

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







Please Note:

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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



Global optimization of product, process and organization

PRODUCT & SYSTEMS DEVELOPMENT

Cesigning, delivering and managing product value and differentiation

PRODUCT SUPPORT

Closing the loop between design and support

LIFECYCLE COLLABORATION

Automating processes across the ecosystem of system contributors





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

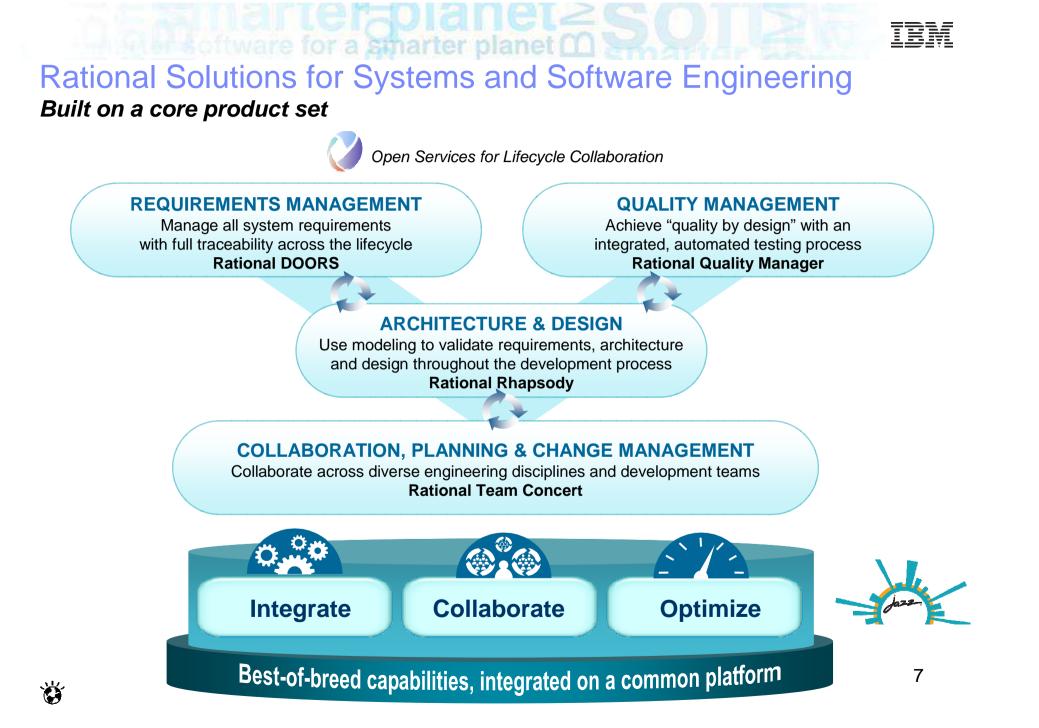
- Poor communication
- Language, culture, time
- Process gaps resulting in rework

Organizational Barriers

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

Infrastructure Barriers

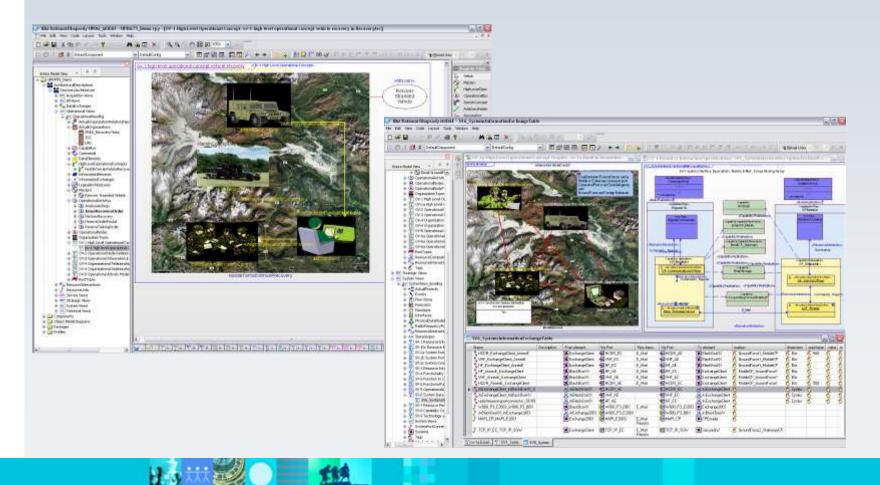
- Incompatible tools
- Unreliable access
- Lengthy on-boarding
- Inflexible integration





Rational Solutions for Systems and Software Engineering Collaboratively refine requirements into a robust system

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

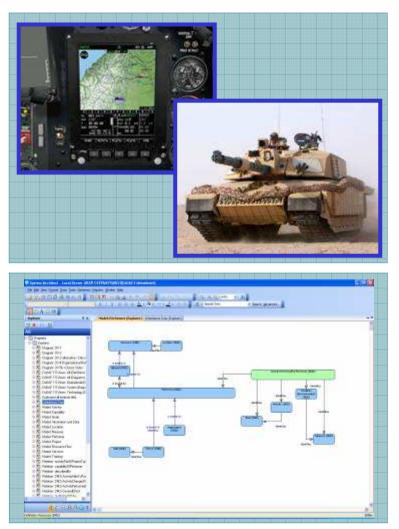


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Architecture First

Specify Operational Capabilities, Enterprise Architectures, and Systems

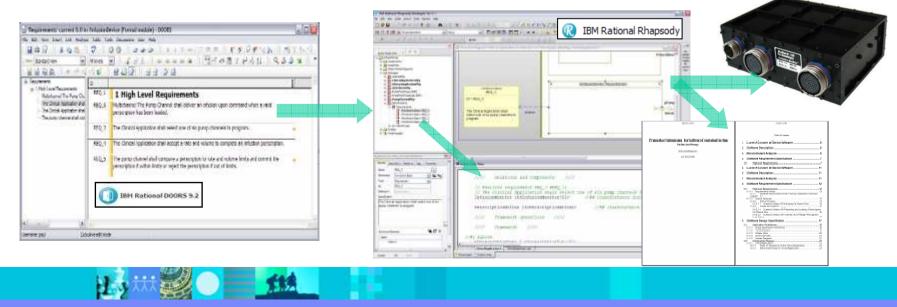
- Specify operational capabilities needed for:
 - Warfighters
 - Network centric operation
- Analyze complex systems of systems
- Comply with DoDAF, MoDAF, FSAM architectural framework requirements





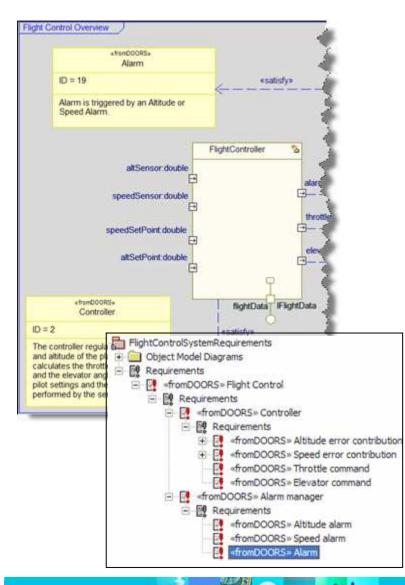
Manage Requirements across Lifecycle and Disciplines

- 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

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

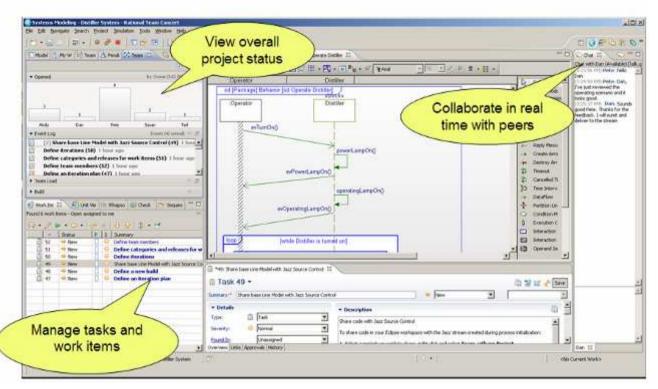
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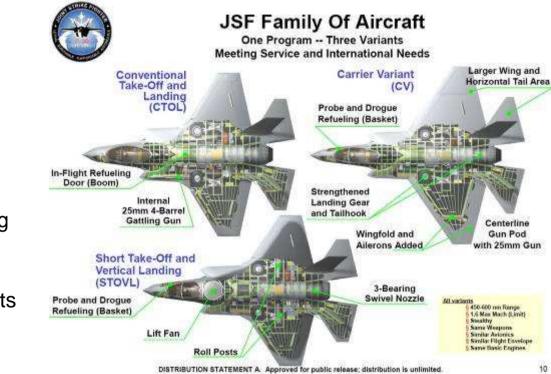
Collaborate and Communicate throughout Development

- 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



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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

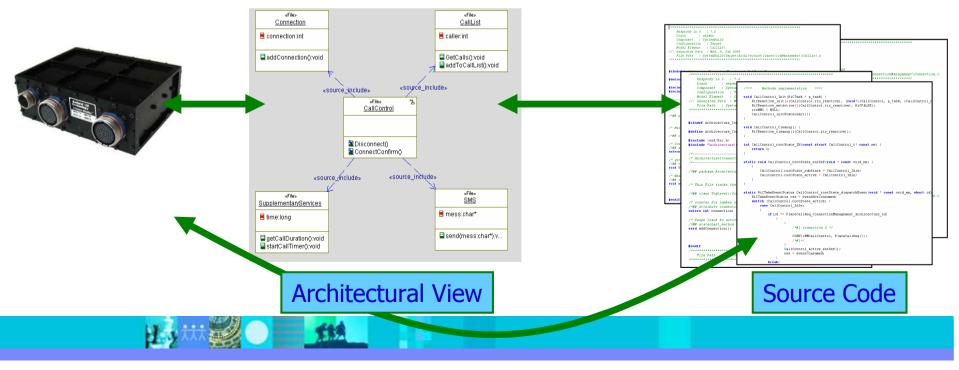




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Control the System with Optimized Software

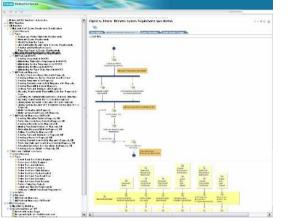
- Design efficient embedded source code
 - Specify and create from the system requirements
 - Generate complete C, C++, Java, and Ada applications
- Unite the architecture and code
 - Simultaneously work with the system design, software and target platform
 - View how a change in any one area is reflected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



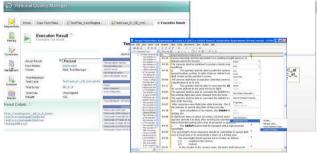


Technology, Tools, Best Practices, Services

Practice library



Starting templates



Dashboards



Tool mentors

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Collaborative Design Management

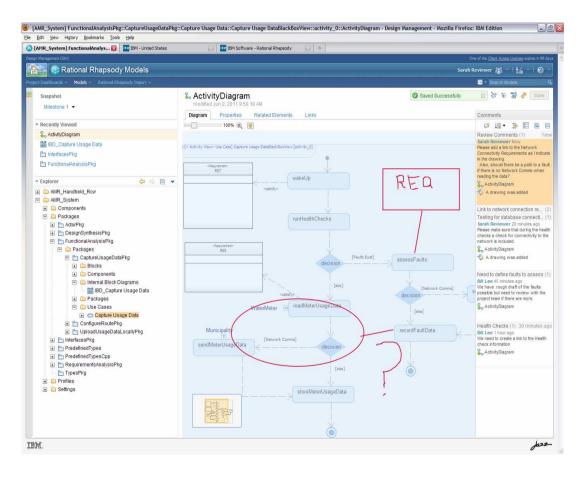
Enhance cross-team collaboration in systems & software design

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







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.

 \checkmark Related and dependent data Electronic Software Progress on related tasks (process visibility) Mechanical \checkmark WIP Design WIP WIP data artifacts Progress related to the overall program plan data Visibility to changes in related system elemen 0 x 5 x 1x change rate change rate change rate **Many Different Roles** Field Req'ts Hardware Mechanical Software Engineer Engineer Engineer Engineer Maintenance **Best of Breed Applications, Domain Specific Processes Domain Specific Program** Assets Assets Assets 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: Tra

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%
	Increase ability to predict system behavior prior to testing Implement or alter new product development processes for a multi-disciplinary approach Increase real time visibility of product Bill of Materials (BOM)

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

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Engineering environments are highly fragmented -

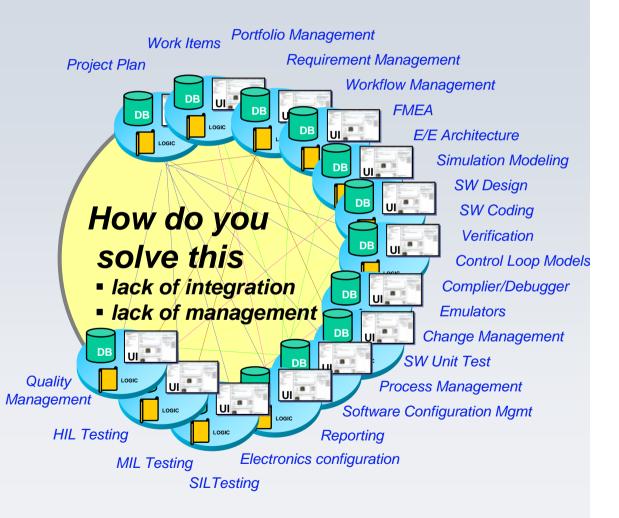
the challenge to connect them is increasing exponentially

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

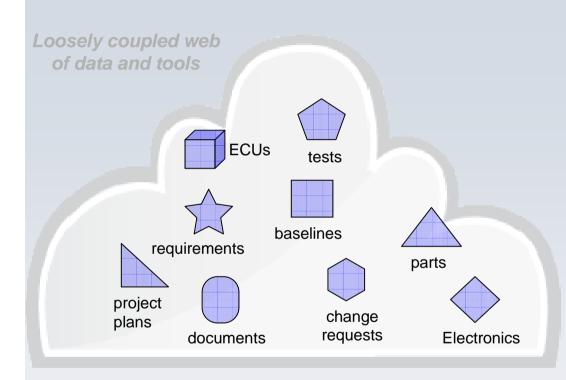




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Jazz Integration Architecture enables a loosely coupled "web" of engineering data



Federated integration architecture

Provides common, cross-product capabilities (search, query, report, process, etc.)

Integrate tools multi-vendor and inhouse tools

No duplication/synchronization of data

Incrementally add tools and capabilities

Leverage existing tool investments and best of breed capabilities

Upgrade parts individually

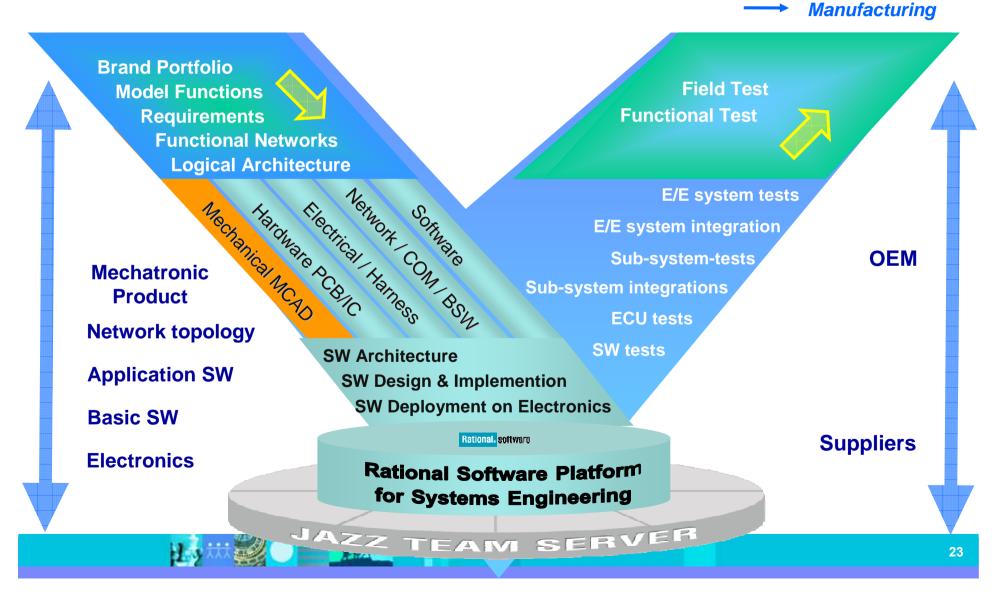




Integrating Engineering Disciplines with IBM Rational Platform

integrates teams, disciplines and workflows along the V-Model

→ Service After Sales





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")
- Asprirational
 - 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?



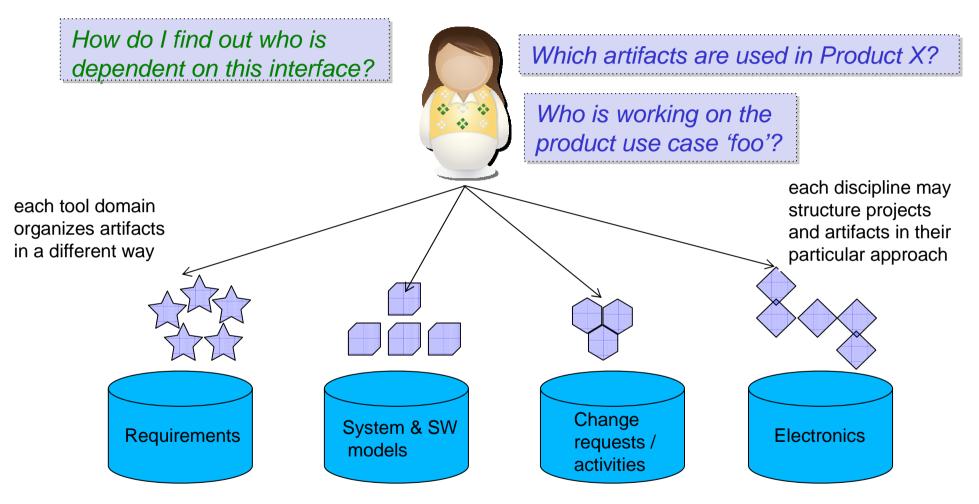


Agenda The Systems Engineering Challenge – Rational Perspective **Engineering Lifecycle Management needs** Tool integration patterns for Engineering Summary





Each tool domain has its own organizational structure



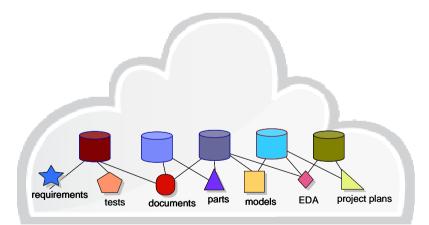
No shared view of project/product configuration No single point of access or integrated view/perspective



Integration Architecture Challenges

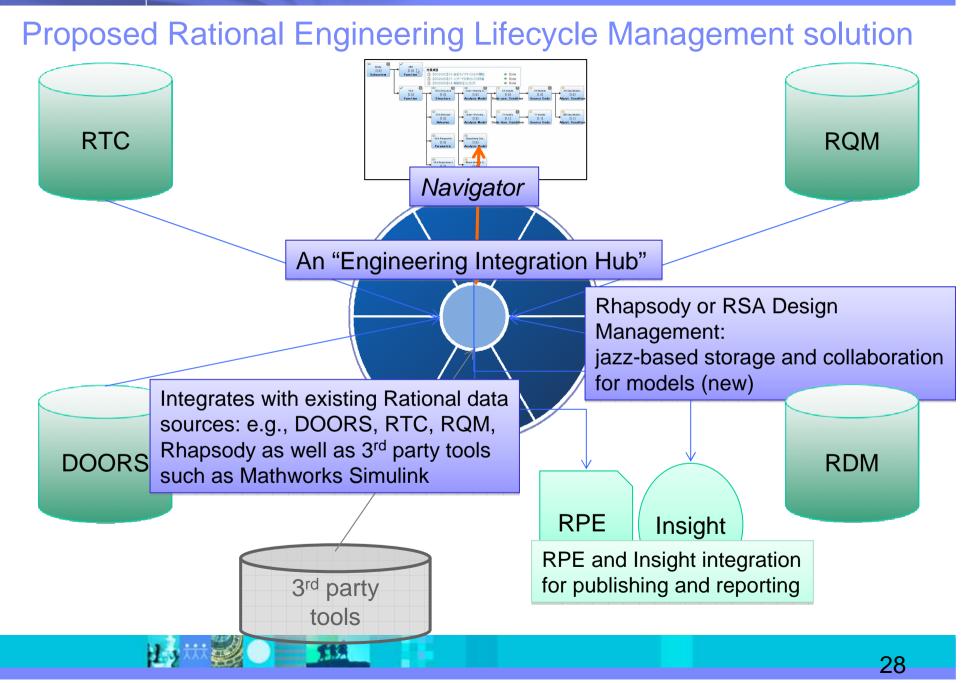
Challenges for a federated integration architecture

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





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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



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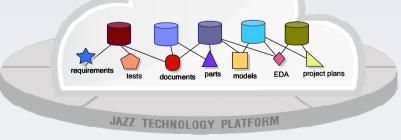
Connected data and tools

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







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Turning Product Development Into Competitive Advantage:

IBM Rational Solutions for Systems and Software Engineering in Aerospace & Defense—DO178-B

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







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

+60 – 100%	Typical DO-178B Project	• Added 60% - 100% Cost
+25-40%	Successful DO-178B Project	• Added 25% - 40% Cost for Initial Development
	Technical Project without DO-178B	

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



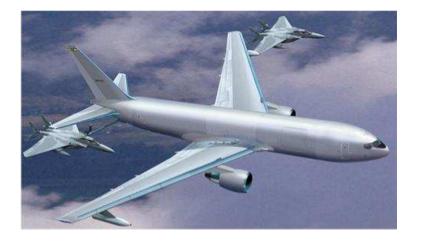
DO-178B at 30,000 feet

- 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

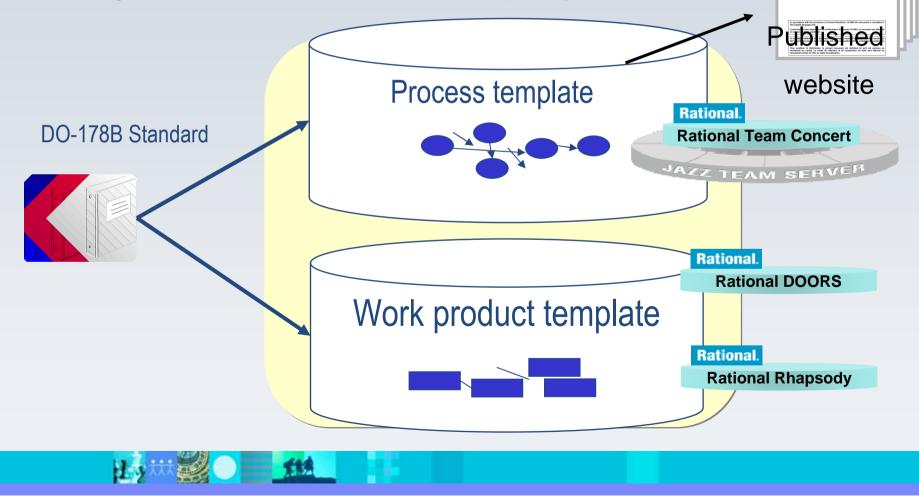






A look to the inside: Overview of IBM practices for DO-178B

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





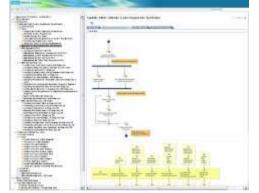
IBM Rational Solutions for DO178-B provide process support

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Learn and check how to use a Practice

A Practice library & tool mentors



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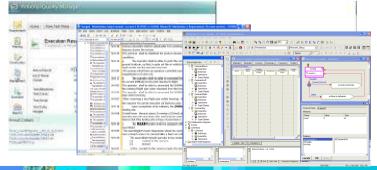


Check progress Understand tasks and deliverables

Practice tasks based on work items in RTC



Execute my tasks Update my tasks Collaborate with colleagues



Starting templates

Artifact samples

Tool usage

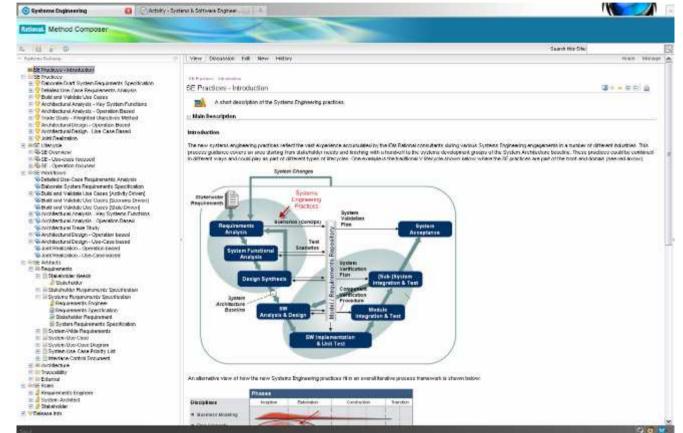
DOORS

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



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Role and team dashboards

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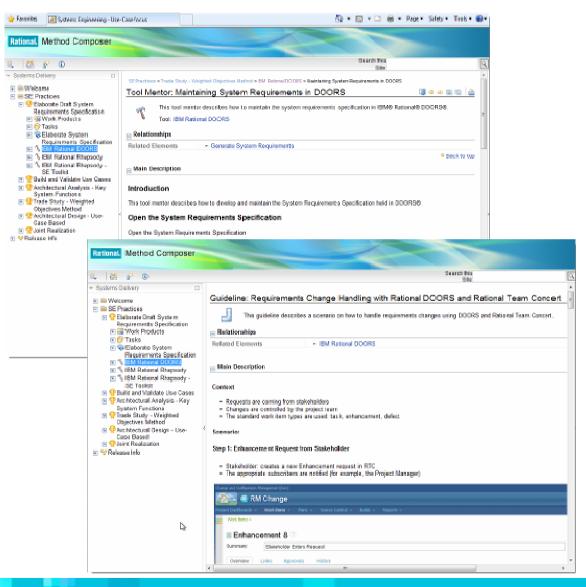
 Rational Team Concert dashboards provide summaries of the state of an individual or team activities, such as the application of one of the Practices.

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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

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DO-178B	The DO-1 products products, developme	ccelerator DO178 Accelerator 78B mapping is a set of pages providing links between the objectin specified in the RTCA DO-178B standard (particularly Appendix A) process roles and guidance provided by the Rational Practices. The ent of software intended to be certified under this standard by provi- process assets represented within the Rational Practice library and	and the work tasks, work his mapping is meant to aid the ding links between the standard
	 Main Description ◆ About this configuration ◆ Welcome to the DO178 Website! This configuration includes the practices, delivery process and the mapping to the DO-178 standard. 	Navigation Links Roles Work Products Tasks Note that the DO-178B standard calls for a number of project anticipated that the process content in this configuration form those plans (see the Artifact section). This entrails customizin with project-specific information. This refers specifically to the Management Plan, Software Quality Assurance Plan, Software Verification Plan, supplemented with additional project data in Software Aspects of Certification is created within the DO-178 in an external document. Process assets provided within the library include: Tasks - include a description of the task, a set of inputs 	s the base content for most of g this content for each new project Software Configuration e Development Plan, and Software external documents. The Plan for B Certification Practice but results



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

- Process framework workshops
- Rational Harmony family of Best Practices and Processes
- Process training

Implementation services

- Adoption quick starts
- Deployment support
- Project architecture workshops
- Project management
- Planning support
- Escalation/risk mitigation

Training and mentoring

- Product familiarity
- Product expertise and specialization
- Technology transfer
- Adoption mentoring
- e-Learning

Technical services

- Measured Capability Improvement Framework (MCIF)
- Product optimization and customization
- Tool configuration



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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|IBM Software Group | Rational software





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



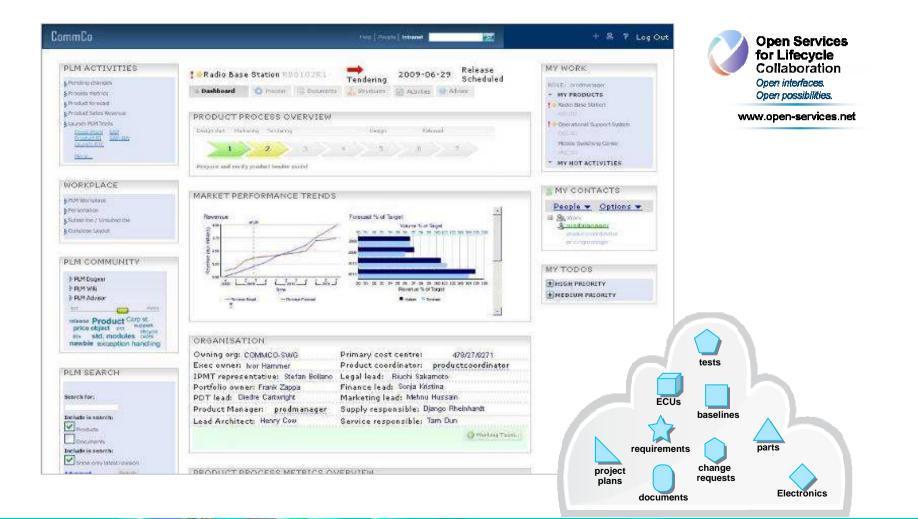




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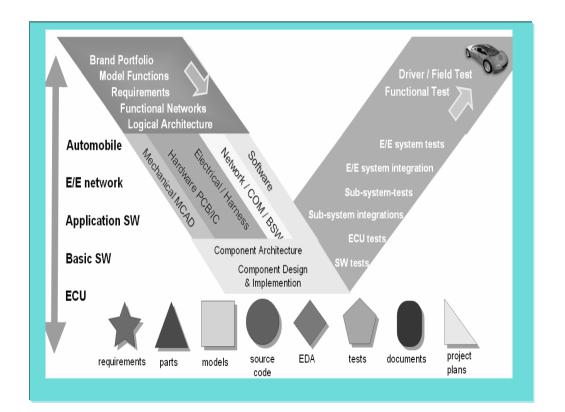
Jazz: An open platform approach "Jazz Dashboard" OSLC: Simplifying lifecycle integration





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





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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
 - <u>Accelerating Collaboration Across the Systems Development Lifecycle</u>

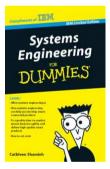
Industry Resources

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

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: <u>Systems Engineering and Embedded Software Development</u>

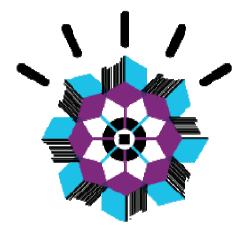






Summary: The delivery of smart products is significantly improved through systems and software engineering

- 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

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Symposium: Seize the Day

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

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Ask us questions

Make This Your Day – Interact – Ask - Provide Feedback

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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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