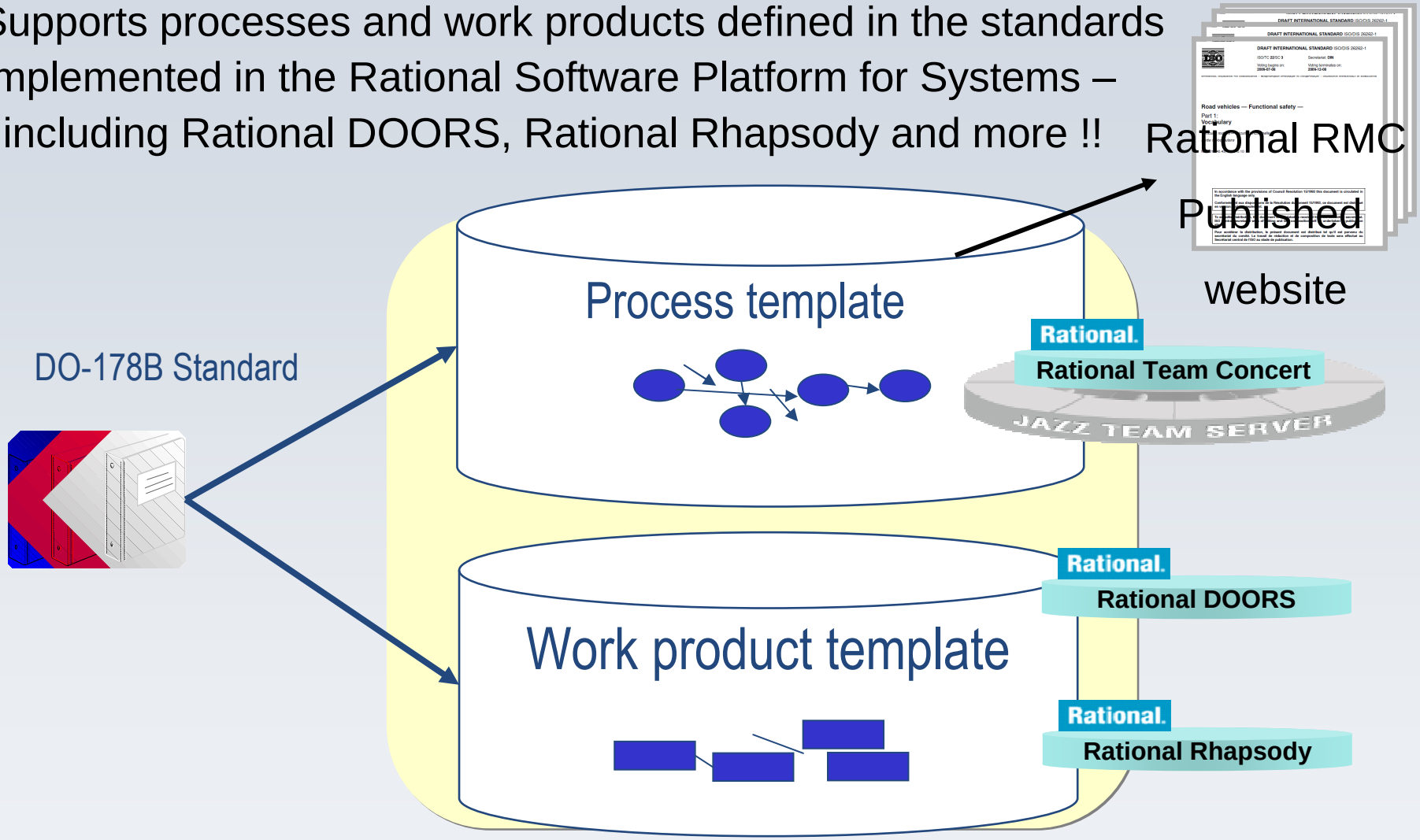
DO-178B at 30,000 feet

- DO-178B defines detailed guidelines for development of aviation software that performs intended functions
- The Federal Aviation Authority (FAA) accepts use of DO-178B as a means of certifying software in avionics
- DO-178B outlines the *objectives* to be met, the work activities to be performed for each objective, and the *evidence* (output documents) to be supplied for each objective (based on criticality level A-E)
- Objectives are organized into process areas
  - Planning
  - Development
  - Verification
  - Configuration Management
  - Quality Assurance

Overview of IBM Rational Solutions for DO-178B

A look to the inside: Overview of IBM practices for DO-178B

- Supports processes and work products defined in the standards
- Implemented in the Rational Software Platform for Systems – including Rational DOORS, Rational Rhapsody and more !!



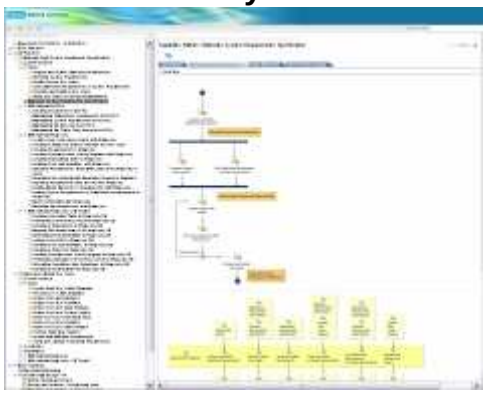
IBM Rational Solutions for DO178-B provide process support

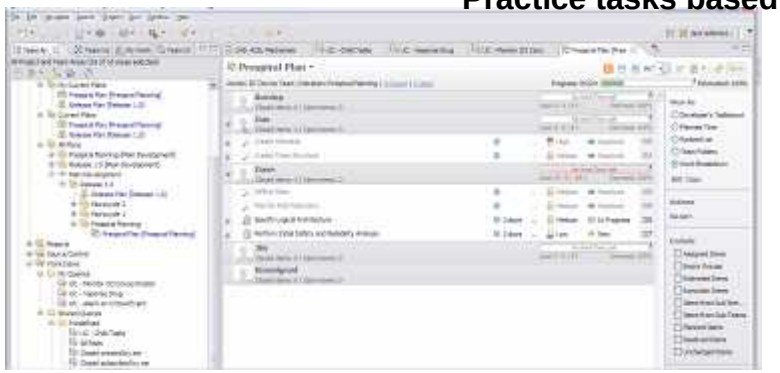
Learn and check how to use a Practice

A dashboard in RTC

Check progress
Understand tasks and deliverables

A Practice library & tool mentors



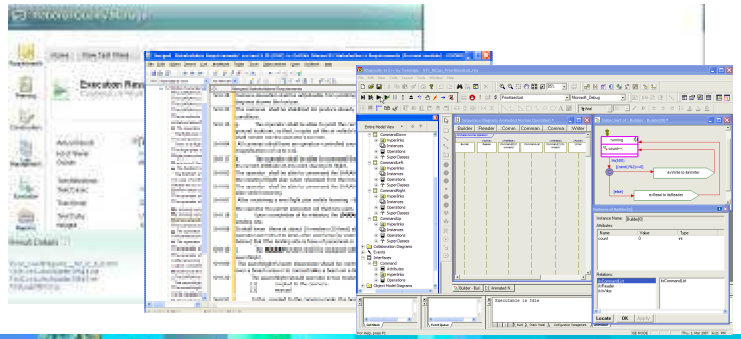


Practice tasks based on work items in RTC

Execute my tasks

Update my tasks

Collaborate with colleagues



Starting templates

Artifact samples

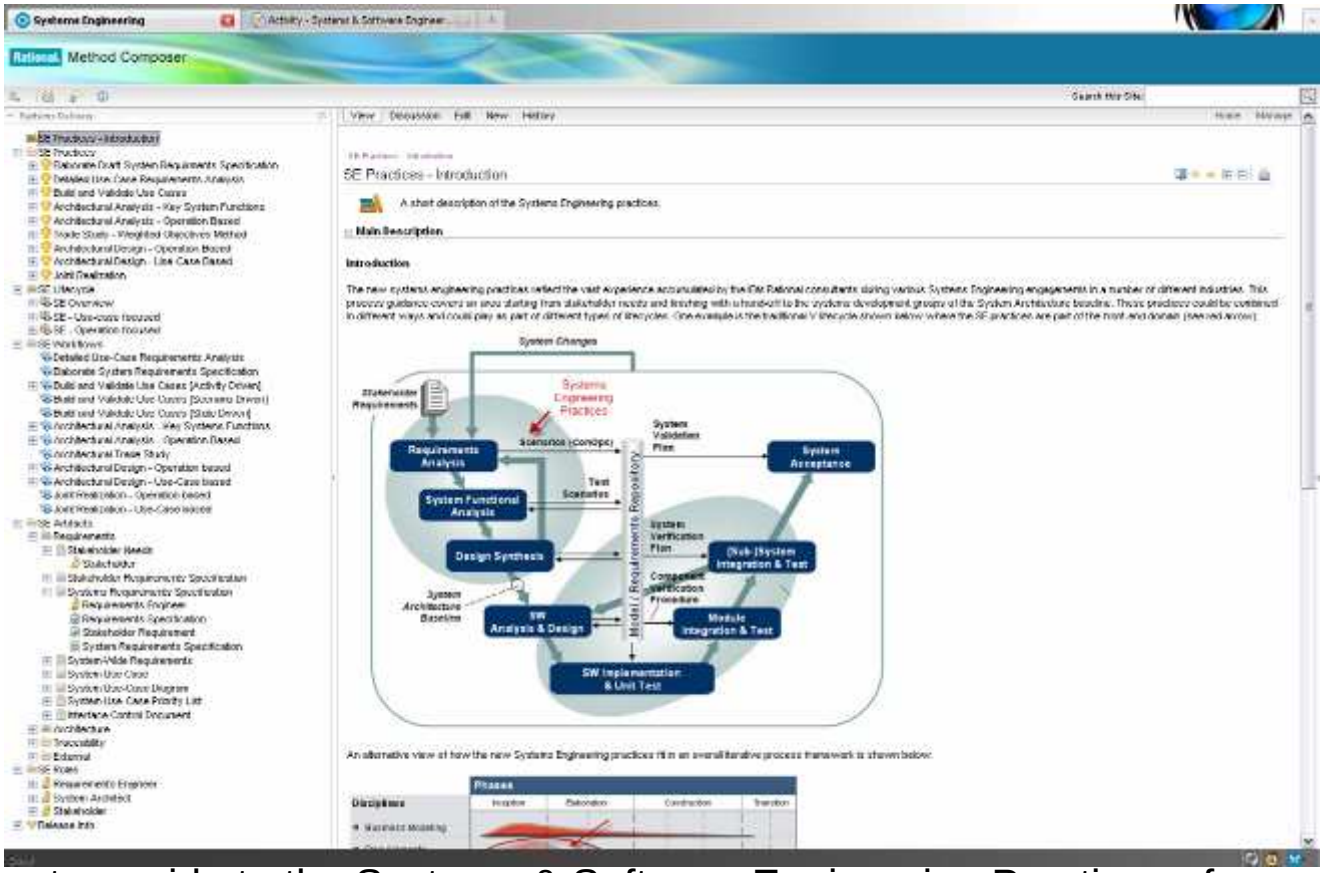
Tool usage

DOORS

Rhapsody

IBM Rational Solutions for DO178-B

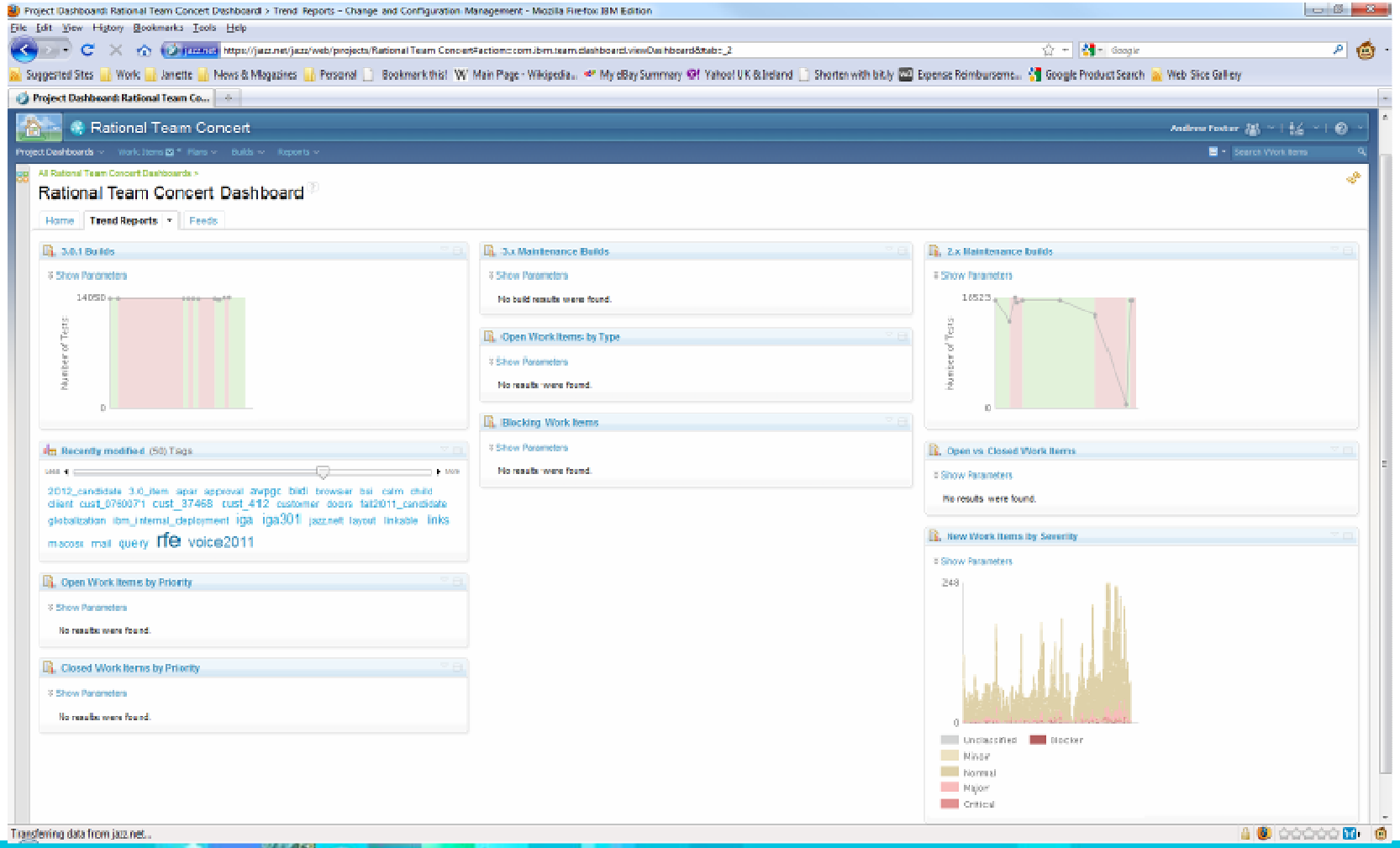
Practice library and published web-site



- A step by step guide to the Systems & Software Engineering Practices, formed from the well proven IBM experience with Harmony and the application of Rational Unified Process to Systems
- Delivered as RMC and published web-site content

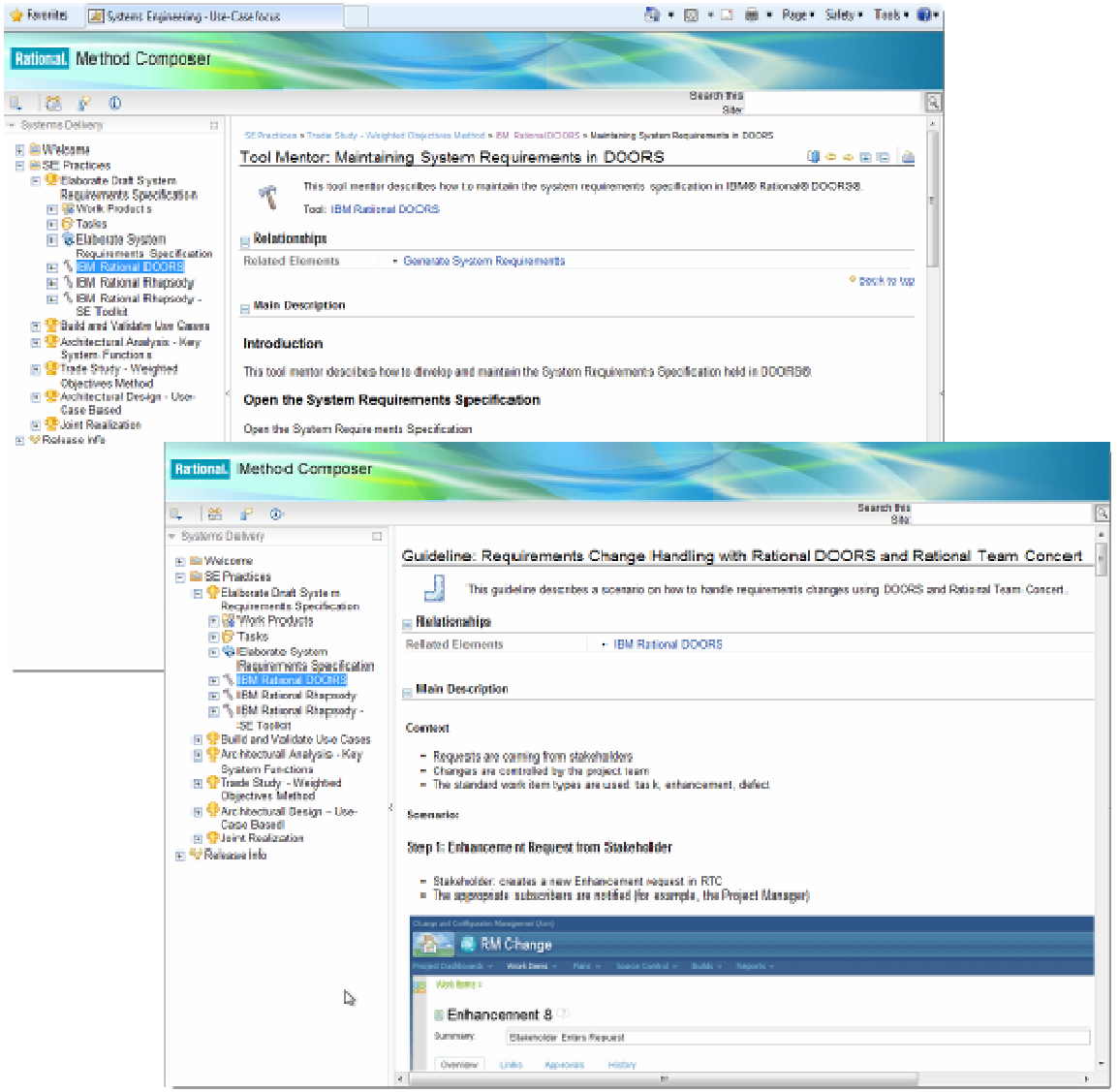
Role and team dashboards

- Rational Team Concert dashboards provide summaries of the state of an individual or team activities, such as the application of one of the Practices.



Practice Tool mentors and Practice guidelines

- A hands on view of the Practice steps are illustrated in a core set of IBM Rational tools,
  - DOORS and Rhapsody
- Describes “How to” in the tool
  - E.g. build a specific deliverable
- Additional specific guidance provided for RTC in the context of Requirements Change Handling with DOORS

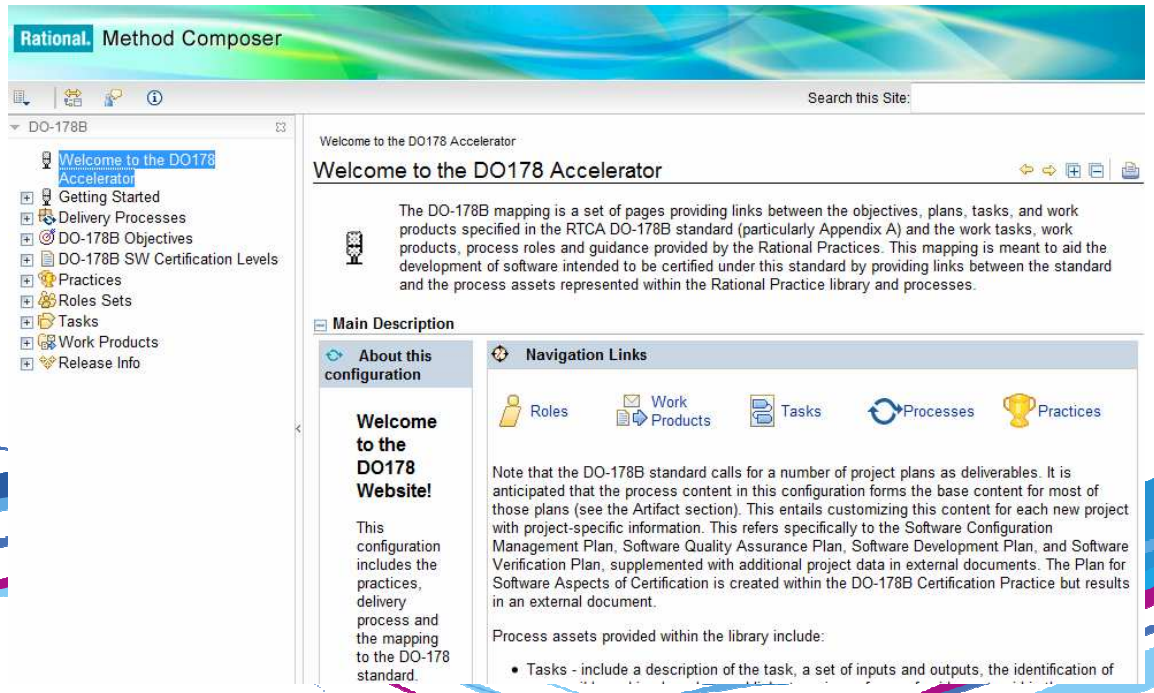


DO – 178B practices

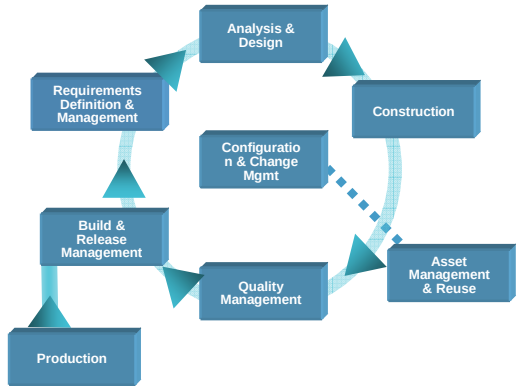
IBM provides process support for safety critical development

DO–178B

A set of industry practices and process/work item templaces to help organizations developing products for certification under DO-178B. Covers the 5 main processes concerning Planning, Development, Verification, Configuration Management and Quality Assurance



Extend the Solution to Meet Your Needs



The Rational solution can be tailored to meet virtually any systems development workflow :

- *Automated reporting and documentation* with **Rational Publishing Engine**
- *Embedded software testing* with **Rational Test RealTime**
- *Team-based configuration management* with **Rational ClearCase** or **Synergy**
- *Domain specialization with defense architecture frameworks*
- *Embedded platform development* with **Wind River Workbench/VxWorks**
  - Support also exists for **Green Hills Integrity, QNX Momentics/Neutrino** and many other embedded platform operating system environments
- and many others…

Ensure Success with Rational

Rational. software

Process and methodology	Implementation services	Training and mentoring	Technical services
• Process framework workshops	• Adoption quick starts	• Product familiarity	• Measured Capability Improvement Framework (MCIF)
• *Rational Harmony* family of Best Practices and Processes	• Deployment support	• Product expertise and specialization	• Product optimization and customization
• Process training	• Project architecture workshops	• Technology transfer	• Tool configuration
	• Project management	• Adoption mentoring	
	• Planning support	• e-Learning	
	• Escalation/risk mitigation		

Summary

- Complexity can rapidly increase as you develop products and systems
- Maintaining the various systems relationships manually is very difficult – maybe impossible
- IBM's *solution for Systems and Software Engineering* automates the building of structures and dependency relationships to:
  - Manage increasing complexity
  - Ensure designs and products meet market demands and industry requirements
  - Perform effective impact and change analysis across different disciplines and subsystem views
  - Enable collaboration across the entire development organization

Learn more at:

- IBM Rational software
- IBM Rational Software Delivery Platform
- Process and portfolio management
- Change and release management
- Quality management
- Architecture management
- Rational trial downloads
- Leading Innovation Web site
- developerWorks Rational
- IBM Rational TV
- IBM Business Partners
- IBM Rational Case Studies

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www.ibm.com/software/rational

Deliver Smart Products with Rational

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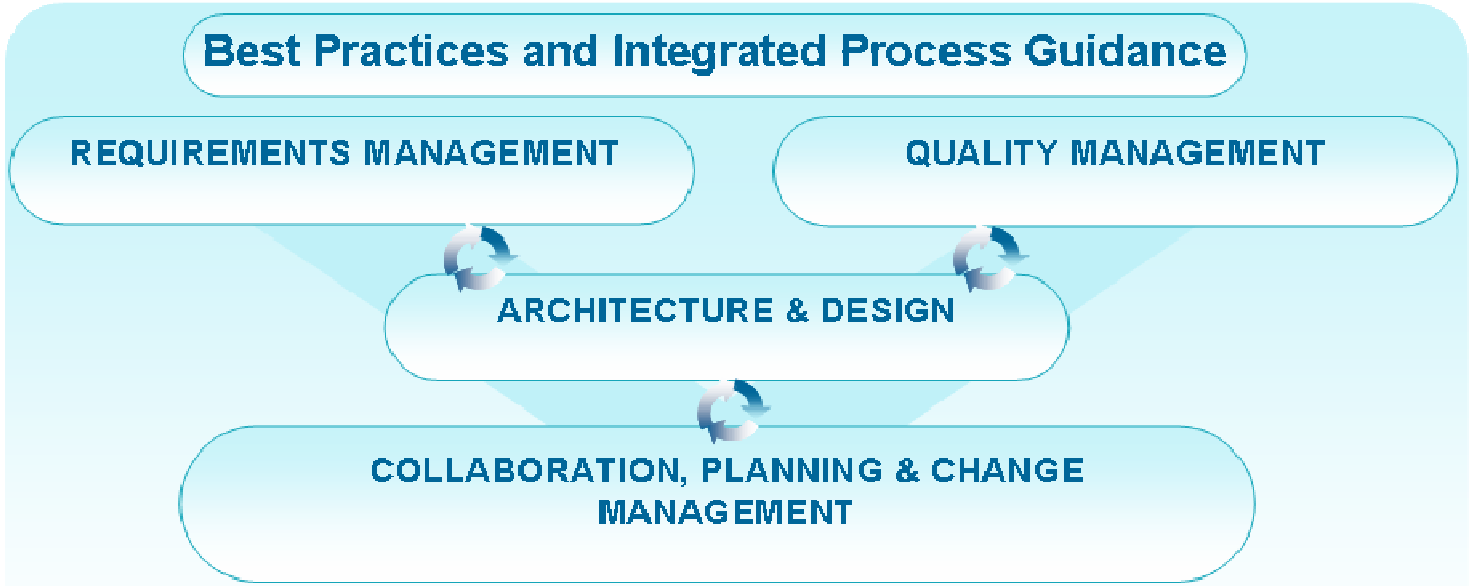
Rational Solution for Systems & Software Engineering

Best Practices, Tools and Services on an open platform



Accelerating Development for A&D and Automotive

Supporting industry-specific methodology

- Extends base Solution with industry-specific A&D and Automotive content
- Accelerates process and practice guidance

- **A&D**
  - Support for defense architecture frameworks (e.g., DoDAF, MoDAF)
  - Support for **DO-178B** standard: the international and de facto standard for certifying all aviation safety-critical software.

- **Automotive**
  - Support for AUTOSAR, an indudstry standard for ECU development
  - Support for **ISO 26262,** an upcoming new automotive functional safety standard for in-vehicle electric and electronic (E/E) systems

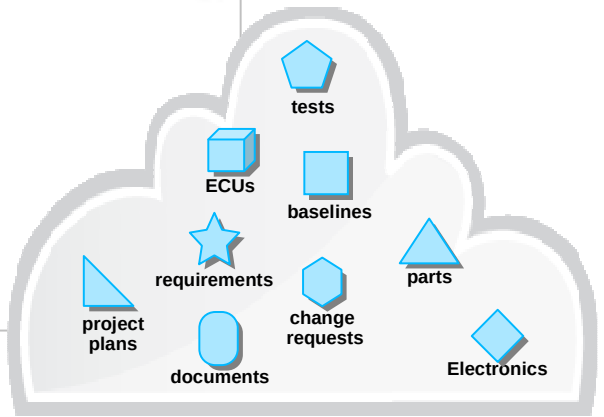
Accelerating Development for Electronics

Supporting industry-specific methodology

- **Extends the Solution with support for HW/SW Co-design**.
  - Provides process, practice guidance and tooling that support developing hardware and software better in synch
  - Lifecycle approach with multiple entry points
  - Integrations with key EDA companies like Cadence and MentorGraphics

Jazz: An open platform approach “Jazz Dashboard”

OSLC: Simplifying lifecycle integration



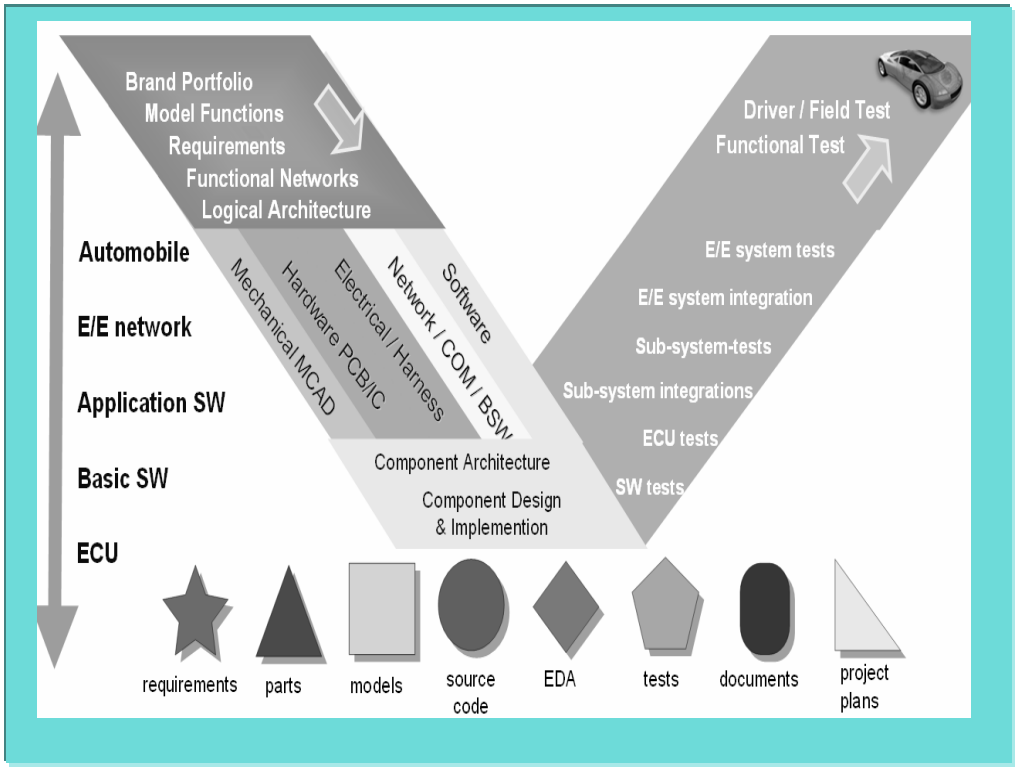
Open Services for Lifecycle Collaboration

Open interfaces. Open possibilities.

www.open-services.net

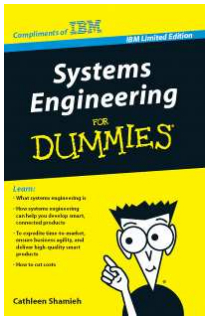
Participate in the next generation of integration and collaboration

- Access engineering artifacts
- Enable queries and reports across artifact types
- Capture product configurations
- Provide common engineering project planning and dashboards



Resources for more information

- **Rational Solution for Systems and Software Engineering**
  - Systems Engineering for Dummies **ebook**
  - Aberdeen Self Assessment **on System Engineering**
  - Taming the Complexity of Smarter Products with Systems Engineering
  - Demo video: 8 min
  - Executive Brief: Turning product development into competitive advantage



- **Automating Process Guidance**
  - Accelerating Collaboration Across the Systems Development Lifecycle

- **Industry Resources**
  - **Webcast:** Success with Model-Driven Development for DO-178B Projects
  - **Webcast:** Creating & Managing Requirements for Hardware and Software Design
  - Video: The Chevrolet Volt: IBM Rational Software Helps GM Deliver Smarter Products

Web pages

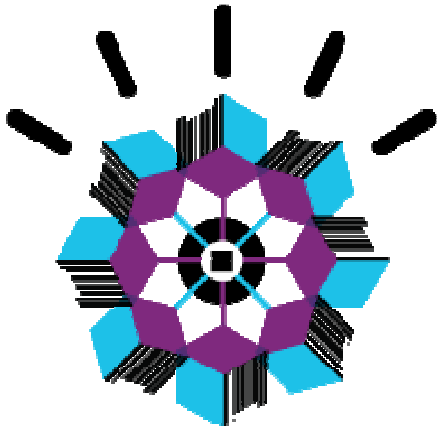
- IBM Rational solution for systems and software engineering

- IBM Rational systems engineering and software solutions for aerospace and defense

- **Jazz.net Community site:** Systems Engineering and Embedded Software Development

Summary: The delivery of smart products is significantly improved through systems and software engineering

- Products and services of all types are becoming increasingly ***instrumented, interconnected and intelligent***
- Best-in-class companies will benefit from **increased profitability and market share**
- The interconnection of multiple products and services into a ***"system of systems"*** delivers unique value and benefits
- The Rational Jazz platform can help companies **design, deliver and manage smarter products**



Smart Products

Symposium: Seize the Day

- Take advantage of the technical sessions
- Meet your peers, develop new relationships
- Ask us questions

Make This Your Day – Interact – Ask - Provide Feedback

Symposium 101: Seize the Day

Key Topics:

- Aerospace and Defence Roadmap
- The Rational Solution Demo
- Product Line Engineering: A General Motors Case Study
- UPDM, a UML/SysML Implementation of DoDAF/MoDAF for Military and Commercial Architectures
- NASA: Benefits of the Space Program
- Agility in Complex Systems Development
- Getting Requirements Right with Model Based Functional Analysis

Make This Your Day – Interact – Ask - Provide Feedback

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