Innovative Solutions for Product and Systems Development

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Agenda

- Rational Engineering Solution Platform
- Design Objectives
- Major Capabilities
- Application to A&D Programs
Motivation: The ‘make up’ of products and systems has changed…
…Led by software-driven innovation

- Manufacturers are struggling to manage the resulting product complexity

Aerospace and Defense
Today’s F35 has 10 million lines of code on board, twice the amount on the F-22, another stealth fighter.

Energy and Utilities
Smart meters for water utilities will lead to $29.9 million in sales by 2017 compared with $10.3 million in 2011.

Automotive
Electronics drives 80 percent of the automotive industry’s functional innovation—software is the key to most of it.

Telecom
Between 2012-2016, mobile data traffic will multiply tenfold, with video content acting as the biggest driver.

Electronics
By 2014, 230 million Smart TVs will be installed with 57 million homes watching web-based streams over broadband.

Medical Devices
The da Vinci S surgical robotic system:
- 1.4 million lines of code
- Computing power of 7 laptops
- 10,000 individual parts
A System

...using a system

...to build systems
Three imperatives for a systems approach to product development

1. Traceability across the lifecycle
2. Access to all engineering information
3. Collaboration across engineering disciplines
Rational Engineering Platform: Systems Engineering and Software Engineering

- Cross-discipline concerns addressed by systems engineering solutions
- Deep functionality for software development
- Supporting functionality for other Engineering disciplines
Rational Engineering Solution Platform

- Translate Requirements into a System Design
- Full Traceability: requirements to design to test to deliverable documents
- Requirements Management

- Systems Modeling
- Change Management
- Configuration Management

- Verification & Validation
- Quality Management

- Collaboration and Workflow Management

- Asset Repository Management
- Process and Method Authoring and Management

- Query & Organize
- Document Generation
- Analytics

- Manage baselines and configurations across disciplines
- Manage requirements across lifecycle and disciplines
- Share and manage engineering assets for effective reuse

- Integrate, analyze, optimize and use engineering information
- Generate requirements, design, specification documents

- Flexible integration of additional technologies—IBM and others
- Facilitates Architecture and Model Centric Approaches
- Manage change throughout lifecycle
- Collaborate and Communicate throughout Development
- Team / individual planning—agile, planned, other styles
- Real-time dashboards and reporting with analytics

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Rational Engineering Solution Platform

Integrated modular cross-discipline engineering solution
10

Requirements Management

Verification & Validation

Change Management

Quality Management

Configuration Management

Open Standards

Open Architecture

Information Integration

Process and Method Authoring and Management

Asset Repository Management

Collaboration and Workflow Management

Query & Organize

Document Generation

Analytics

Model Integration
Rational Engineering Solution Platform

Built on a core product set

- **Requirements Engineering**
  - Rational DOORS
  - Manage all system requirements with full traceability across the lifecycle

- **Architecture and Design**
  - Rational Rhapsody
  - Rational System Architect
  - Rational Design Manager
  - Use modeling to validate requirements, architecture and design throughout the development process

- **Collaboration, Coordination & Change Management**
  - Rational Team Concert
  - Rational ClearQuest / ClearCase
  - Rational Change / Synergy
  - Collaborate across diverse engineering disciplines and development teams

- **Verification, Validation and Quality Management**
  - Rational Quality Manager
  - Achieve “quality by design” with an integrated, automated quality process

- **Information Integration**
  - Rational Engineering Lifecycle Manager
  - Query, Analyze and Optimize cross-discipline information

- **Publishing & Reuse**
  - Rational Asset Manager
  - Rational Publishing Engine
  - Process & Practice Engineering
  - Rational Method Composer

- **Process & Practice Engineering**
  - Rational Engineering Solution Platform
  - COLLABORATE
  - AUTOMATE
  - REPORTING and ANALYTICS
  - Best-of-breed capabilities, integrated on a common platform
<table>
<thead>
<tr>
<th>Solution Offering</th>
<th>Key Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements Engineering and Traceability</td>
<td>End-to-end, live traceability to source, mission and system/subsystem requirements.</td>
</tr>
<tr>
<td>Model-Based Systems Development</td>
<td>Model requirements, system functionality, realization, trade studies, execution, validation</td>
</tr>
<tr>
<td>Technical Work Management</td>
<td>Manage collaboration, change, shared repository, configuration</td>
</tr>
<tr>
<td>Information Integration</td>
<td>Query, Analyze, Integrate and Optimize the use of engineering information across platforms and systems</td>
</tr>
<tr>
<td>Automated Work Products</td>
<td>Generate requirements, design, specification documents</td>
</tr>
<tr>
<td>Measuring Engineering Effectiveness</td>
<td>Automatic collection, tracking, reporting, dashboards</td>
</tr>
<tr>
<td>Integrated Systems and Software Engineering</td>
<td>Flow-down of requirements and models, embedded development</td>
</tr>
<tr>
<td>PLM Integration across the Development Lifecycle</td>
<td>Sharing models and data among systems, software, electrical, mechanical domains, model integration</td>
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<tr>
<td>Safety-Critical Software Development</td>
<td>Instrument comprehensive traceability and change management to meet standards</td>
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Focus on Systems Engineering

To Help Manage Complexity Across Disciplines

According to Aberdeen Group…

“The Best-in-Class are able to manage the challenges of systems engineering by providing for a multidisciplinary approach, improving collaboration across disciplines, testing the performance of the entire system earlier in development stages through simulation, and formally tracking design requirements.”

Value of Systems Engineering: Cost and Schedule

Applying the right amount of systems engineering is critical to meeting cost and schedule targets.

Source: Honour, Eric (2010), *Systems Engineering Return on Investment*, University of South Australia, p9
Value of Systems Engineering: Success and Quality

Applying the right amount of systems engineering is critical to program success.

Figure 12. Correlation of SE Effort to Subjective Success

Figure 13. Correlation of SE Effort to Technical Quality

Source: Honour, Eric (2010), Systems Engineering Return on Investment, University of South Australia, p9
Main Solution Concepts:
Traditional Systems Engineering: Document Oriented vs. Model-Oriented

• Work is **serial**, and team members are **disconnected** and often waiting on the work of others, leading to **delays** and **missed market opportunities**

• Artifacts handed off from the previous process step are **ineffectively** shared, reviewed, tested and traced, leading to **poor quality** and **increased risk** when making changes
One source of truth in model/requirements repository enables collaboration across functions, teams and lifecycle.
Open Services for Lifecycle Collaboration

An initiative aimed at simplifying tool integration across the software delivery lifecycle

Barriers to sharing resources and assets across the software lifecycle:

- Multiple vendors, open source projects, and in-house tools
- Private vocabularies, formats and stores
- Inextricable entanglement of tools with their data

Open Services for Lifecycle Collaboration

- Specifications for sharing lifecycle resources
- Inspired by Internet architecture
  - Loosely coupled integration with “just enough” standardization
  - Common resource formats and services
- A different approach to industry-wide proliferation
What is OSLC, and why should I care?

OSLC is an open community building practical specifications for integrating software

**Tool Maker**
- create software using reusable and open assets that will interoperate with other tools both inside and outside your influence providing time and cost savings

**Tool Manager**
- reduce the complexity and risk of increasingly complex software infrastructures, and improve the value of software across a broader set of internal and external stakeholders

**Tool User**
- choose the best tools for your job and have them interact seamlessly to achieve traceability and visibility with the rest of your organization

**Systems Integrator**
- focus energy and resources on higher-value customizations, deliver more business value to your clients, and increase client satisfaction

http://oslc.co/organizations
Timing and Mission of OSLC Domains

- **Draft**
  - Core 3.0
  - Change Management 3.0
  - Asset Management 3.0
  - Configuration Management
  - Quality Management 3.0
  - Requirements Management 3.0
  - Architecture Management 3.0
  - Automation 3.0
  - Performance Monitoring 3.0
  - Resource Reconciliation 3.0
  - PLM/ALM
  - Estimation and Measurement

- **Converge**
  - Core 3.0
  - Change Management 3.0
  - Asset Management 3.0
  - Configuration Management
  - Quality Management 3.0
  - Requirements Management 3.0
  - Architecture Management 3.0
  - Automation 3.0
  - Performance Monitoring 3.0
  - Resource Reconciliation 3.0
  - PLM/ALM
  - Estimation and Measurement

- **Final**
  - Core 3.0
  - Change Management 3.0
  - Asset Management 3.0
  - Configuration Management
  - Quality Management 3.0
  - Requirements Management 3.0
  - Architecture Management 3.0
  - Automation 3.0
  - Performance Monitoring 3.0
  - Resource Reconciliation 3.0
  - PLM/ALM
  - Estimation and Measurement

**OSLC Member Section**
- Core TC
- Change and Configuration Management TC
- Requirements and Quality Management TC
- Automation TC
- Integrated Service Management TC

Other TCs based on other OSLC WGs, OSLC UGs, existing external initiatives, Member interest, or a combination of.

**OSLC UG**

External Initiative

Accenture • Advanced Computational Research • Alcatel-Lucent • APG • Atego • BigLever • Black Duck • Boeing • BSD Group • CESAR • Citigroup • ClearBlade • CloudOne • CM-Logic • Corso • Creative Intellect Consulting • EADS • Emphasys • Empulsys • Ericsson • fluid Operations • Galorath • General Dynamics C4 Systems • General Motors • IBM • Icaro Technologies • iFEST • Institut TELECOM • Integrate Systems Engineering • IRIS • Koneksys • Kovair • KTH • Mentor Graphics • MobileSmith • NASA Jet Propulsion Laboratory • Northrop Grumman • OFFIS • Oracle • Orb Data • Perforce • Phunware • PointSource • Price Systems • QSM • Rally Software • Ravenflow • SCM Solution • Shell • Siemens • Sogeti • SourceGear • SPRINT • State Street • Stoneworks Software • Tasktop • Taxal • Thales • Tieto • TOPIC Embedded Systems • UrbanCode • Virtual Vehicle • Washington Metropolitan Area Transit Authority • WebLayers

© 2013 OSLC User Group for Communications
Connect across systems, software and electrical/electronic engineering

- System & Software Design
- Engineering Lifecycle Management
- Requirements Management
- Quality Management
- Task & Change Management

OSLC and OASIS standards

- Context SDM
- Capital
- Multiple other integrations, e.g. MCAD
- Sourcery CodeBench
- Expedition Enterprise
- Volcano

IBM Jazz platform

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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

How do you solve this:
- lack of integration
- lack of management
IBM Rational Change Management

- **Implements Collaboration**
  - Integrated work items, chat and process guidance, reporting

- **Streamlines Change Management**
  - Out-of-the-Box, Customizable Workflows*

- **Automates Project Governance**
  - Assess project status and trends in real-time with web-based dashboards, metrics and reporting

- **Scales to the Enterprise**
  - Supports teams ranging from a few to thousands of contributors and stakeholders

- **Unifies Diverse Teams**
  - Supports Visual Studio, Eclipse, Web, and open source

- **Provides a Foundation for Collaborative ALM**
  - Easily meet your growing software delivery needs with seamless integration of Jazz based lifecycle products
Technical Work Management: Collaboration and Communication

- Communication among teams facilitated by Systems Engineering
- Reduce wasted time / error associated with misunderstandings and incomplete mental pictures of system requirements
- Build common, shared work products among cross-functional teams
  - Model-based
  - Shared repositories (requirements, change requests, issues, defects, configurations)
- Coordinated, automated workflow tied to shared work products
  - Avoid email exchange of work products, multiple versions, confusion
- Build on integrated tooling infrastructure
  - Limitations of point-to-point integration
  - Jazz Platform and OSLC Vision

Why are small teams so effective? (Why better than email?)
Technical Work Management: Enabling Effective Collaboration

- Manage Portfolio & Product Priorities
- Capture & manage requirements
- Develop - Model-Driven System Engineering
- Software Engineering
- Electrical Engineering
- Mechanical Engineering
- Execute Tests
- Capture customer requests & market driven enhancements
- Integrated Change Management
- Collaboration, Process, Workflow
- Shared Repository
- Collaborate across Development Disciplines
  - Software
  - Electrical
  - Mechanical
Collaboration in Action

Team Awareness
- Shows team members and their online status
- Shows what they are working on

Change Awareness
- Automatically links to changes if mentioned in chat
- Drag and drop any work item or query into chat
Iteration Planning

Understand how well you are progressing against your targets in real-time.

Plan and execute on iterations while managing load.

Drag-and-drop work items to change owners/create child parent relationships.
Multi-Level Traceability

*Information transparency allows you to take control*

- Trace to & from information both inside and outside DOORS
- View traceability from multiple perspectives allowing you to perform impact analysis across the whole lifecycle

Technical Reqs  Suspect Links  Discussions  Higher Level Reqs  Evidence Detail

Make maintaining traceability an asset rather than an overhead
Rational DOORS is closely linked with Rational Rhapsody

- Rational Rhapsody and Rational DOORS provide Model-Driven Requirements Management
  - Models facilitate requirements and systems traceability, early validation of design; catch problems earlier in lifecycle to greatly reduce cost of errors
  - Full UML 2.1 and SysML support
Model-driven system development models a system-of-systems in four recursive stages.

- **Context** describes the system and the people and systems who interact with it (actors).

- **Usage** describes how the actors use the system is used to produce the results and purposes of the system.

- **Realization** describes how each usage is accomplished by a collaboration of system elements using various viewpoints.

- **Execution** enables demonstration and proof of the model through execution.
Model-Driven Development for Systems & Software
Rational Rhapsody®

"Using Rhapsody software improves the quality of the application software that is integral to the series hydraulic hybrid system development process."

Steve Zielinski, Eaton chief engineer for software

Capabilities

- Requirements-driven analysis and design for technical, embedded or real-time solutions, including those based on multi-core architectures
- Rapid design validation and verification with frequent simulation and testing
- Development and deployment of complete C, C++, Java and Ada applications

Benefits

- **Build the right product** through non-ambiguous communication and frequent collaboration
- **Eliminate defects early** and increase quality by continually testing the design
- **Reduce development time** by automatically generating applications and documentation
- **Re-use and adapt existing technology** through reverse engineering and product line engineering
Rational Rhapsody

• One modeling tool
  – Systems Engineering
  – System/Subsystem modeling
  – Domain-specific systems models
  – Embedded Software Development
  – Model Integration

• Standards-based
  – Unified Modeling Language – UML 2.x
  – Industry-standard notation for specifying, visualizing, and documenting systems and software designs

• Systems Modeling Language - SysML
  – Extends/specializes UML to address needs of the Systems Engineer
  – Open standard published by the OMG and INCOSE

• Domain-focused notations include:
  – DoDAF, MODAF, UPDM
  – AUTOSAR, MISRA, MARTE

Visualize:
  ▶ Use cases
  ▶ Requirements
  ▶ Structure
  ▶ Behavior
  ▶ Interaction
  ▶ Constraints
  ▶ Tests
Rational Rhapsody: An Organizational Modeling Solution

- **Rational Modeler** – free UML and Domain Specific Modeling (DSL) tool based on Rhapsody.

- **Rhapsody Architect for Systems Engineers** – core product for systems engineers: requirements visualization, UML, SysML, AUTOSAR, DSL, static analysis, parametric constraint evaluation.

- **Rhapsody Designer for Systems Engineers** – includes Rhapsody Architect for SE; adds simulation for trade-off analysis, model execution, rapid prototyping and model based testing.


- **Rhapsody Developer** – full edition of Rhapsody targeting embedded software developers working in C, C++, Java, C# or Ada. Includes Rhapsody Architect for Software functionality and adds full behavioral software development (structural only for C#) and application code generation, simulation & target execution, AUTOSAR.

- **Rhapsody Design Manager and Rhapsody Design Manager Reviewer** – supports Collaborative Design Management by using Jazz technology to help teams develop, share, search, review and collaborate on design.
Collaborative Design Management

_Increase cross-team collaboration on software and systems design_

**Systems Modeling Design Hub**

- Enterprise-wide design storage for search, review, analysis, and reuse
- Links design elements to lifecycle artifacts
- Navigate and visualize relationships

**Stakeholder Collaboration**

- Automated design reviews at all stages of development
- Intuitive extended team web client for broader access to designs

**Document Generation and Reporting**

- Create documents directly from the development lifecycle
- Draw from information and assets linked through OSLC

_“The ability to review and comment on models from the Web client encourages feedback from a wide array of stakeholders... leading to faster consensus and improved quality of solution designs.”_

– Lars Tufvesson, Sellegi
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
Design Server

Maximize productivity and lower costs

- Increase team knowledge through an enterprise and system-wide repository with Web-based access
- Leverage Jazz to quickly search across designs for review, analysis and potential reuse
- Analyze the impact of design changes

- Teams need to quickly find existing designs to review, analyze, and identify reuse, but...
  - Information may be stored in multiple designs or models
  - Desktop client installation is required to view the design information
  - Access to SCM system also may be required to access the information

- With Collaborative Design Management...
  - All designs for an organization or system can be stored and accessed from a central location
  - All known designs can be searched, viewed, analyzed on the server from Rhapsody, RSA or Web client
  - The new Relationship diagram supports impact analysis and discovery of related design elements and resources
Collaborative development in Rhapsody
Create Rhapsody UML (and SysML) Model Elements directly within Teamcenter Systems Engineering

For a given breakdown of Rhapsody UML (and SysML) Elements created in Teamcenter Systems Engineering, create a Rhapsody Diagram using “Rhapsody Live”

Based on the type of Rhapsody UML Elements selected in Teamcenter Systems Engineering browser Rhapsody launches from Teamcenter, and elements can be visualized in UML (and SysML) diagrams
Reuse and Beyond: 
Versions, Variants and Configurations

Configuration A: 2013 L for Europe

Configuration B: 2012 XLT for US
## IBM Rational Quality Manager

**A central hub for business-driven software quality**

### Mitigate business risk with collaboration

- Stakeholder and team coordination reduces mistakes
- Risk identification and management leads to educated prioritization decisions
- Test traceability linked to business requirements improves customer satisfaction

### Improve operational efficiency with automation

- Running tests earlier leads to reduced repair costs
- Running more tests in less time improves coverage
- Reducing manual labor leads to fewer testing errors
- Lab configuration automation improves efficiency and asset utilization

### Make confident decisions with effortless reporting

- Real-time dashboards enable proactive risk management
- Customizable reports facilitate ongoing process improvement
Comprehensive dynamic planning and updates

Process flow, not artifacts drives team activities

- Live dynamic documentation
- Defines test process
- and strategy
- Defines responsibilities
- Activity based versus hierarchy
- Business level reporting against quality objectives
Rational Quality Manager Open Ecosystem Today

Automated Testing
- Rational Functional Tester
- Rational Performance Tester
- Rational Service Tester for SOA Quality
- Rational AppScan Tester Edition
- Test RealTime
- Rational Robot
- Rational Rhapsody

Builds, WorkItems and Defects
- Rational ClearQuest
- Rational Team Concert
- Rational BuildForge

Requirements
- Rational Requirements Composer
- Rational ReqPro
- Rational DOORS

Supporting bidirectional integration with the Jira change management system

Managing mobile applications testing across a global handset test environment

Accelerating test cycles with virtual machine management and execution

Reporting
- Rational Insight

Enabling greater quality and productivity with automated SOA governance support

Provisioning
- Tivoli Provisioning Manager (TPM)
- Tivoli Service Request Manager
- TADDM

RapidRep

Rational Insight

Tivoli software

Certify

Worksoft software

Quick Test Professional

LoadRunner

TMAP Process

hp software

WebLayers

Enabling greater quality and productivity with automated SOA governance support
Traditional Embedded Software Development Process

- **Project Manager**
  - Create change request
  - Assess progress

- **Systems Engineer**
  - Modify requirements and evaluate impact
  - Derive software requirements

- **Software Engineer**
  - Software Development

- **Quality Engineer**
  - Plan tests and link to requirements
  - Schedule tests
  - Submit defect

- **Test Engineer**

Tools:
- DOORS
- Rhapsody
- Team Concert
- Quality Manager

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Integrated Systems Engineering and Verification

IBM Rational Quality Manager

Test Plans
Test Cases
Test Schedules

National Instruments Test System
MIL, SIL, HIL, SysIntLab, Mechanical, Field Test

National Instruments Test Components

IBM Rational Quality Manager

Execution Records
Requirement Links
Quality Dashboards

Dashboards, Execution Records, Test Plan Documentation

Requirements Documents
Reporting Infrastructure

• Reporting capabilities in each module allow for information extract and management

• Information from multiple modules can be consolidated and transformed into deliverable-ready documents

• Status and management information can be aggregated and analyzed for business management
Dashboards and reporting

Trending by project or by individual team

Team member details

Current milestone status

Getting Started with Work items
Team Wiki

Current Work Item Plans (2)
Current Iteration: 0.6 RC1
Foundation & Work Items

Work Item Event Log (15 new)
1. WebUI - Hide comment is confusing - lost work (51725) 10 minutes ago
2. Indexing slow on attachment with long lines (48006) 15 minutes ago
3. User photo lost when creating new user (49010) 15 minutes ago
4. Deliver new csvicon (52856) 15 minutes ago
Automated Document Generation

- Treat documents as reports of live information
- Facilitate re-use and consistency
- Easily accommodates change
The Process, the Plan and the Play
The power and efficiency of an integrated workflow
A Systematic Approach to Method and Process

Standardize representation and manage libraries of reusable **Method Content**
- Content on systems engineering
- Content on agile and iterative development
- Guidance on Service-oriented dev’t

Tool user guidance
- Model-based SE
- Configuration mgmt guidelines

Lessons learned from previous programs
- Corporate guidelines on compliance

Develop and manage **Processes** for performing projects
- Process assets patterns
- Standard or reference processes
- Project plan templates

**Configure** a cohesive process framework
**Tailor** for specific needs (division, program)

**Enactment** of process in the context of my project
**Plan and Monitor** as program proceeds
Method and Process Deployment Overview

Process Design
- Method Content
- Process Content
- Enactment Content
- Building Blocks

Process Tailoring
- Team Process Tailoring
- Building Configurations
- Variability and New Content

Process Enactment
- Work Items
- Reviews and Approvals
- States
- Checklists
- Planning

You've got work!
Rational Method Composer: Authoring

Library view

Editor view

Configuration view
Combine IBM Practices with organization and program-specific methods and processes for a comprehensive, tailored process system
Process Tailoring – 3 Levels

1. Team Process Tailoring
   - Tailoring a published process directly
   - Easy; good for quick changes or non-persistent changes

2. Selective Tailoring
   - Selects from library to build new method configuration before publishing
   - Use wizard or checkboxes (or both)

3. Variability Tailoring
   - Start with any base method/process
   - Define additions, extensions, modifications
   - Publish new resulting configuration
Process Enactment: *Generated process reference*

Role-based guidance available as a Web site

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**Role: Team Lead**

This role leads the planning of the project, coordinates interactions with the stakeholders, and keeps the project team focused on meeting the project objectives.

Role Sets: Basic Roles, Project Management

### Relationships

- **Team Lead** performs:
  - Assess Results
  - Assign Change Request
  - Identify and Assess Risks
  - Manage Iteration
  - Plan Iteration
  - Plan Project

- **Team Lead** is responsible for:
  - Iteration Plan
  - Project Plan
  - Risk List
  - Work Items List

### Additionally Performs
- Develop Technical Vision
- Envision the Architecture
- Refine the Architecture

### Modifies
- Risk List

### Main Description

The person in this role:

- Coaches the team to drive a successful outcome of the project and the acceptance of the product by the customer
- Is accountable for the outcome of the project and the acceptance of the product by the customer
- Is responsible for the evaluation of project’s risks and for controlling these risks through mitigation strategies
- Applies management knowledge, skills, tools, and techniques to a broad range of tasks to deliver the desired result for a particular project in a timely manner
Process Enactment: *Integrated Process and Tools*

**Execute the process and track progress**

- Create RTC Work Item Templates based on WBS in RMC
- Instantiate Templates in RMC as a Project Plan, Iteration Plan or ad-hoc set of tasks
- Process Guidance linked to each work item
- Track and report on project status with RTC Dashboards and reports
What is engineering asset management?

Asset warehousing is critical to successful reuse

Engineering asset management is all of the infrastructure and processes necessary for the effective management, control and protection of the engineering assets within an organization, throughout all stages of their lifecycle.
Customer Success Stories
An aircraft manufacturer implements an advanced multi-domain optimization solution to more effectively design complex systems.

Enabled improved engineering collaboration that **avoided redevelopment expenses** and facilitated efficient design that reduced cabin weight by **5%**

**Business problem:** Business units were working in isolation and relied on instinct to design components. The lack of collaboration caused engineers to periodically miss design dependencies among components, which translated to costly and time-consuming modifications later in the development lifecycle.

**Solution:** By establishing a holistic view of architecture criteria, engineers can quickly verify the validity of architectural concepts, pinpoint optimal component designs and ultimately create safer, more efficient aircraft for airline companies and their passengers.
MBDA, a European defense company, provides its transnational staff with a common platform for modeling, testing and sharing highly complex designs and design protocols.

Reduced typical system design time from

**60+ months**

to

**18 months**

while enabling design team collaboration across geographies.

**Business problem:** Needed to improve complex engineering design collaboration and cycle time across geographical borders

**Solution:** A model-based systems engineering platform across widely distributed design and engineering teams to analyze and communicate software, mechanical and electrical requirements

“We’re now able to define and model all the requirements of a complex missile system very early in the development process. This differentiates our delivery capabilities in a highly competitive global marketplace.”

— MBDA executive
A major aircraft manufacturer is keeping engineering, production and ordering data in sync through product lifecycle collaboration.

Design configuration synchronization providing a cost savings of $9.5 million while ensuring 100% compliance to FAA regulations.

**Business problem:** Struggled with data inconsistency between engineering and production data that led to delays, higher costs and degraded quality.

**Solution:** Automated collaboration processes and tools to synchronize all updates to parts, change management data and assemblies.
A European aviation company streamlines aircraft engineering and meets archiving regulations with digital content management.

Increased speed of design iterations by

70%

while reducing engineering changes by up to

90%

**Business problem:** Needed to meet regulatory requirements for secure, long-term archiving of design data while increasing engineering productivity and reducing error

**Solution:** Comprehensive all-digital enterprise content management solution integrated with core engineering and design applications

“The digital content management system serves extended set of purposes – including regulatory and legal - in addition to storing engineering files and design notes that can be used in future aircraft designs.”

— *Company executive*
Customer Success

Valtech

Challenge
- Needed to create a new OO development process for global development in response to avionics customer request for DO-178B Level B systems – could not re-use requirements across projects with similar systems which increased costs
- Needed to maintain CMM level 5 with processes founded on agile principles
- Distributed development environment

Solution
- Adopt a model based approach around Rhapsody

Key Benefits
- Increased productivity by 40%
- Reduced defects by 75%
- Lowered costs to end customer to be more competitive
- Able to deliver new baseline every 6 weeks for customer review

“The first thing we noticed was better communication…They reduced development time by reusing architectures and components, ensuring that there is no duplication of effort.”
Customer Success

Major Aerospace Company

Challenge

- Increasing complexity and number of Systems:
  - Collision Avoidance Systems
  - Instrument Landing Systems
  - Communications Systems, etc
- Incorporating these systems into Integrated Modular Avionics (IMA) environment
- Distributed development environment

Solution

- Process Automation for Requirements, Traceability, Change and Configuration Management

Key Benefits

- Increased communication and collaboration of globally distributed team
- Reduced cycle time by 50%
- Decreased manual efforts for verification activities

“We get faster deliveries to the customer. We get more turns of the hardware. All the testing and everything...it happens twice as fast.”

Principle Engineer
Communications and Navigation Systems
Major Aerospace Company

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
### Boeing Space Systems: Future Image System Ground Station Architecture

#### Client situation

**Very large project**
- Approximately US$5 billion development project
- Team made up of four companies with developers at five sites
- Approximately five million lines of code, much of it new

**Status**
- One hundred forty-five system engineers building requirement specifications based on functional allocations
- Poor communications with software developers; little progress
- Engineering documents unusable by developers
- Spending US$1 million a week

**Challenge**
- Introduce a process that scales to a large project that enables the different teams and stakeholders to collaborate

#### Solution

- Use the IBM **Systems Engineering solution, modeling and requirements management** for architecture framework
- Organize a cross-functional team including system engineers and software architects
- UML model created for all engineering efforts
- Adopt iterative program management
- Use-case-driven iteration and test planning

#### Results

“Project on track through five iterations, millions of dollars in savings. The solution enhanced our project success rate from 14 percent to over 90 percent.”

— Michael Mott, technical fellow Boeing S&IS
National Aeronautics & Space Administration: James Webb Space Telescope

**Client situation**

**James Webb Space Telescope (JWST)**

The next-generation telescope, which will succeed the Hubble space telescope, is expected to be launched by 2013. It will study galaxy, star and planet formation in the universe. To study the earliest star formation, NASA will observe infrared light using special instruments optimized to capture this part of the spectrum.

**Challenges**

- Develop and govern a large systems program
- Reduce development time and cost
- Provide consistency in designing large-scale systems across the program and various instruments being built (hardware and software co-development of systems)
- Manage distributed systems development across systems integrators and NASA, which included the four instruments
- Use standard processes for systems development across the organization, and comply with CMMI regulations
- Reuse the software for the instruments across the program to improve productivity

**Solution**

IBM Rational systems development solution—*an integrated approach to architecting, building and governing complex systems of systems*

- **IBM Rational Requirements Management**—implemented requirements from business need to implementation in for traceability
- **IBM Rational RealTime software**—implemented full system model using UML to facilitate communication and reuse; increased predictability and reliability of the systems
- **IBM Rational ClearCase and Rational ClearQuest software**—facilitated collaboration and asset reuse of artifacts across JWST

**Results**

“It was important that NASA be forward-looking with the James Webb Space Telescope by using a systems development platform that would be reliable and ahead of the marketplace throughout the extensive life of the mission.”

—Glen Camarata, ISIM flight software development lead, Satellite Software Corporation
Naval Air Warfare Center China Lake:  
**Integrated Countermeasure Assessment System**

### Client situation

**Integrated Countermeasure Assessment System (ICAS)**
ICAS integrates a variety of technologies into a single system that simulates and evaluates defensive measures. The assessment capability spans missile and aircraft. The goal is to ensure the operation of protection systems without costly live-fire tests.

**Challenges**
- Reduce development time and cost
- Address compliance with the DoD 5000
- Need for repeatable and predictable process to operate at CMMI Level 3
- Manage evolving and changing IPT requirements and traceability from business needs to implementation requirements
- Improve communication and collaboration across the program, which spans the Electronic Combat Range (ECR), test programs, project management activities (PMAs) and Department of Test & Evaluation
- Address evolving technology in warfare
- Provide visibility into the program status and tracking of the project

### Solution

- **IBM Rational Unified Process solution for Systems Engineering**—applied iterative systems development best practices and use-case flow-down methodology with an integrated tool set
- **IBM Rational Requirements Management**—implemented requirements from business need to implementation for traceability
- **IBM Rational RealTime software**—implemented full system model for improving communication and reuse among developers
- **IBM Rational Change and Configuration Management software**—built collaboration and tracked program status using Unified Change Management functionality; facilitated asset reuse of artifacts and models

### Results

“The Rational tool set has significantly increased communication across the IPT, providing a universal understanding of the project, reducing risk and keeping the development on track. The IPT is achieving its goals to meet CMMI Level 3 and DoD 5000 conformance.”

—Ric Soard, deputy project manager, ICAS
Raytheon Missile System

**Client situation**

Raytheon’s Non-Line of Sight Launch System (NLOS-LS) program aims to develop a family of artillery missiles with a unique, flexible launch ability. Missiles can be fired from a vertical launcher deployed by ground or air and integrated quickly into the battlefield network (net-centric operations).

Systems engineering groups were using a traditional functional decomposition approach to analyze customer requirements.

Software engineers were using OOAD methods using UML.

**Solution**

- Recommended an IBM Systems Engineering solution to sort out system dependencies.
- Utilized use cases and use-case flow-down approach to logically decompose the system of systems.
- Conducted workshops on use-case flow down using the customer’s project as exercises in the workshop.

**Results**

Raytheon team members gained agreement with their customer, and filled in gaps in the requirements process. They also improved systems and software team collaboration, helping Raytheon’s NLOS-LS missile systems position itself for success.
Lockheed Martin and Naval Surface Warfare Center, Dahlgren Division: Aegis Open Architecture

**Client situation**

**LMIT – Navy Aegis Open Architecture Program**

Navy Aegis Weapons Systems (AWS) redesign and rearchitectured to ensure maintainability and software (COTS) refresh. Improve extensibility for introducing new war-fighting capabilities in a net centric environment, reduce time and maintenance cost.

**Challenges**

- Compliance with DoD5000 and certification with open architecture
- Combat system certification with open architecture components
- Manage evolving external program requirements
- Improve distributed team collaboration and communication in a classified environment.
- Decrease time to deliver quality software products to the fleet.

**Solution**

- **IBM Systems Engineering Method solution**— applied iterative systems development practices and an integrated toolset
- **IBM Modeling software**—implemented full systems model
- **IBM Rational ClearCase and ClearQuest MultiSite software**—distributed collaboration environment with Navy and subcontractors and synchronization of data from unclassified to classified sites; facilitated asset reuse

**Results**

“IBM Rational’s product, process and services enabled better collaboration between the Navy and Lockheed Martin to accelerate the Navy OA certification cycle, thus delivering faster and better capability to the fleet at a reduced cost.”

—Kelly Lenahan, Lockheed Martin lead for Navy support of Aegis Open Architecture
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