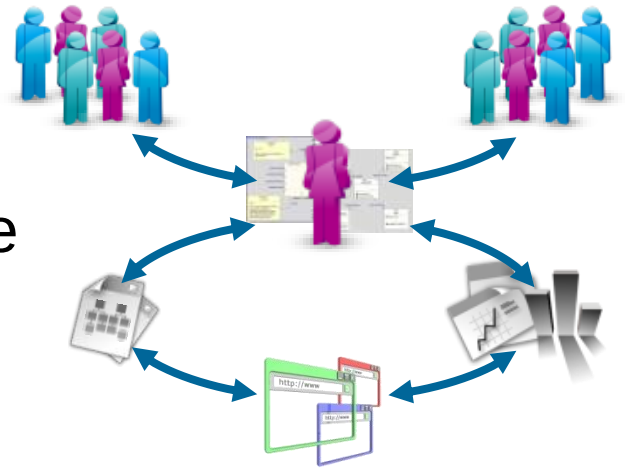
IBM System and Software Solutions

Design and Model Management across the Product Development Lifecycle



Amit Fisher, IBM Rational Systems Technical Client Relationship Manager,
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Agenda

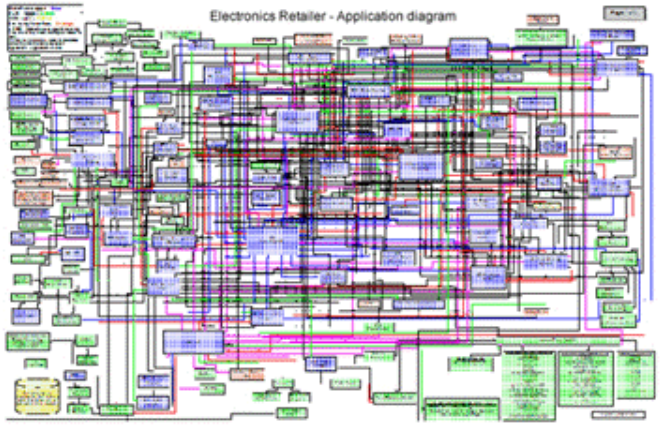
- **Integration of multiple life-cycle artifacts – why a new approach is needed?**
- The new approach …
- IBM Rational solution offerings
- A word on versioning and configuration
- Standards, call for action!

Complexity is the biggest challenge facing organizations today!

"Today's complexity is only expected to rise, and more than half of CEOs doubt their ability to manage it."

IBM 2010 Global CEO Study: 1500 face-to-face interviews, Companies of all sizes across 60 countries, representing 33 industries. (IBM CEO study)

Whether IT or device-based, software-based applications continue to grow in size and complexity. Globally distributed and diverse teams, outsourcing and supply chain dependencies lead to increased challenges in the timely launch of competitive products and services.



Organizations struggle to balance agility and complexity.

It's not enough to manage development, the design process itself must become more streamlined and efficient.

Smarter products mean that complexity is rising

- Product innovation enables companies to:
  - Leapfrog their competition
  - Grow demand
  - Increase revenues
  - Raise profits
- The next generation of innovative, smarter products requires more:
  - Instrumentation
  - Intelligence
  - Interconnection
- This leads to increasing complexity

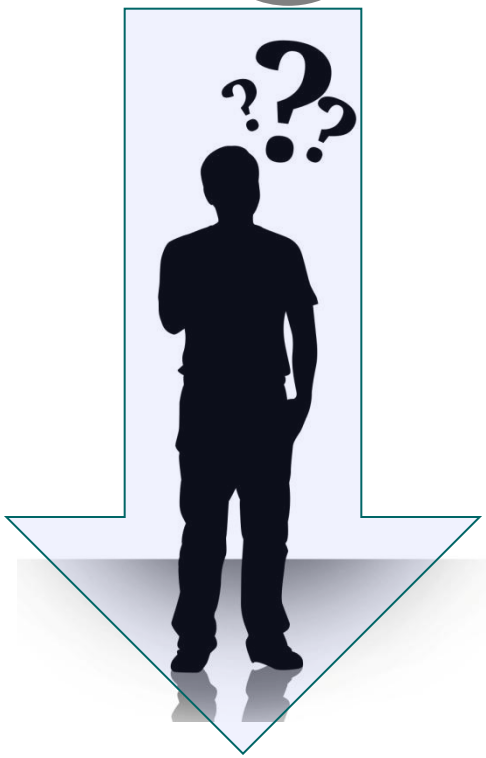
Increased complexity impacts productivity and innovative capacity

Engineers struggle to answer key questions

Which requirements, tests and model elements contain the words 'on-board radar'?

A safety standard has changed—which requirements, tests, design elements and implementation artifacts are impacted?

Are we ready to ship our new UK aircraft variant?



How many requirements for the satellite payload are related to tests that failed on their last execution run?

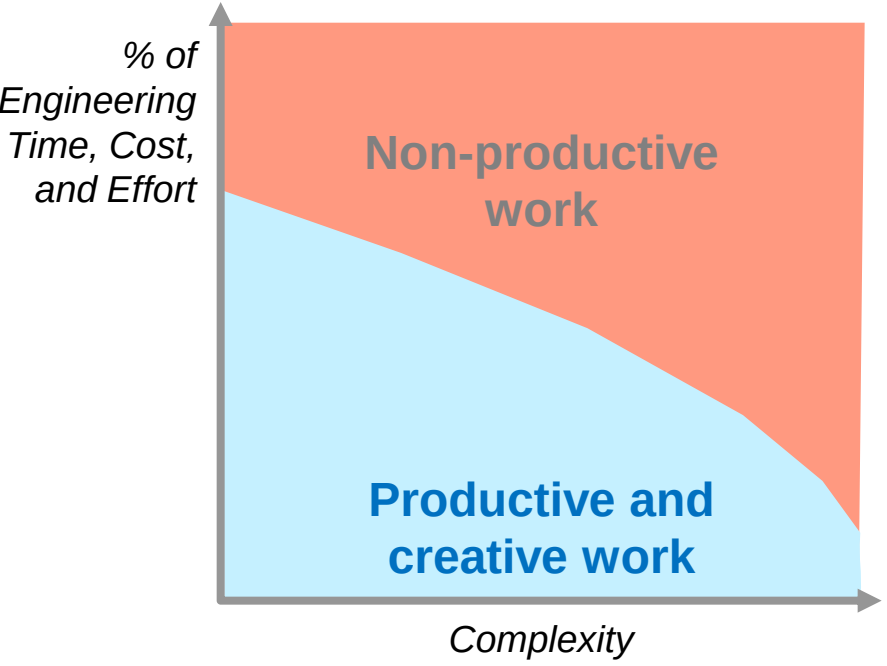
I need to define a new variant for France that reuses parts of the US model – which artifacts define the US variant?

Less Productivity = Less Innovation

The need for smarter products means that complexity will keep rising

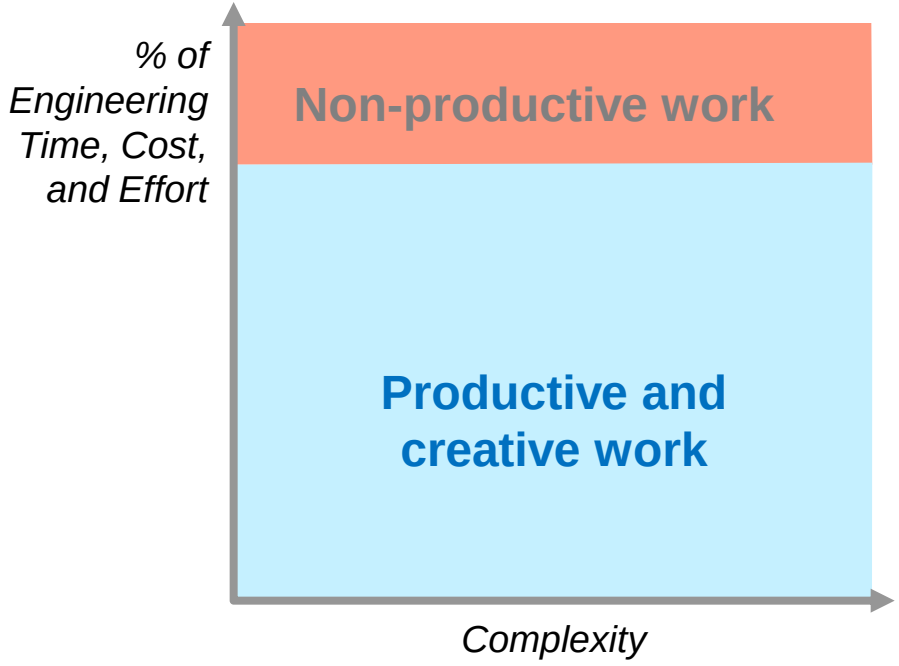
The time, cost, and effort needed to manage complexity increases faster than the complexity itself

Core Engineering Current Workload
(trying to manage complexity)



- Engineers spend more time trying to manage complexity and less time being productive
  - Extra manual steps are needed resulting in increased errors

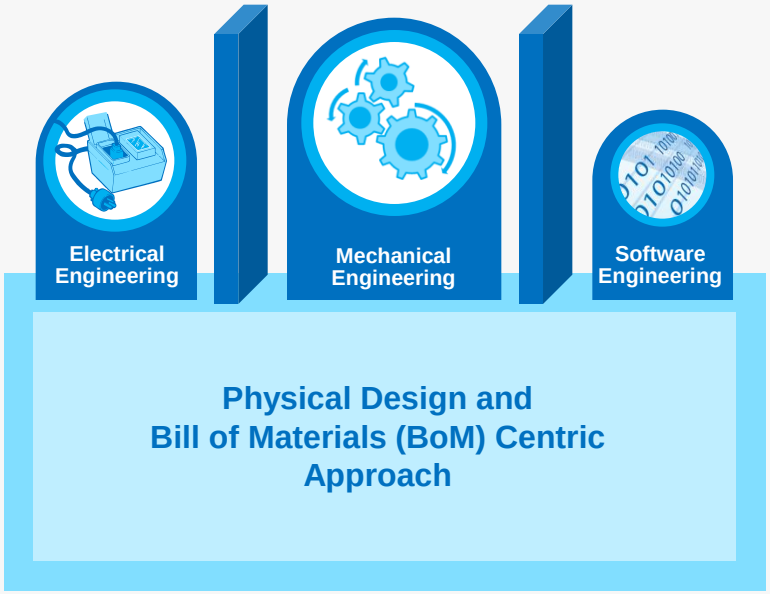
Core Engineering Desired Workload
(Successfully managing complexity)



- Engineers spend more time being productive
  - Automated steps deliver higher quality work with less errors

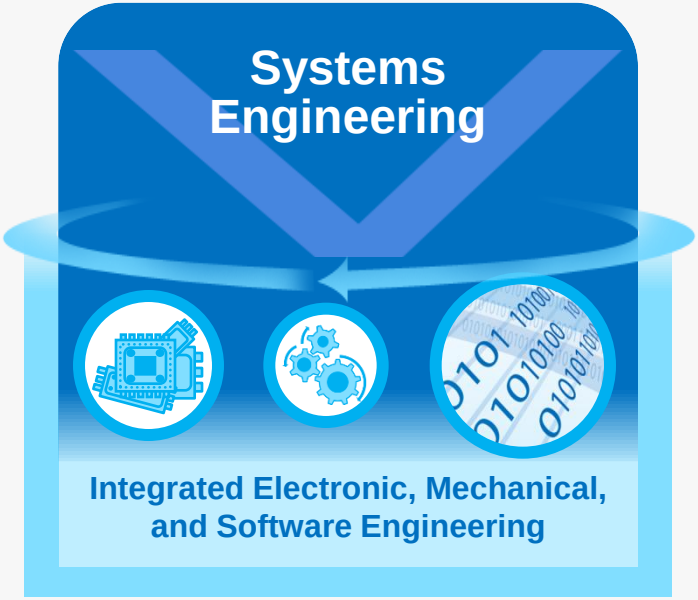
Smarter products won't be developed the same old way

Traditional Product & Systems Development



- Focused on CAD/CAM and BoM
- Slower to react to change
- Silos of engineering disciplines

Next Generation Product & Systems Development



- More focus on software and electronics
- Responsive to change
- Systems engineering methods optimize product designs and engineering collaboration

But what does it really mean?

- The challenge is multi-dimensional…
  - Model Management is part of a bigger lifecycle management challenge
- No single vendor can address the challenge alone…
  - ~~Most~~ **All** Systems companies today use large variety of best of breed tools
- No single platform can address the challenge alone…
- No Single standard can address the challenge alone…

- **Yet we need much better integration and cross-domain analysis capabilities …**

- ***We need fresh thinking …..***

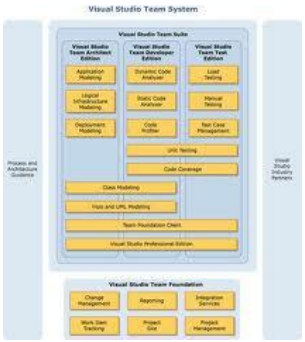
Need better integration approaches

Past integration approaches have provided limited choice and coverage.

Past integration approaches have been disruptive and slow to emerge.

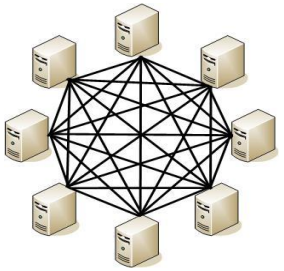
Single repository

“Can I really expect one vendor to provide all the functionality I need? And what about my existing tools?”



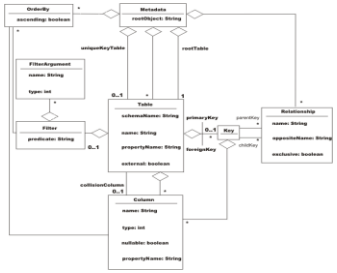
Point-to-point integrations

“How can I ever upgrade one tool without breaking everything else?”



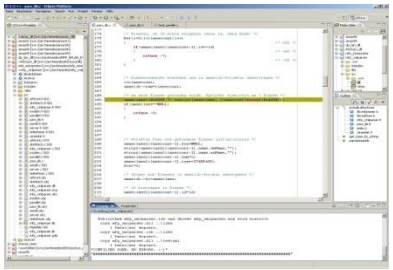
Universal metadata standard

“How did I ever think all those vendors would be able to agree?”

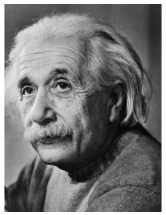


Standard implementations

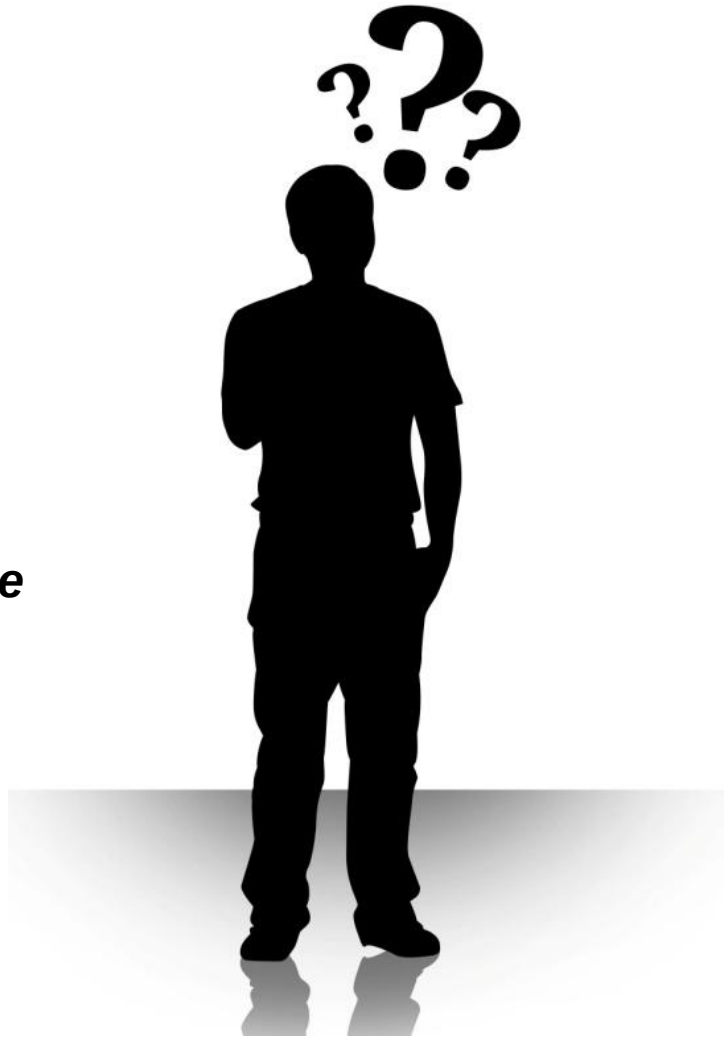
“Did I really believe that every vendor would rewrite their tools on a single framework?”



How can we be different this time?



"We can't solve problems by using the same kind of thinking we used when we created them"



Agenda

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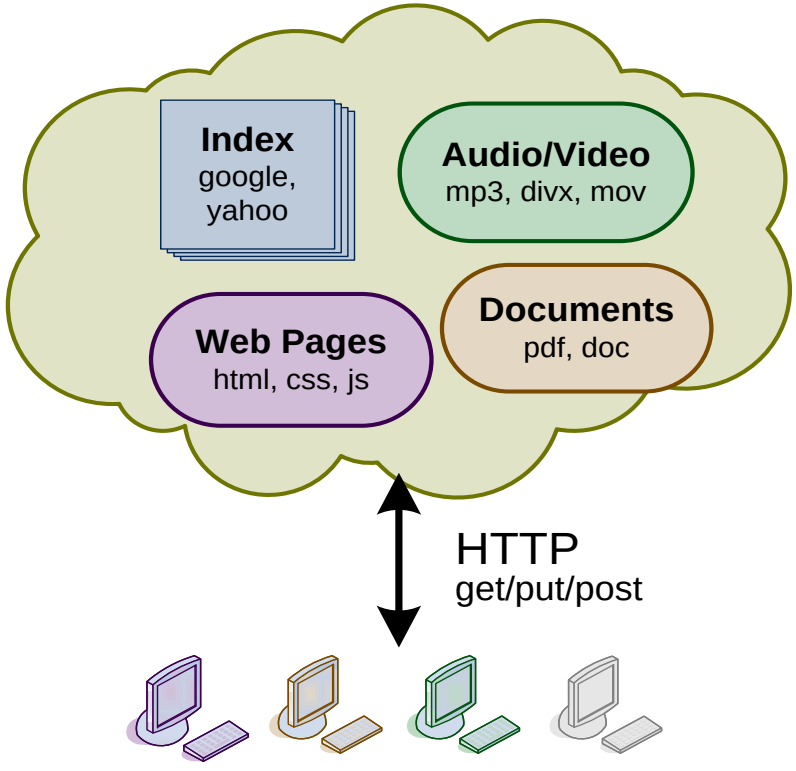
- **The new approach …**
- IBM Rational solution offerings
- A word on versioning and configuration
- Standards, call for action!

Let's look at something we all know very well …

- The Internet : distributed and global "data space" of linked documents.
- Enormous content providers
- Simple – adhering to common basic protocols
- Extremely scalable
- Open, Standardized

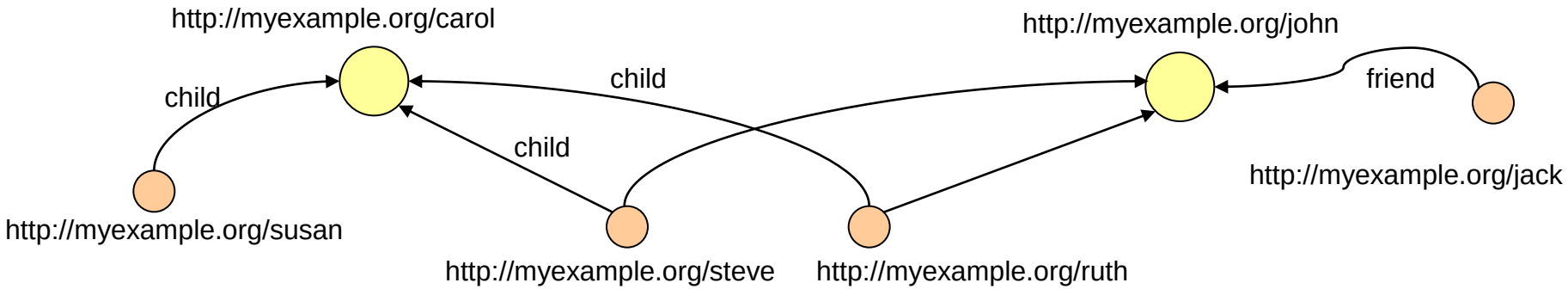


Linked Data

Four simple principals :

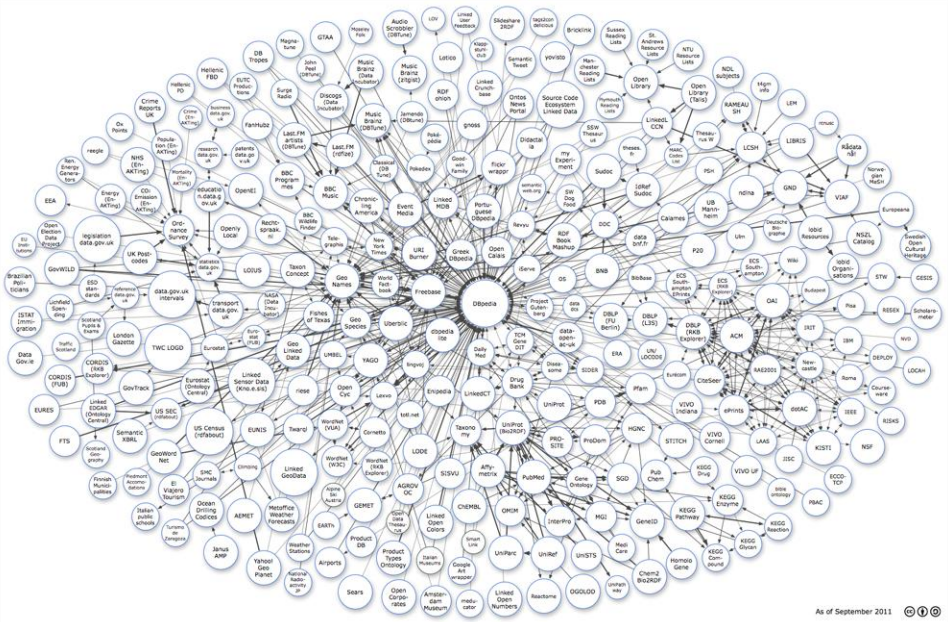
1. Use URIs as names for things
2. Use HTTP URIs so that people can look up those names
3. When someone looks up a URI, provide useful information, using standards (e.g. RDF*, SPARQL**, ***REST)
4. Include links to other URIs, so that they can discover more things

http://www.w3.org/DesignIssues/LinkedData



*RDF, the Resource Description Framework provides a generic graph-based data model for describing things, including their relationships with other things.
** SPARQL is a query language able to retrieve and manipulate data stored in RDF format
***REST, REpresentational State Transfer (REST) is a style of software architecture for distributed systems where requests and responses are built around the transfer of representations of addressable resources

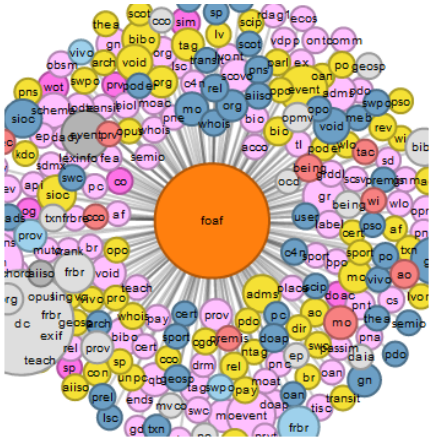
Highly scalable, but still simple

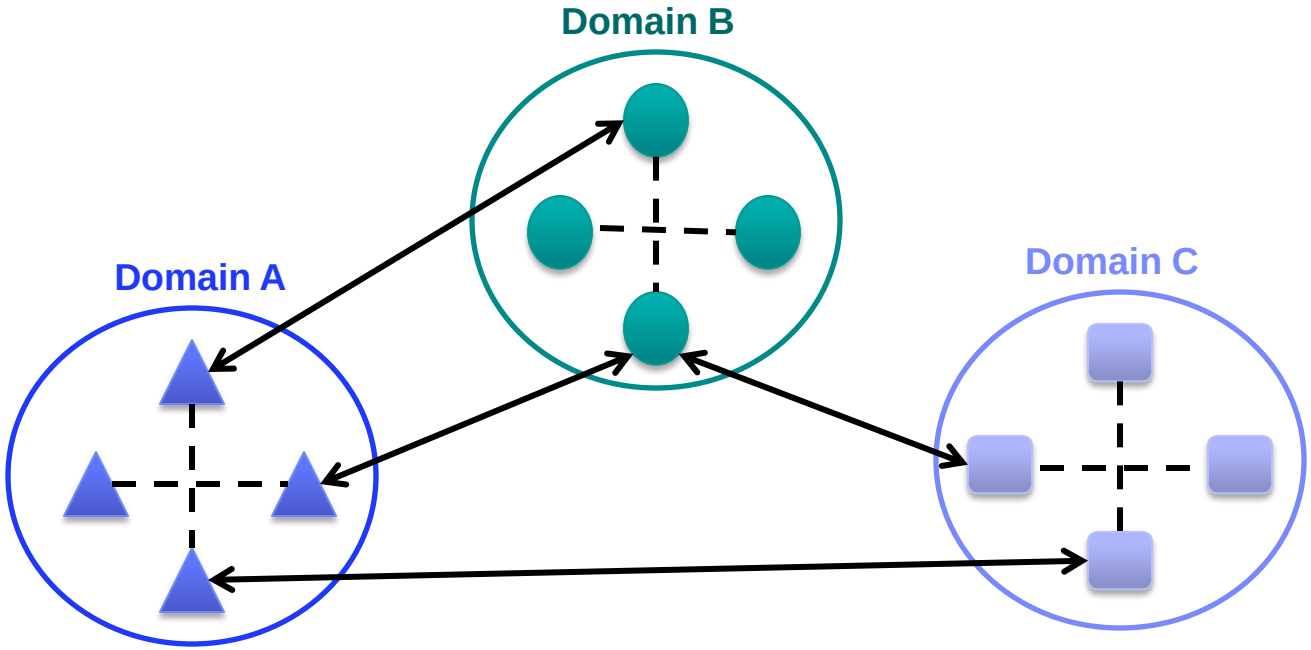


The figures above show the data sets that have been published and interlinked by the Open Data Movement so far. Collectively, the 295 data sets consist of over **31 billion RDF triples**, which are interlinked by around **504 million RDF links** (September 2011).

Domains

- Domain is a formal representation of knowledge as a set of concepts within a specific context, and the relationships among those concepts.
- Domain specifications help in unification and standardization of Linked Data sources that are “semantically close”.
  - Prevent duplications
  - Enhance understanding





Engineering and the Web?

=

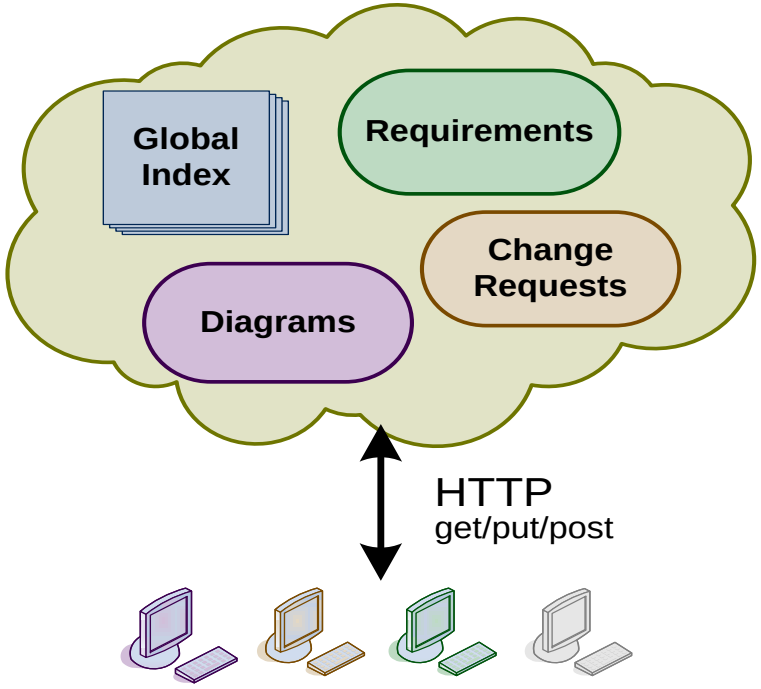
?

E/E engineering environments are highly fragmented - *the challenge to connect them is increasing exponentially*

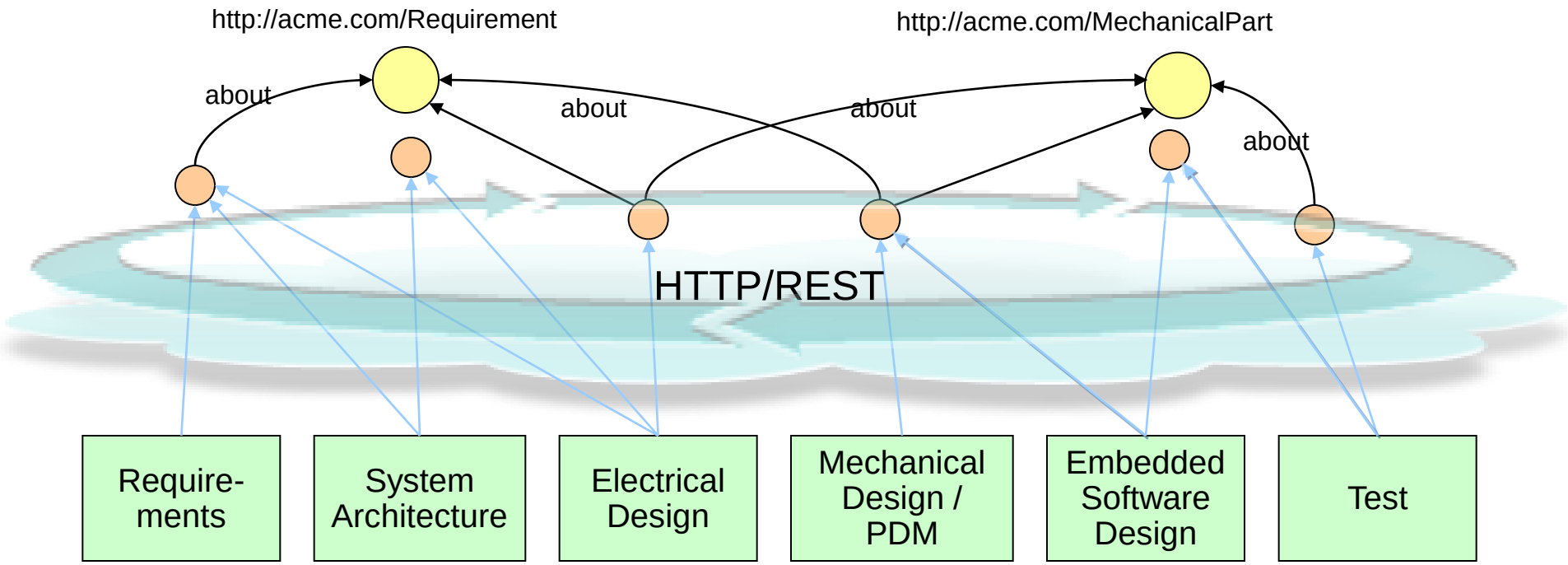
- **Traditionally, each tool came with its own**
  - **UI** - Web and desktop presentations of views and tasks
  - **Logic –** Workflow, process, search, query, scale, security and collaboration
  - **Storage** – individual files on workstation or servers: how to ensure availability and traceability?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

What does Internet inspiration mean?

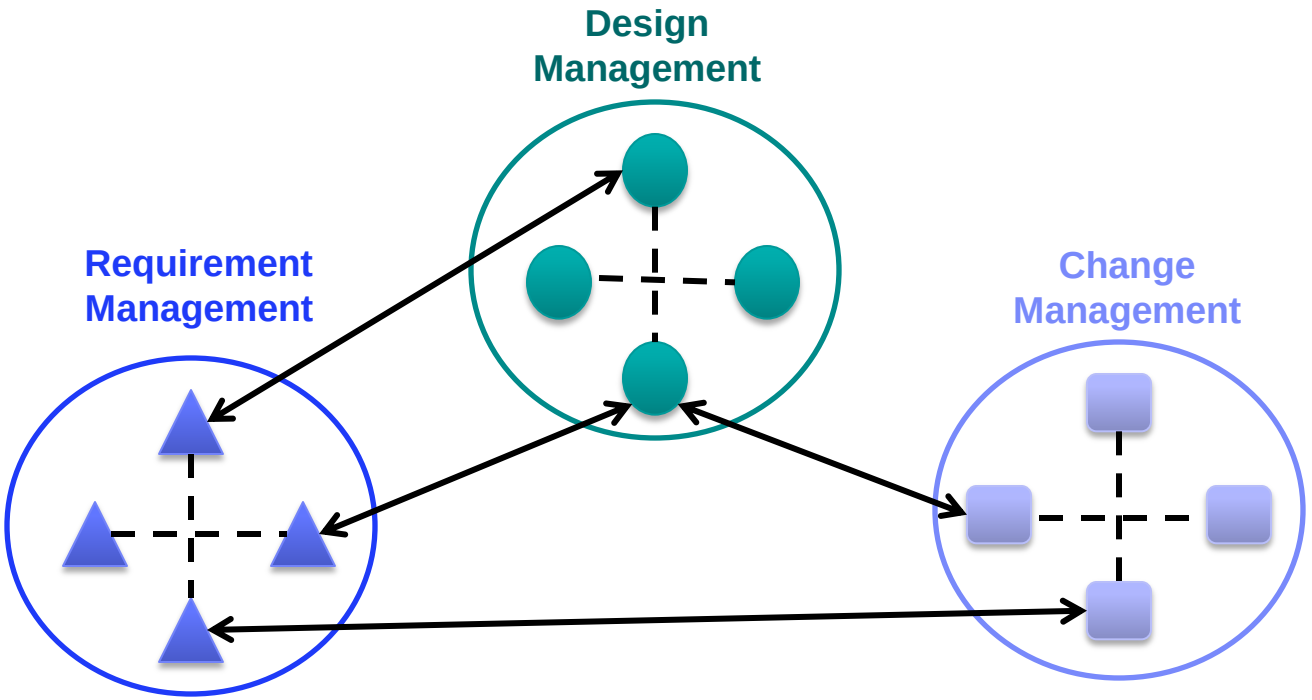
- Data specified independently of tools
- All data are resources with URLs
- Multiple tools access data
- References are embedded URLs
- Resources have representations
- Unprecedented extensibility



Leveraging the Linked Data concepts of Web Technology

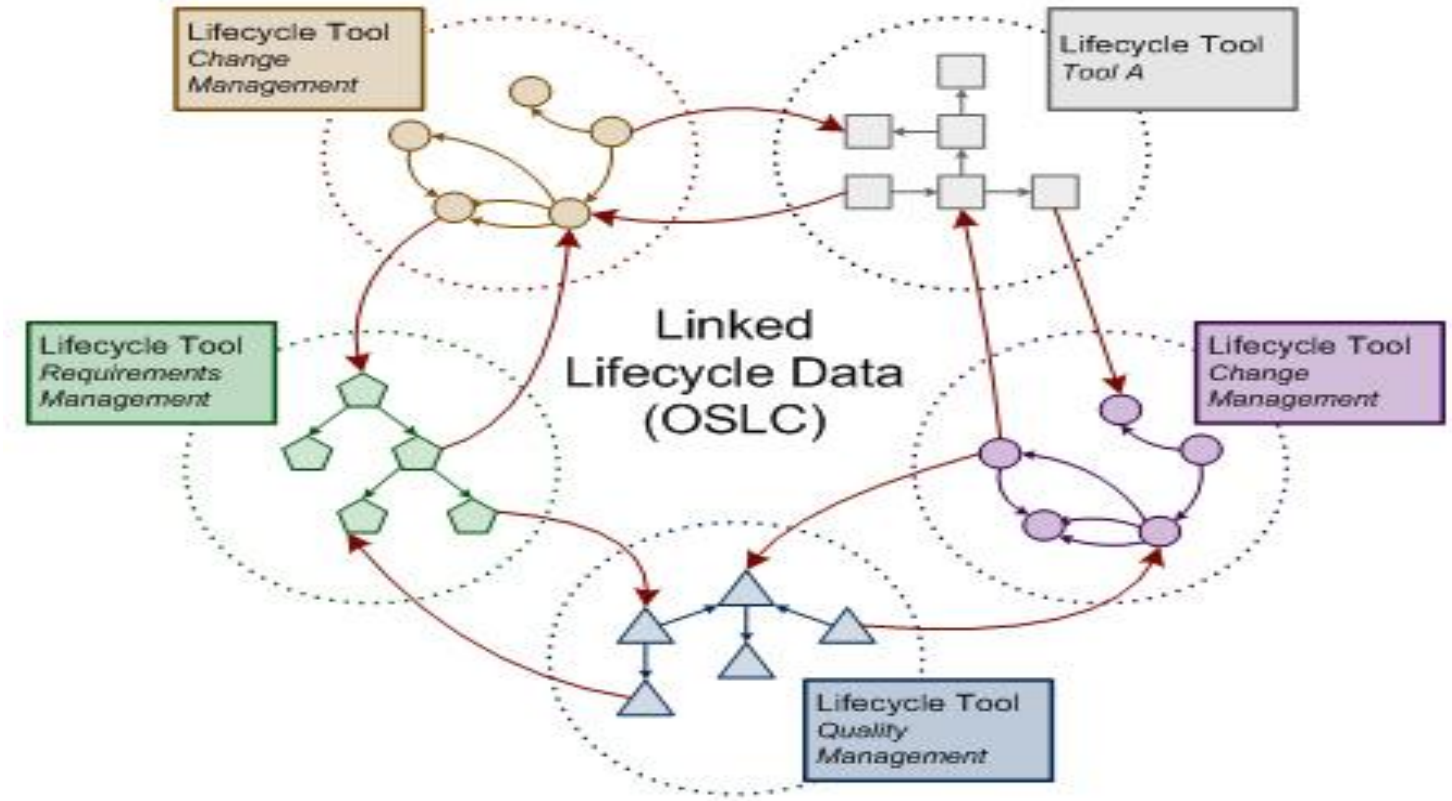


Defining engineering domains



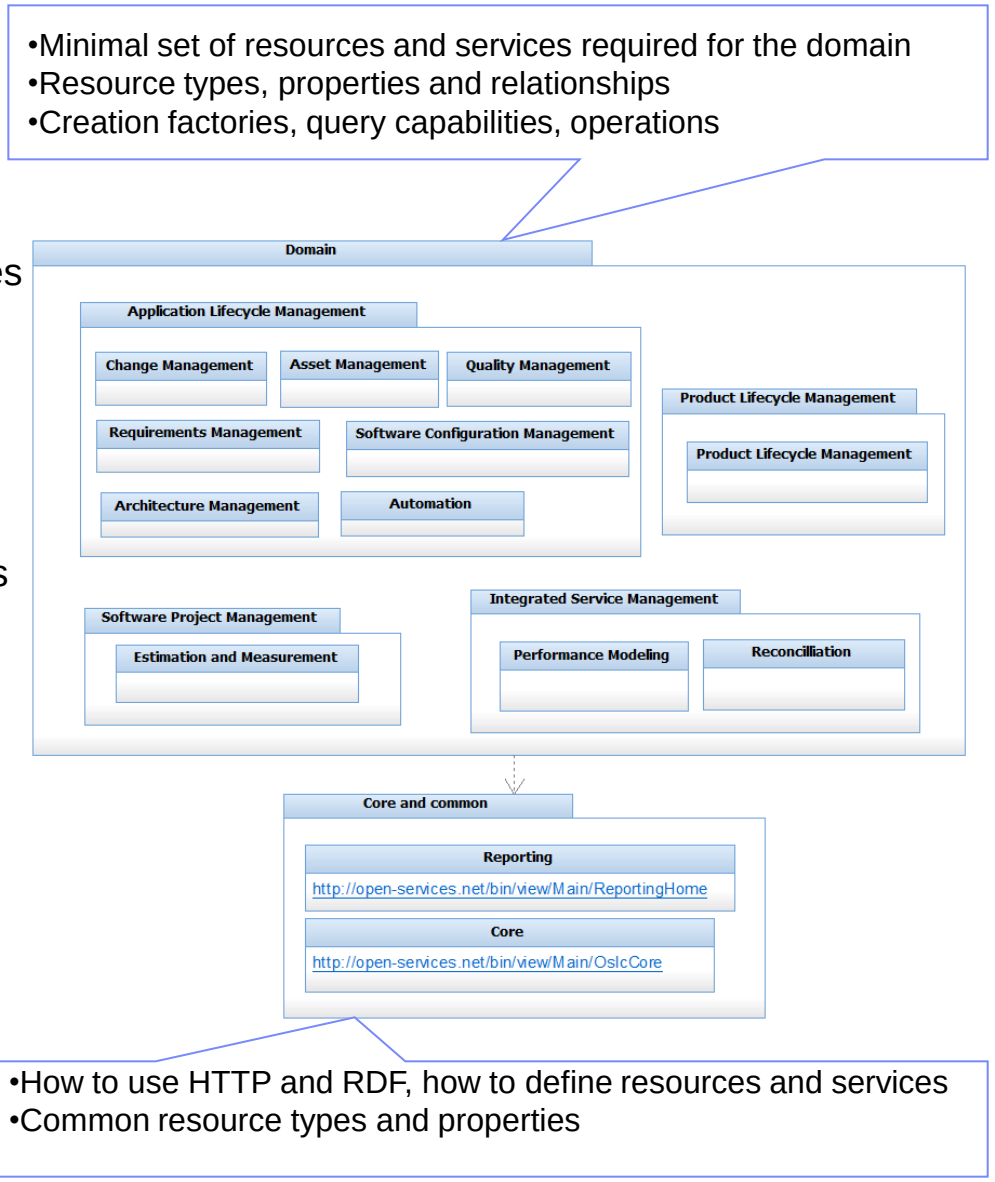
Linking Lifecycle Data via OSLC

- Resources from different domain tools are linked together using OSLC



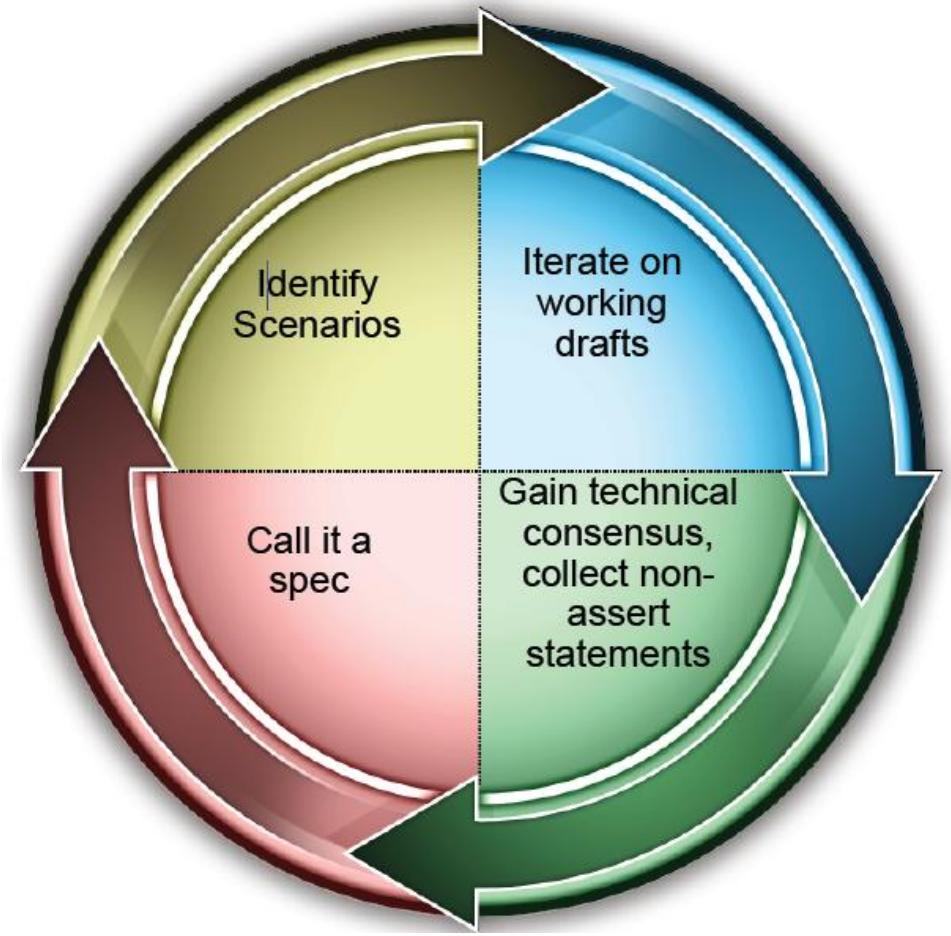
What is OSLC?

- OSLC is a set of *work groups* writing *specifications* for ***interactions between lifecycle tools***
  - Standardizing a small number of resource types and a minimal protocol
  - It is *not* trying to standardize tools behavior, capabilities or data
- OSLC is based on Linked Data:
  - Access life cycle data created by different tools over a web of raw data
  - Every lifecycle artifact (requirement, defect, model element,…) is an HTTP resource identified uniquely by an HTTP URI
  - The resource is manipulated using standard HTTP methods (GET, PUT, POST, DELETE)
  - Every resource must have an RDF representation



OSLC approach to produce specifications

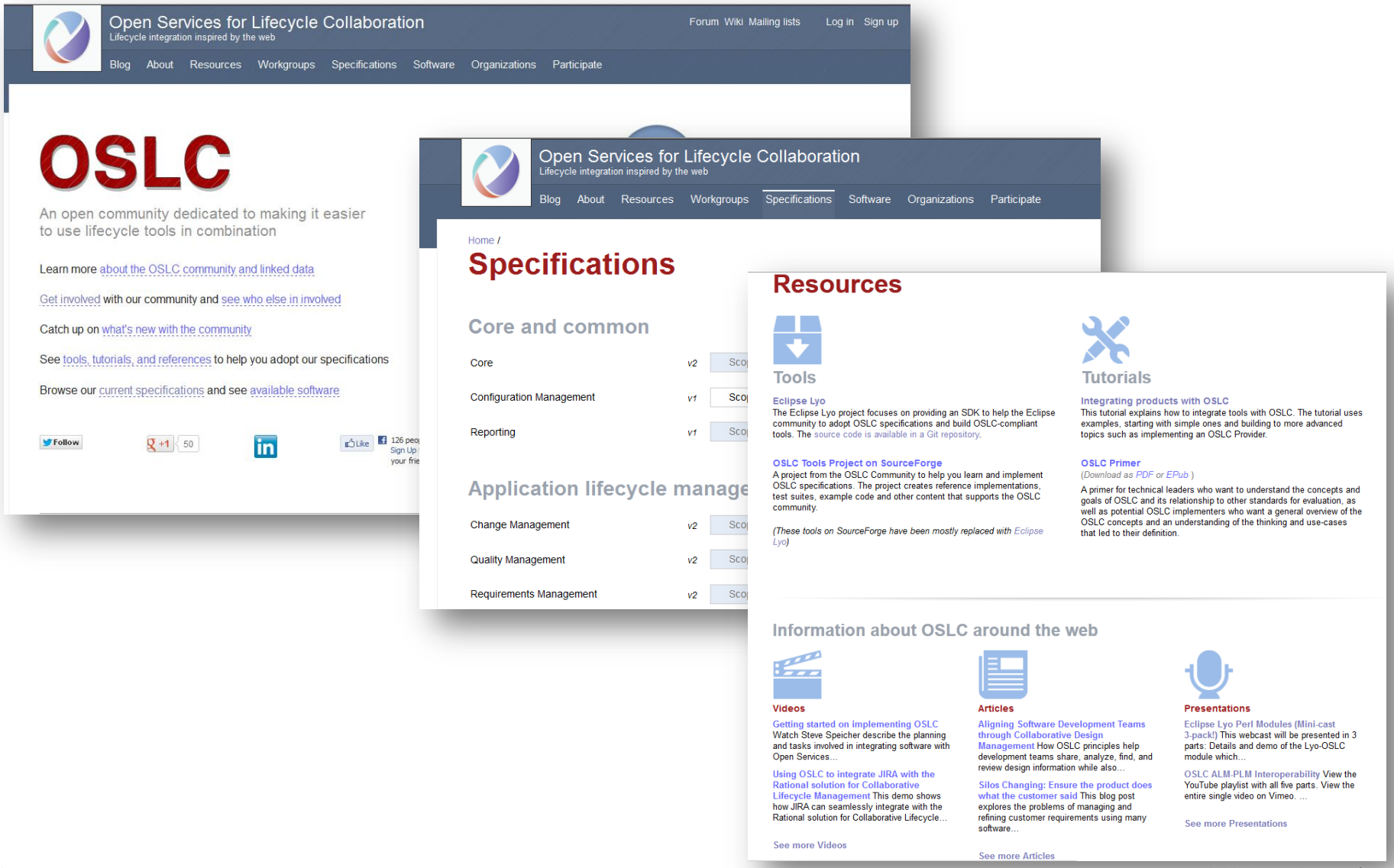
- Minimalist approach:
  - "Just enough" for a given domain
  - No tool's behavior specification
  - No tool's data specification
- Scenario driven scope
- Co-evolve spec and implementation
- Open participation in active workgroups



OSLC community

Wide range of interests, expertise, participation	▪Vendors, end users, industry consortia ▪40+ organizations have had employees participate in specification development efforts ▪Collaborating on solutions for ALM, DevOps, ISM, PLM
Growing list of implementations from IBM and others	▪ Implementations from IBM Rational, Oracle, IBM Tivoli and open source ▪3rd party adapters from IBM, Kovair, Tasktop, and open source ▪Dozens of end users enabling homegrown tools
Completed and active specifications for many domains	▪Change Management, Quality Management, Requirements Management, Asset Management, Architecture Management, Automation ▪Product Lifecycle Management, Configuration Management ▪Performance Monitoring, Reconciliation

OSLC website at http://open-services.net



W3C Linked Data Platform Working Group website at: http://www.w3.org/2012/ldp

W3C Technology and Society domain

The **mission** of the Work Group is to produce a W3C Recommendation for HTTP-based (RESTful) **application integration patterns** using read/write Linked Data. This work will benefit both small-scale in-browser applications (WebApps) and large-scale Enterprise Application Integration (EAI) efforts. It will complement SPARQL and will be compatible with standards for publishing Linked Data, bringing the data integration features of RDF to RESTful, data-oriented software development.

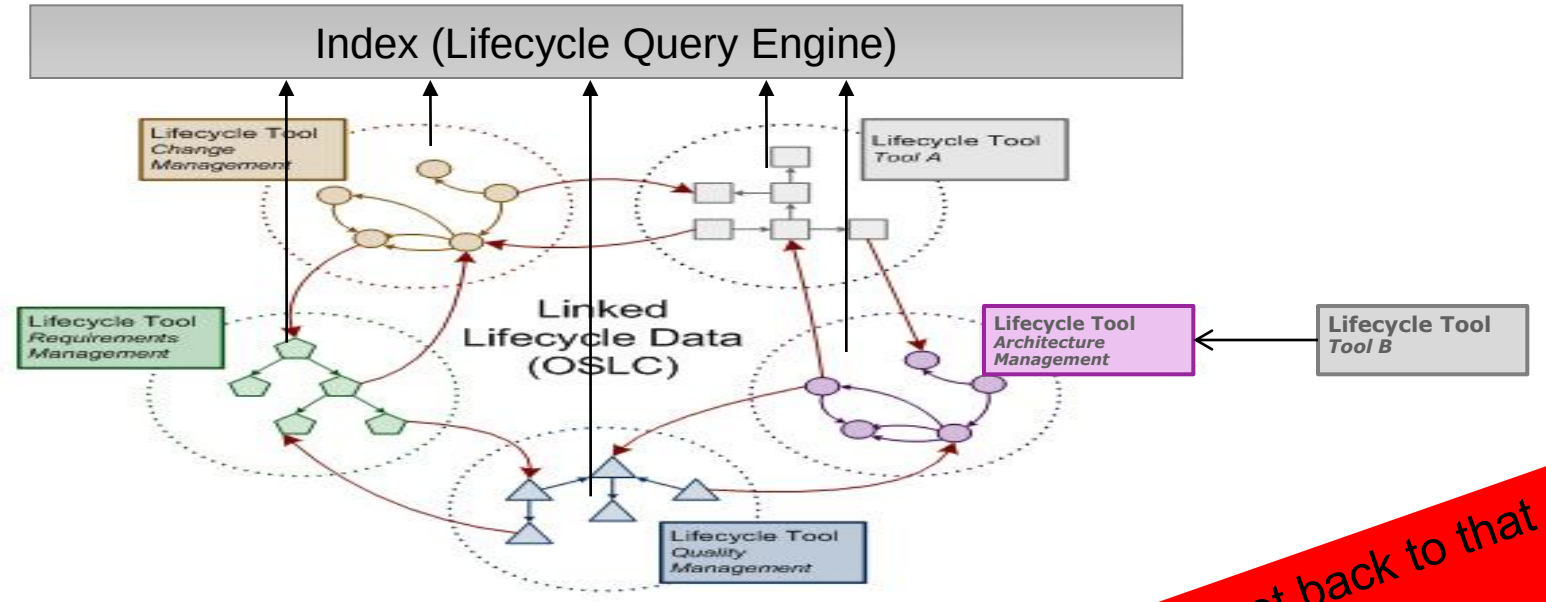
W3C WORLD WIDE WEB consortium

LINKED DATA PLATFORM WORKING GROUP

-*Linked Data Basic Profile*
-IBM, DERI, EMC, Oracle, Red Hat, SemanticWeb.com, Tasktop
-Supporters: Siemens, Cambridge Semantics
-Over forty participants from over twenty organizations

Now it is possible! Index of Linked Lifecycle Data

- An index of Linked Data is created from domain tools that allows for cross-domain ***Lifecycle Analysis***



We will get back to that in few minutes …

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- Integration of multiple life-cycle artifacts – why a new approach is needed?
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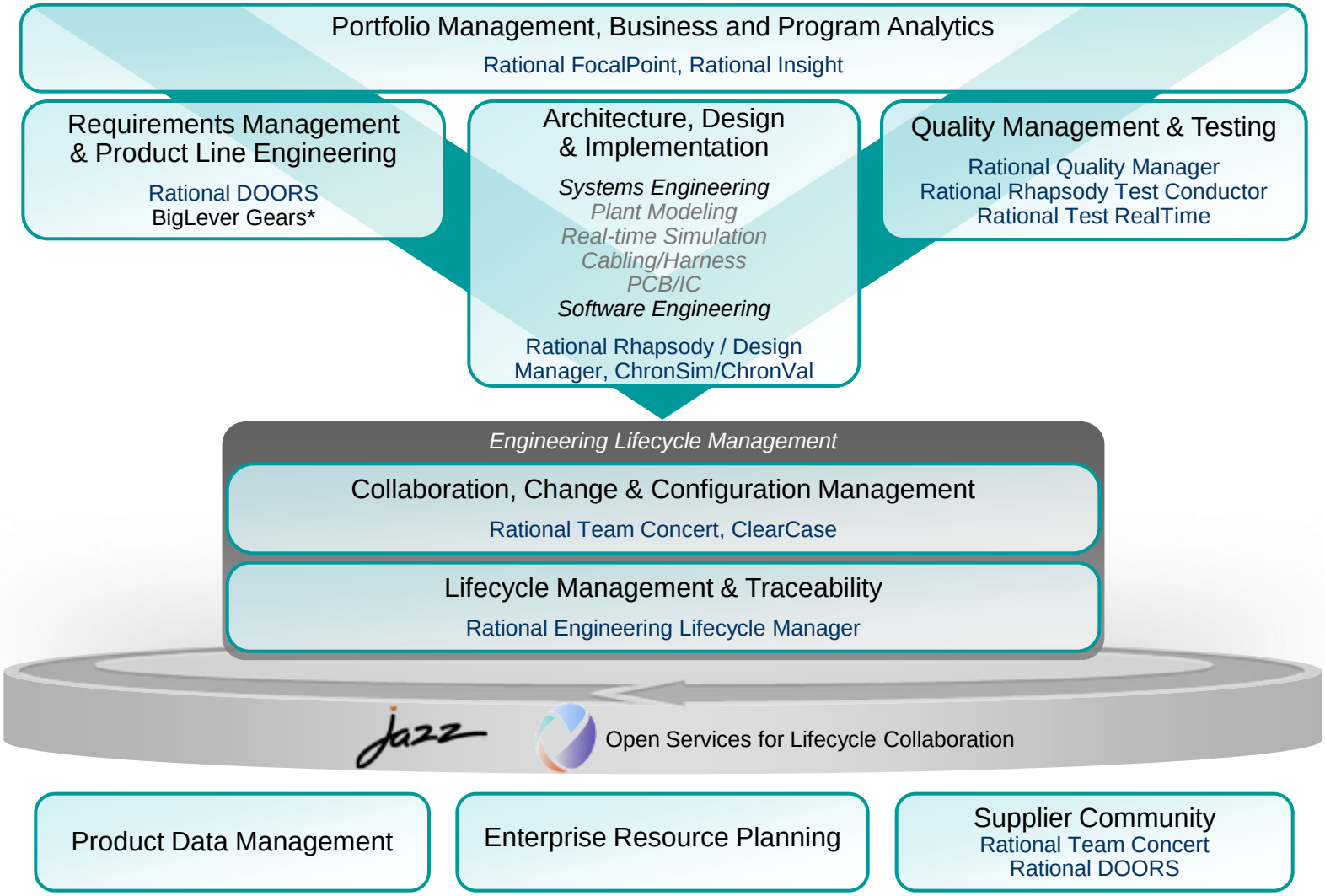
- **IBM Rational Solution offerings**
- A word on versioning and configuration
- Standards, call for action!

IBM Rational Software Platform for Aerospace & Defense Systems

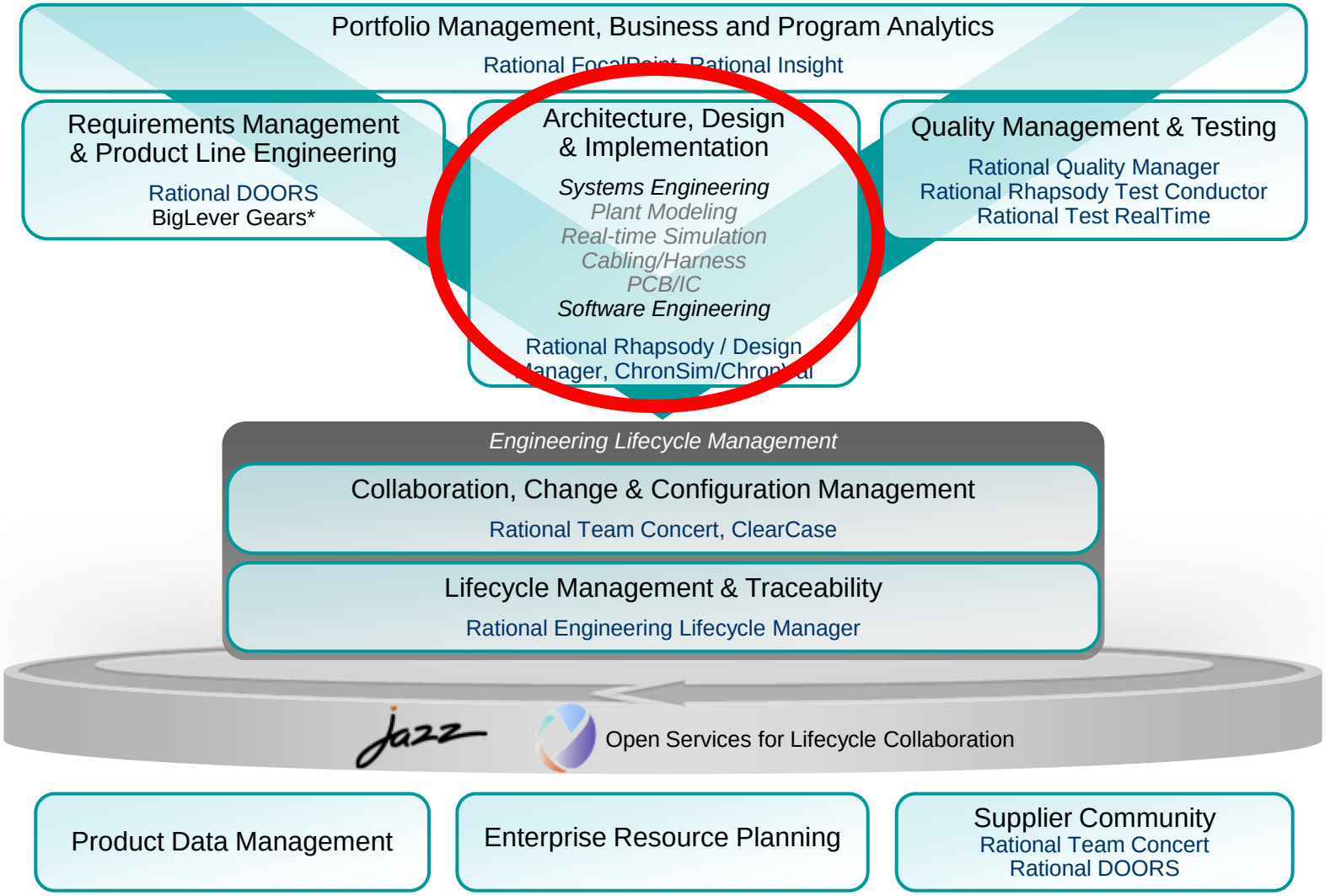
Integrations based on standardized and open technologies



 *Business partner

IBM Rational Software Platform for Aerospace & Defense Systems

Integrations based on standardized and open technologies



 *Business partner

Collaborative Design Management

Enhance cross-team collaboration on software and systems design

Central Design Hub

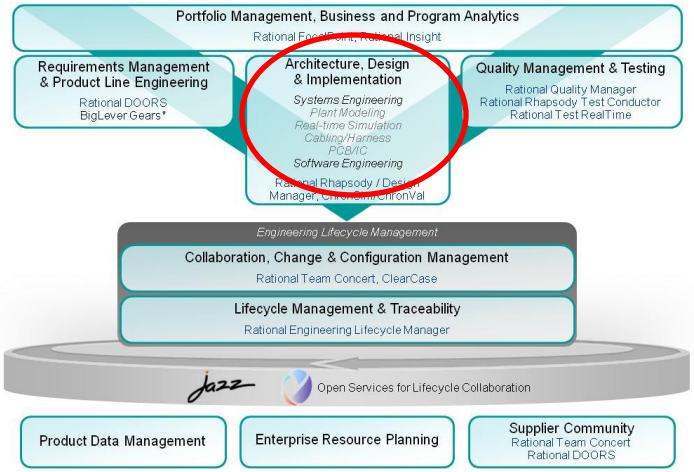
- ✓ *Enterprise-wide design storage for search, review, analysis, and reuse*
- ✓ *Links design elements to lifecycle artifacts*
- ✓ *Navigate and visualize relationships*
- ✓ *Simplify design collaboration through Jazz-based model management*

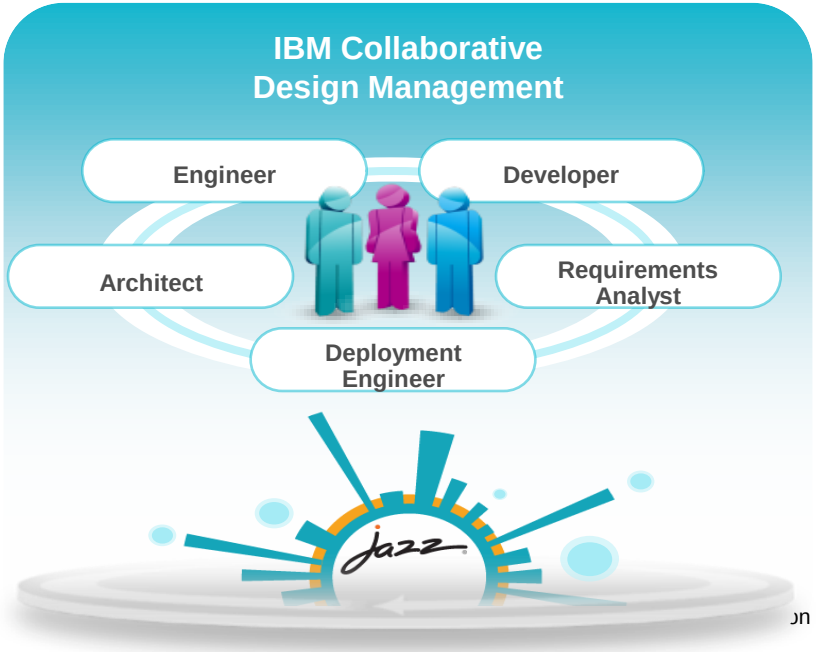
Stakeholder Collaboration

- ✓ *Automated design reviews at all stages of development*
- ✓ *Intuitive extended team web client for broader access to designs*
- ✓ *Unify requirements and design with single-source of truth workflow utilizing OSLC*

Document Generation and Reporting

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





Design Management and Collaboration

Requirements Server
DOORS / RRC

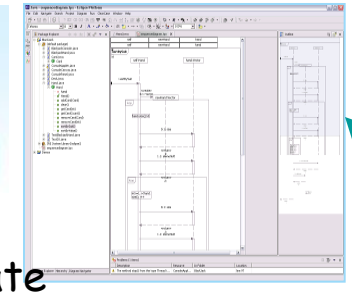
Change Management Server
RTC

Quality Server
RQM

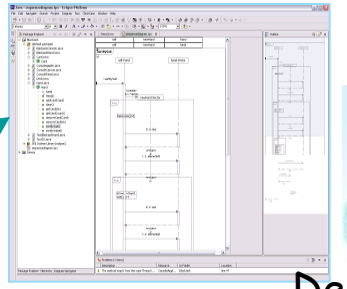
OSLC

DM Team Server
- Models
- Cross Lifecycle links
- Comments & Markups
- Reviews

Design
Collaborate
Manage
Link

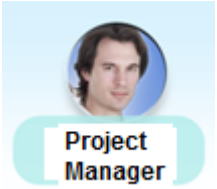


Rhapsody Client



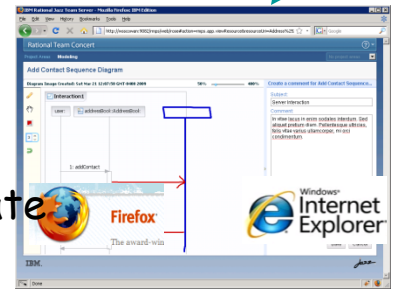
Rhapsody Client

Design
Collaborate
Manage
Link

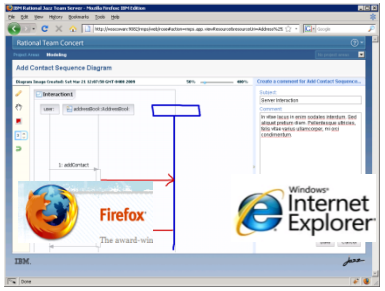


Review
Collaborate
Link

Web Client



Web Client

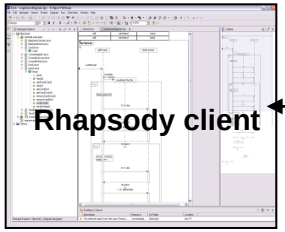


Review
Collaborate
Link

Server Based Model Management

Design change control and versioning (model-based)

Design creation, editing, MDD/MBSE/MBT, search, query, validate, analyze, report



OSLC + DM REST APIs

Design Management services on Jazz Team Server (JTS)

Jazz Storage

§ Architecture Elements

§ Index

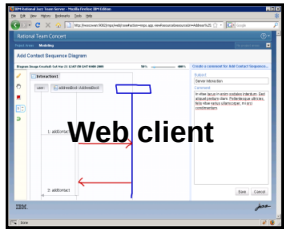
§ Comments (visual, textual)

§ Links

§ Reviews

OSLC + DM REST APIs

Design search, query, view, comment, review, link, report, validate, analyze, limited editing



Benefits

Direct editing of designs and change control on server providing a more simplified environment

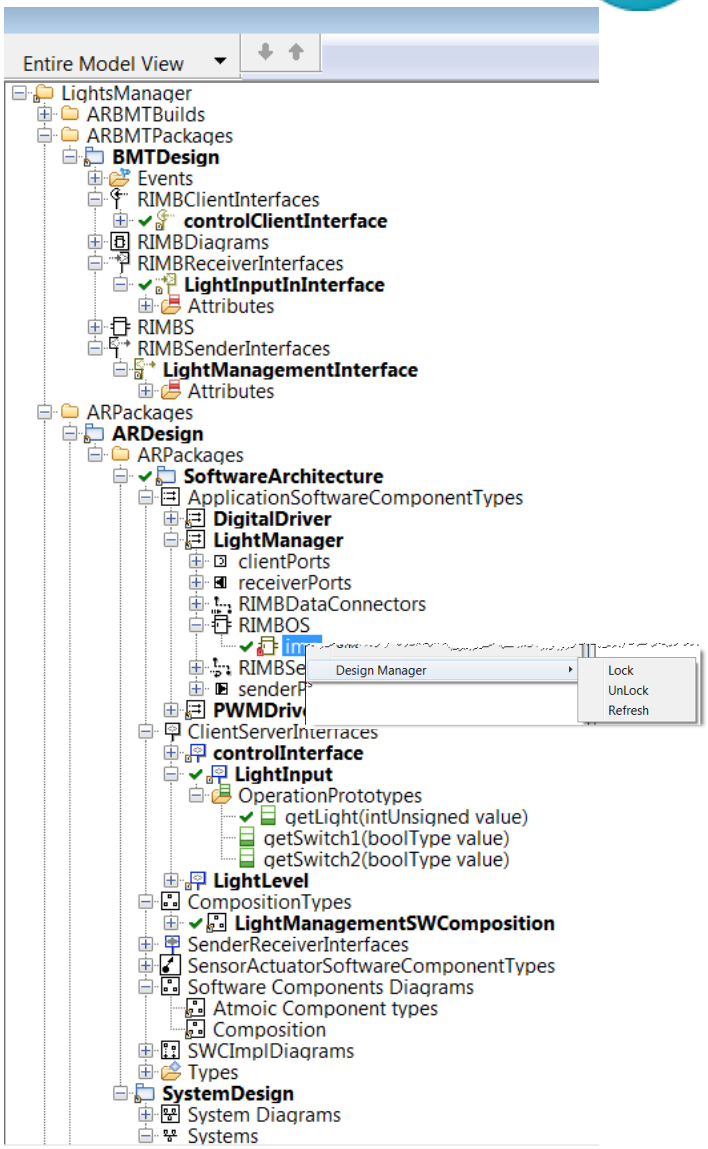
Change control (locking, history) at the model resource level providing more granularity

No duplication or design synchronization issues

Use of SCM still available for users who need more powerful change control capabilities (i.e. Software Engineers)

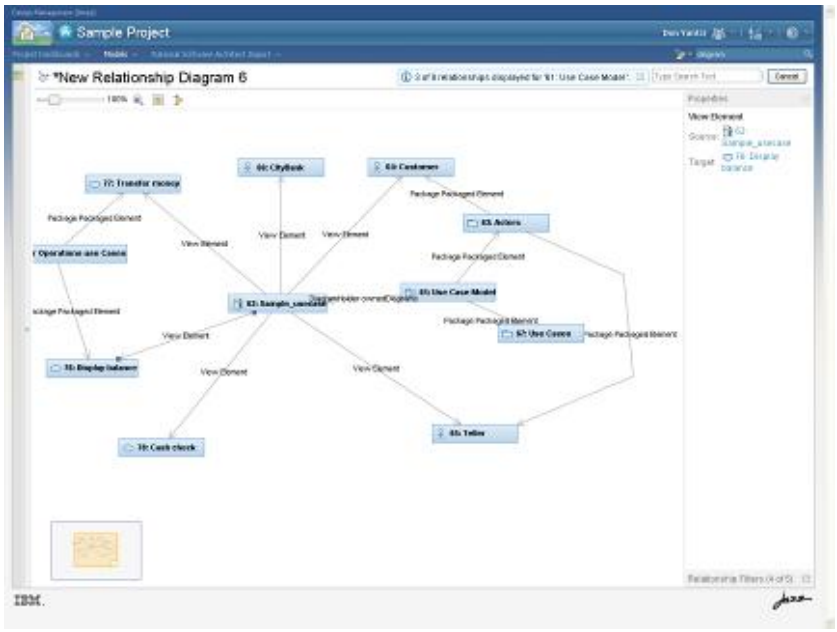
Simplified Design Collaboration

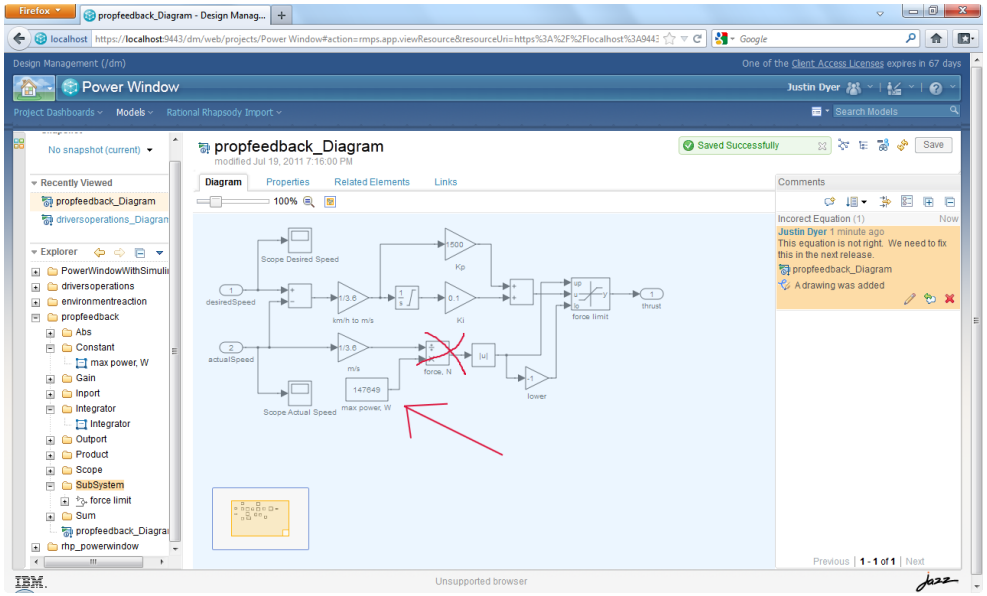
- **Server Based** Model Management
- Designs **directly editable on Jazz** from Rhapsody client
- Locking, versioning, history, and **change control** on **individual model elements**
- **Parallel workspaces** and snapshots
- Changes grouped into **change sets**
- **Design reviews** on private changes prior to sharing



Integrating 3rd party models in Design Manager

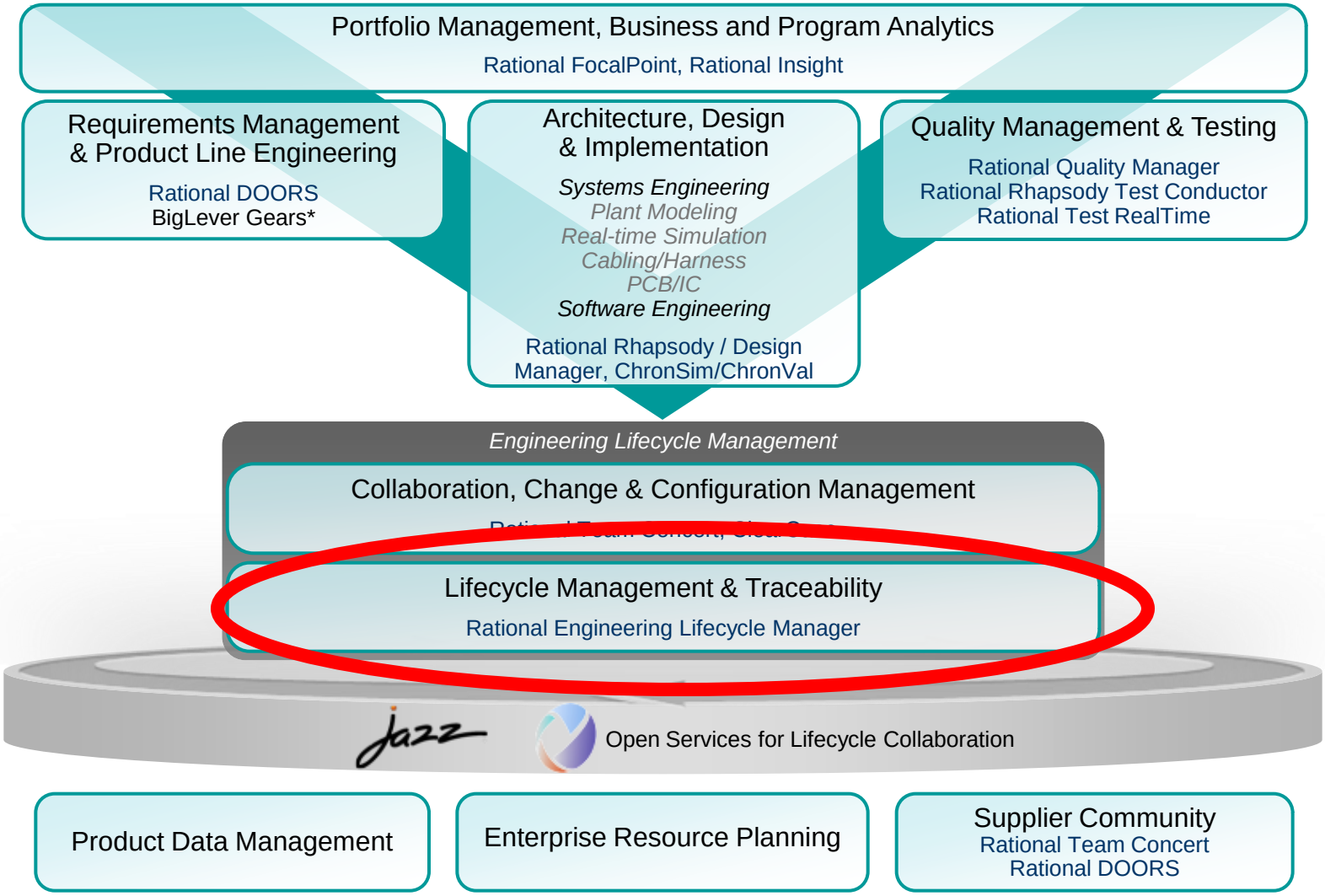
- It is possible to publish 3rd party models into Design Manager DM and create links to the model
- Example below shows Simulink models and its associated OSLC links to external artifacts





IBM Rational Software Platform for Aerospace & Defense Systems

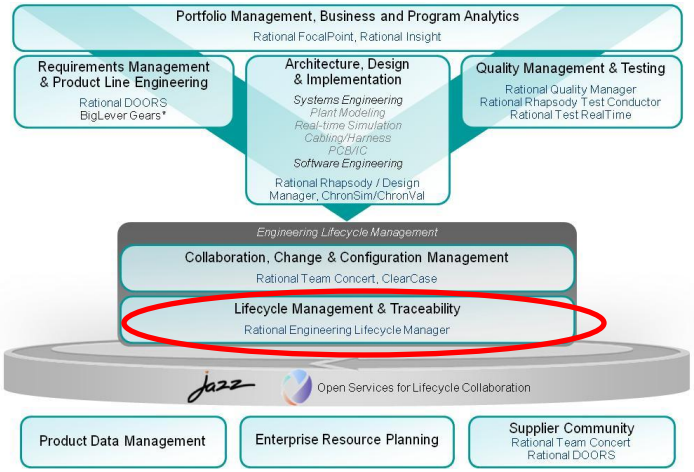
Integrations based on standardized and open technologies

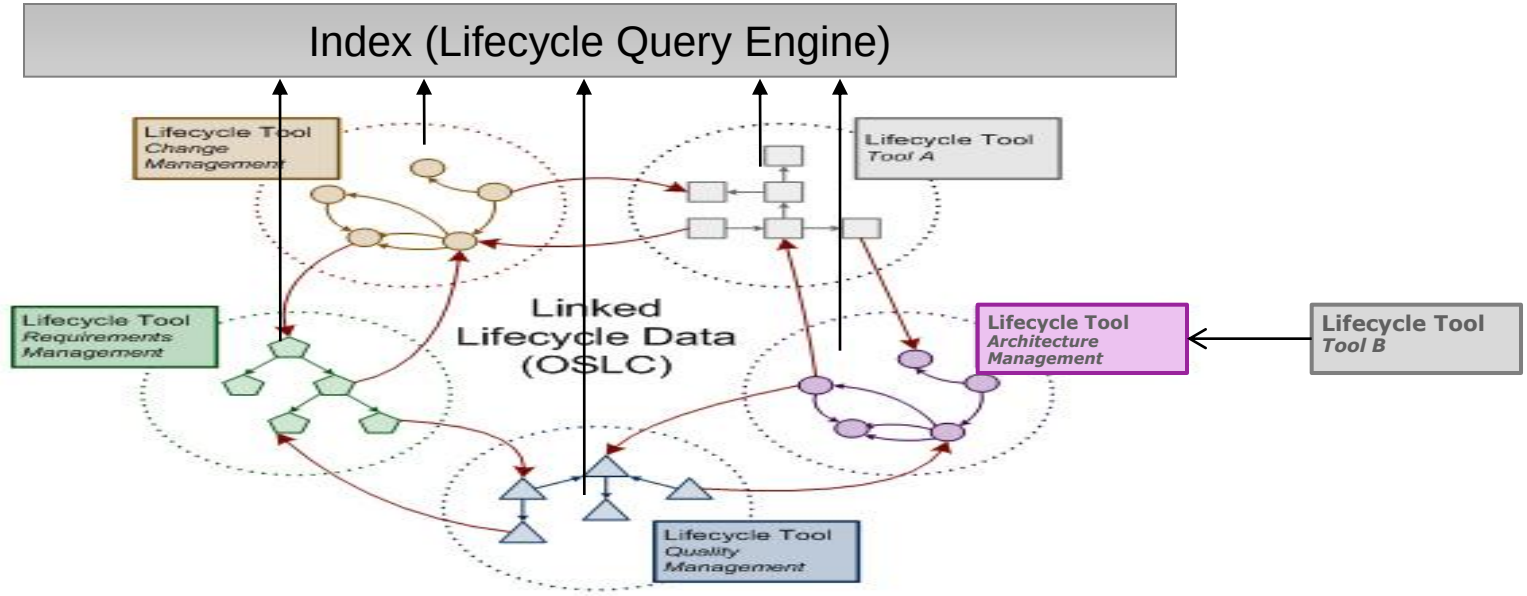


 *Business partner

Reminder: Index of Linked Lifecycle Data

- An index of Linked Data is created from domain tools that allows for cross-domain ***Lifecycle Analysis***

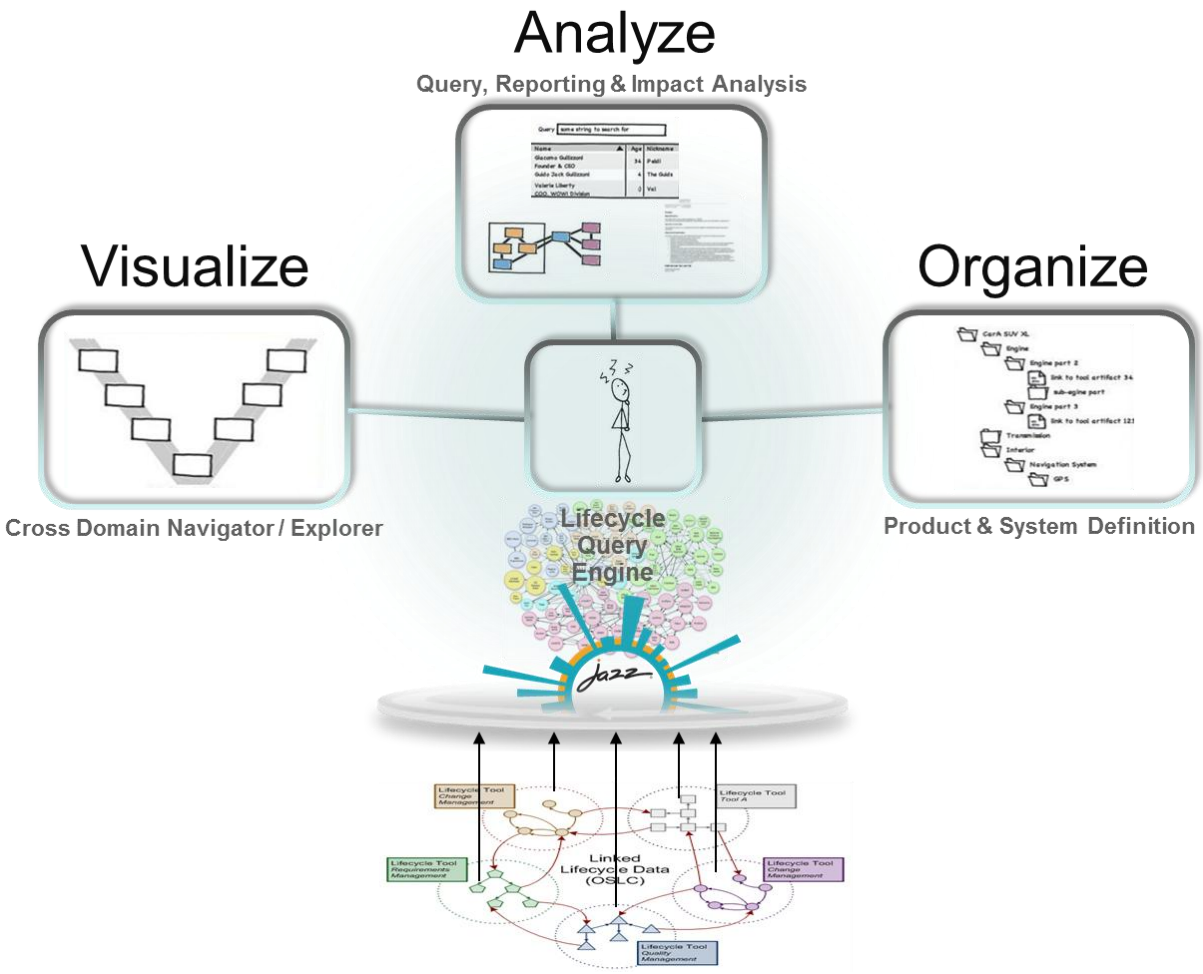




Rational Engineering Lifecycle Manager

Visualize, Analyze and Organize Engineering Lifecycle Data

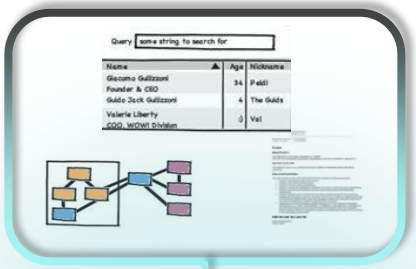
- **Easy search, query and reporting across artifact types regardless of data source/location**
- **Understand relationships between engineering lifecycle data and analyze impact of changes**
- **Visualize engineering data and relationships in the context of role, process or product structure**
- **Get faster, more complete answers to key engineering questions across the lifecycle**



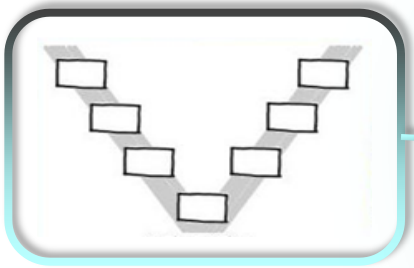
Rational Engineering Lifecycle Manager

Analyze

Query, Reporting & Impact Analysis

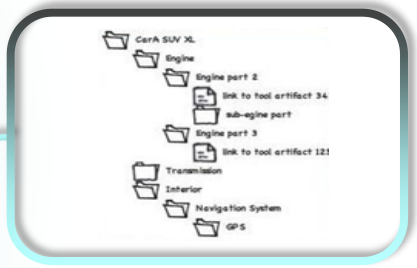


Visualize



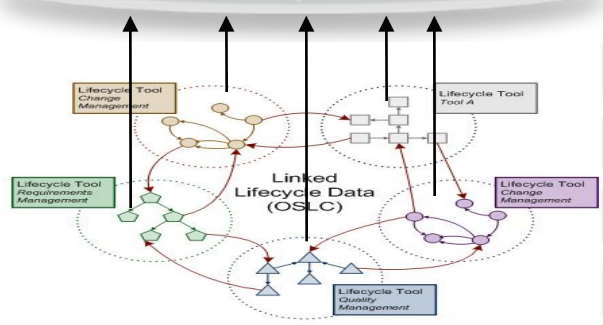
Cross Domain Navigator / Explorer

Organize



Product & System Definition

Lifecycle Query Engine

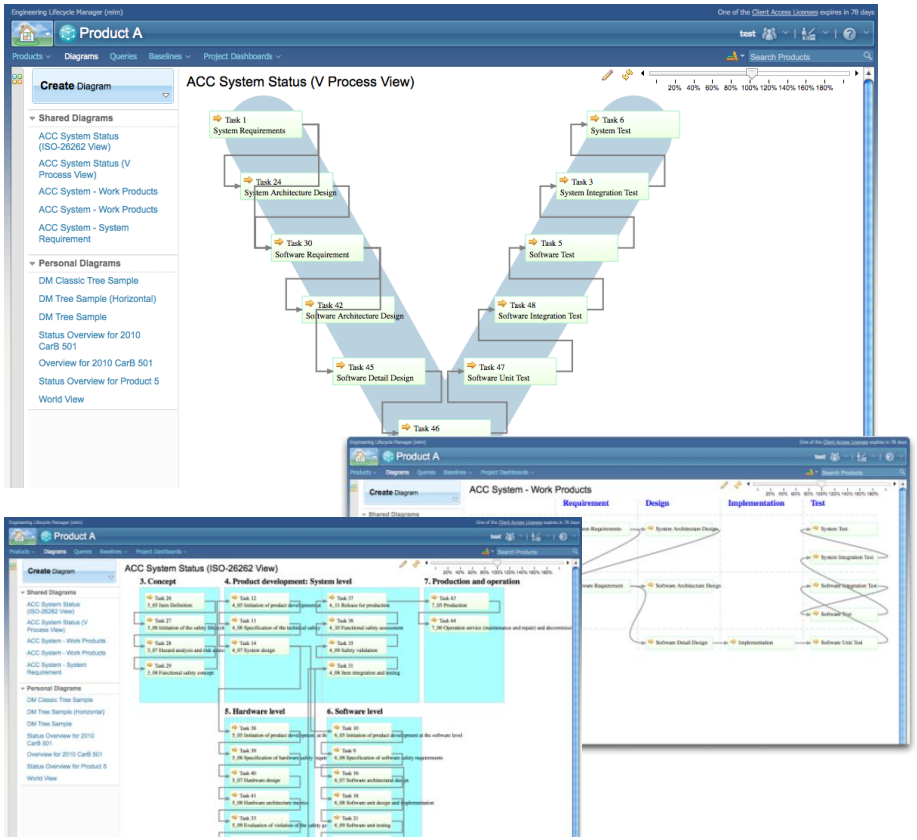


Plus data from integrating products (e.g. Simulink)

- **ARCHITECTURE & DESIGN** — Rational Rhapsody with DM
- **CHANGE MANAGEMENT** — Rational Team Concert
- ... — ...
- **HOMEGROWN** — Homegrown Tool

- **REQUIREMENTS MANAGEMENT** — Rational DOORS
- **QUALITY MANAGEMENT** — Rational Quality Manager
- ... — ...
- **3RD PARTY** — 3rd Party Tool

Visualize: Navigator / Explorer

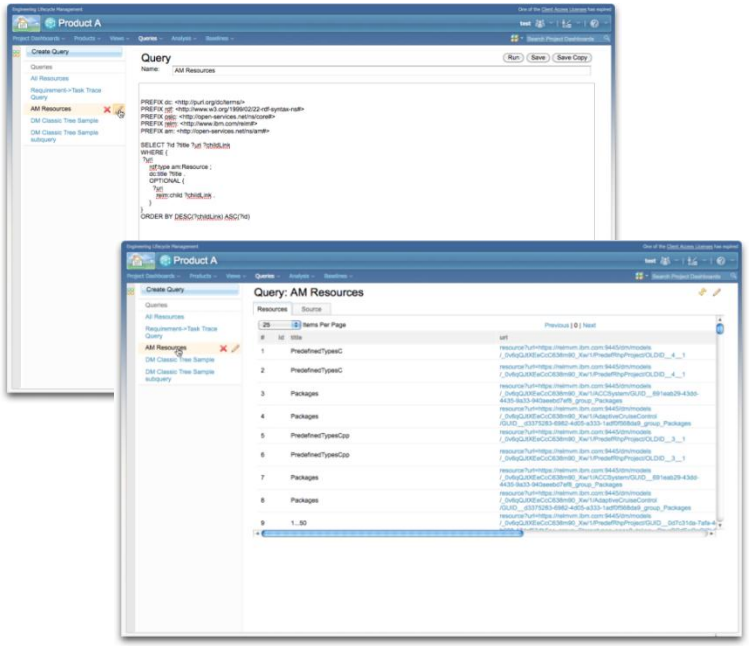


- ***Structured and traceable views of engineering data across the development lifecycle***
  - Role and task relevant views
  - Product, system, sub-system, capability and component centric views
  - Process, standards and framework centric views with access to supporting guidance
- ***Views are 'live' and dynamic***
- ***Interactively explore and interrogate development lifecycle data and relationships***
- ***Predefined views to support specific industries (e.g. ISO 26262)***
- ***Ability to create new views or customize predefined views***
  - Table / Grid, Tree, Freeform
- ***Save and share views***

Example User Story

"So that I can more easily achieve, maintain and monitor compliance to ISO26262, as a Safety Manager I need a view that shows me the different process tasks, their status and related tasks, and allows me to drill down to analyze linked lifecycle resources"

Analyze: Search / Query



- *Perform plaintext searches across development lifecycle data*
- *Construct powerful queries to answer specific questions about development*
- *Save, share and re-use searches and queries*

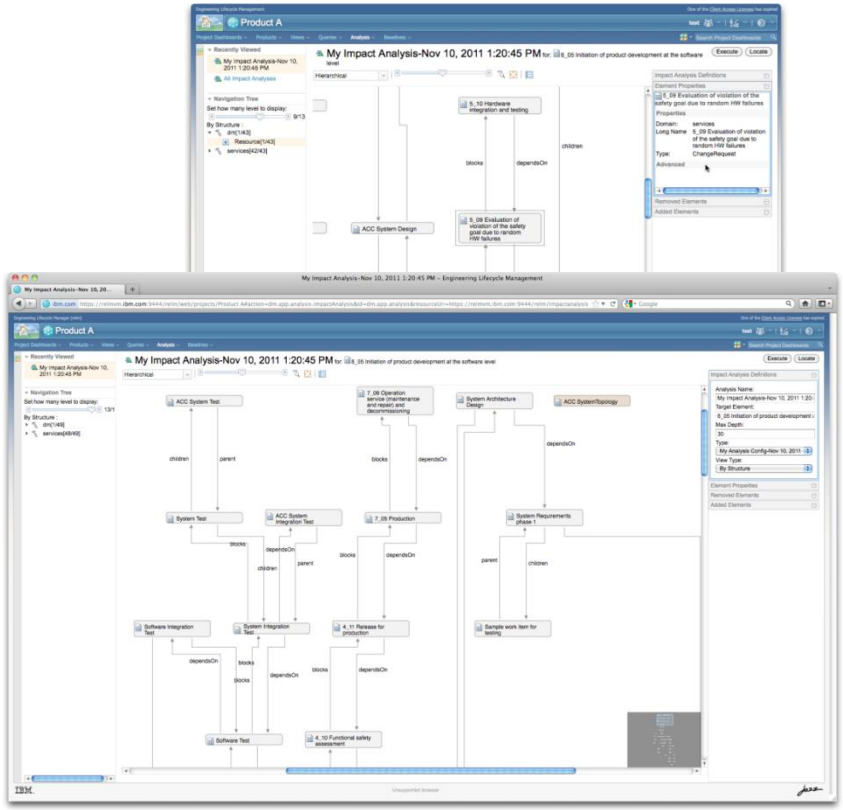
Example User Story

"So that I can understand overall implementation status for a specific product variant for a new market, as a Product Manager I need to be able to construct a query that shows me which requirements are associated with tests that failed on their last execution run within the context of my specific product variant."

Example User Story

"So that I can perform 'Where Used' analysis, as a Systems Engineer I need to be able to construct a query that shows me which products, systems, subsystems, capabilities, components and their versions and variants are associated with a given requirement, logical design element, or E/E artifact."

Analyze: Impact and Coverage Analysis Tool

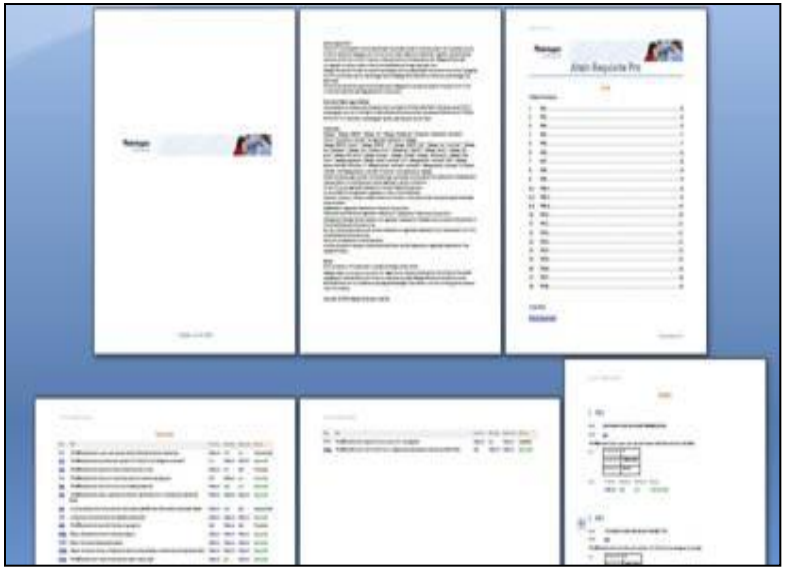


Example User Story

- *Understand the impact of change to development lifecycle resources*
- *Validate coverage of design, test and implementation*
- *Prevent gold-plating*
- *Demonstrate compliance to requirements or standards*
- *Discover which products, systems, sub-systems, capabilities, components and their versions and variants use given development lifecycle resources*
- *Save, re-use and share analysis queries*

"So that we can understand the impact of a change to a safety requirement on product variants for different markets, as a small cross-functional team, we need to be able to visualize any development lifecycle resources related to that requirement"

Analyze: Document Generation

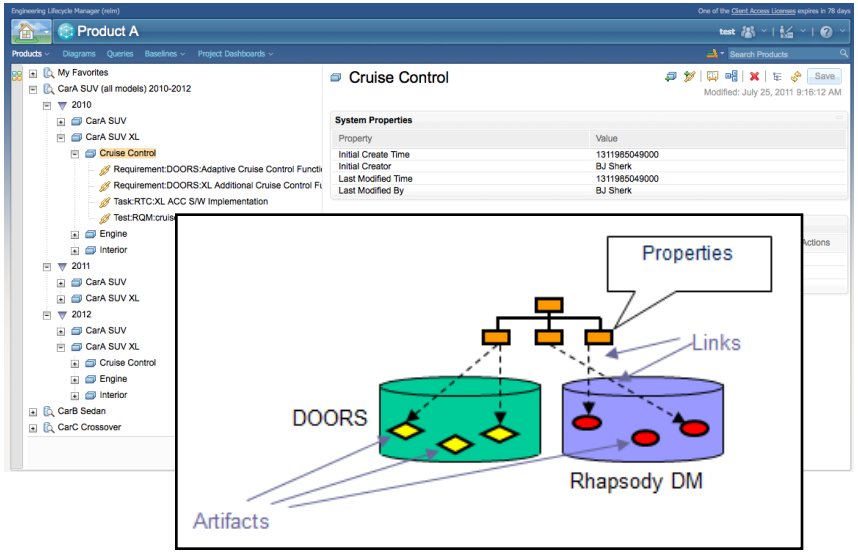


- *Ability to efficiently create important documents including data from across the entire development lifecycle*
- *Predefined documents supporting specific industries / frameworks*
- *Enables documenting proof of compliance (to requirements, to standards etc.)*
- *Enables creation of mandatory deliverables*
- *Uses standard RRDG/RPE technology*

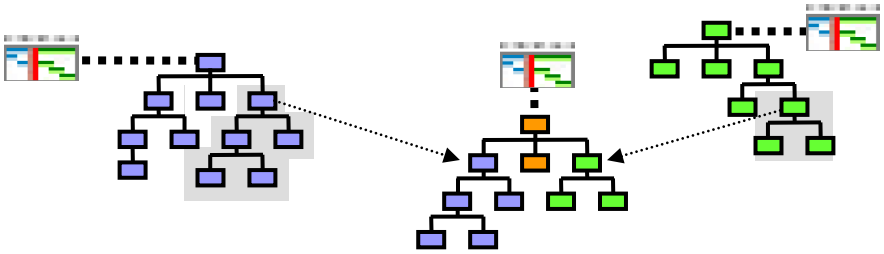
Example User Story

"So that I can document compliance to ISO 26262, as a Safety Manager, I need to be able to create a document that demonstrates required traceability across development lifecycle resources including coverage of safety requirements"

Organize: Systems Definition Tool



- *Central facility to define **hierarchies of products, systems, sub-systems, capabilities and components***
- *Ability to **allocate development lifecycle resources** to definitions of products, systems, sub-systems, capabilities and components*
- *Ability to define and **compare versions and variants of products, systems, sub-systems, capabilities and components***



- *Ability to specify **re-use of development lifecycle resources** across products, systems, sub-systems, capabilities and components*
- *Provides a context for visualization and analysis (e.g. queries, reports, impact and coverage analysis)*

Example User Story

"So that I can define product variants for specific markets, as a Product Manager, I need to be able to create a structure for my product and sets of re-usable capabilities, and allocate lifecycle development resources to that product structure"

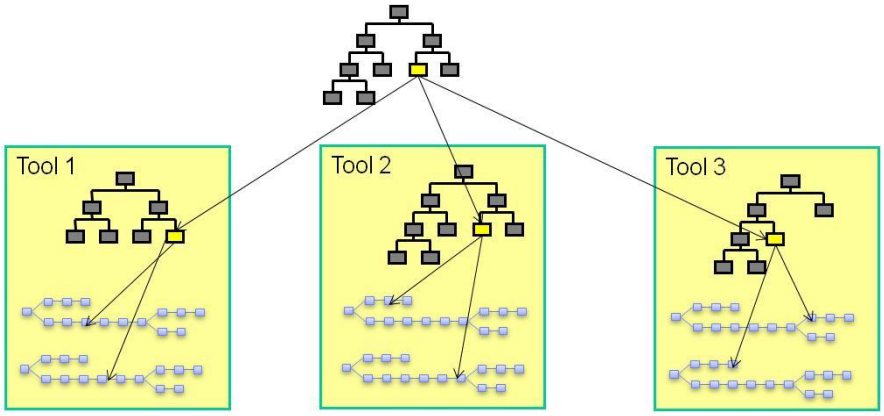
Agenda

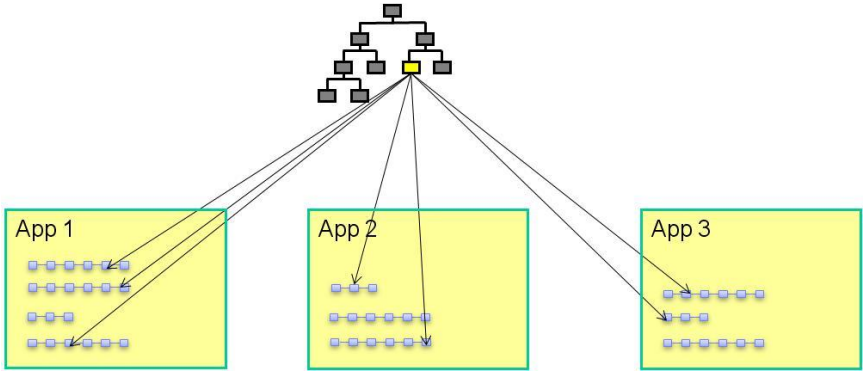
- Integration of multiple life-cycle artifacts – why a new approach is needed?
- The new approach …
- IBM Rational Solution offerings
- **A word on versioning and configuration**
- Standards, call for action!

Versions, Variations and Configurations (VVC)

- VVC stand for a community effort to standardize and simplified the configurations of versions and variants of linked data resources across multiple tools
- VVC is addressing the following two goals:

1. Support composite or global configuration management coordination scenarios, with an open API specification (OSLC)
2. For applications that do not have existing configuration management, provide a versioning system and configuration management capabilities using a linked data model



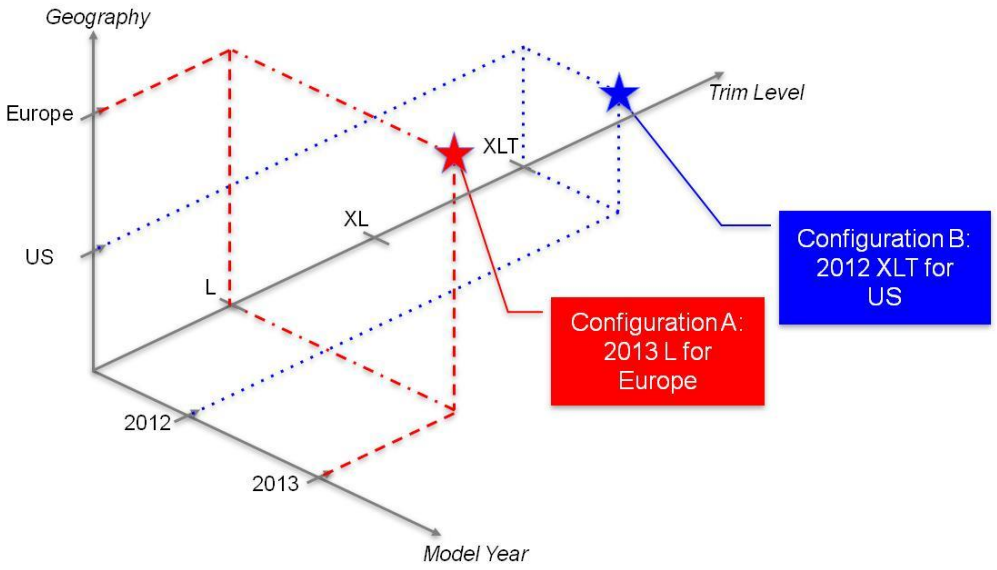


Versions, Variations and Configurations - Dimensions

•Different configurations for some set of resources vary according to different criteria, for example by **time, by platform, by geography or language**, and so on. These criteria that differentiate between configurations are called **variability dimensions or just dimensions**

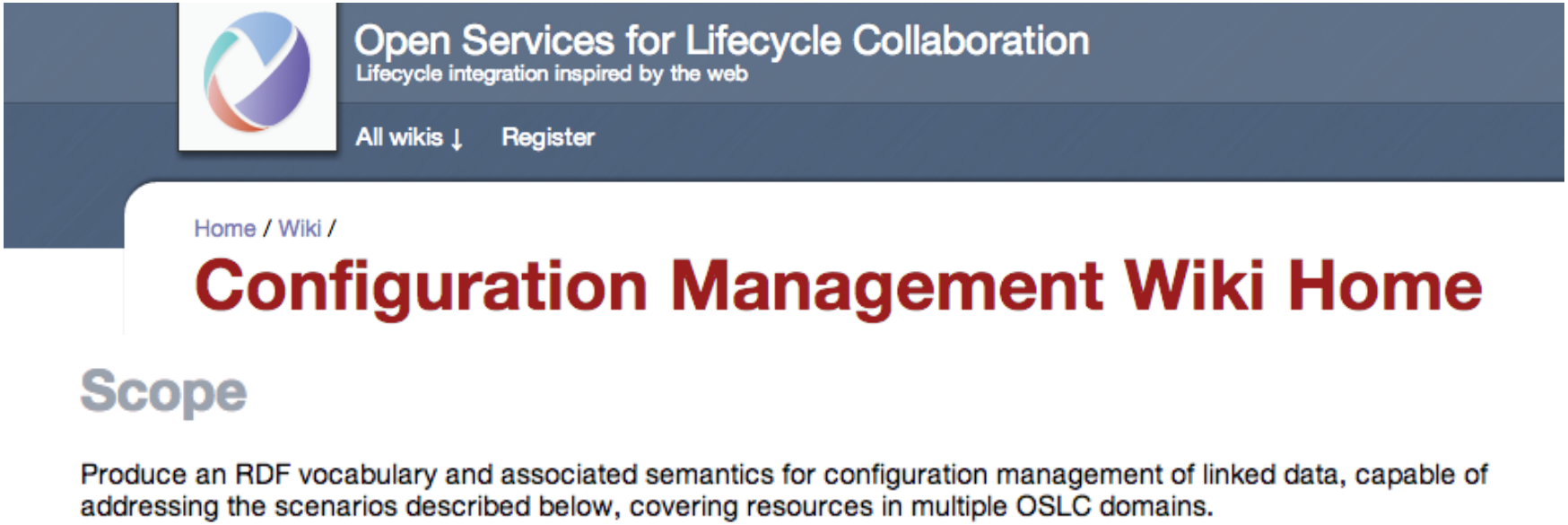
•VVC provides two out-of-the-box dimension: time (used for snapshot/baseline) and purpose(used for streams or branches)

•Users can define their own dimensions, and the values for those dimensions



OSLC Configuration Management Working Group

- http://open-services.net/wiki/configuration-management/

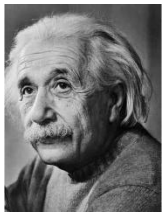


- Work has begun on scenarios, terminology, and resource definition

Agenda

- Integration of multiple life-cycle artifacts – why a new approach is needed?
- The new approach …
- IBM Rational Solution offerings
- A word on versioning and configuration
- **Standards, call for action!**

Call for action !



"We can't solve problems by using the same kind of thinking we used when we created them"

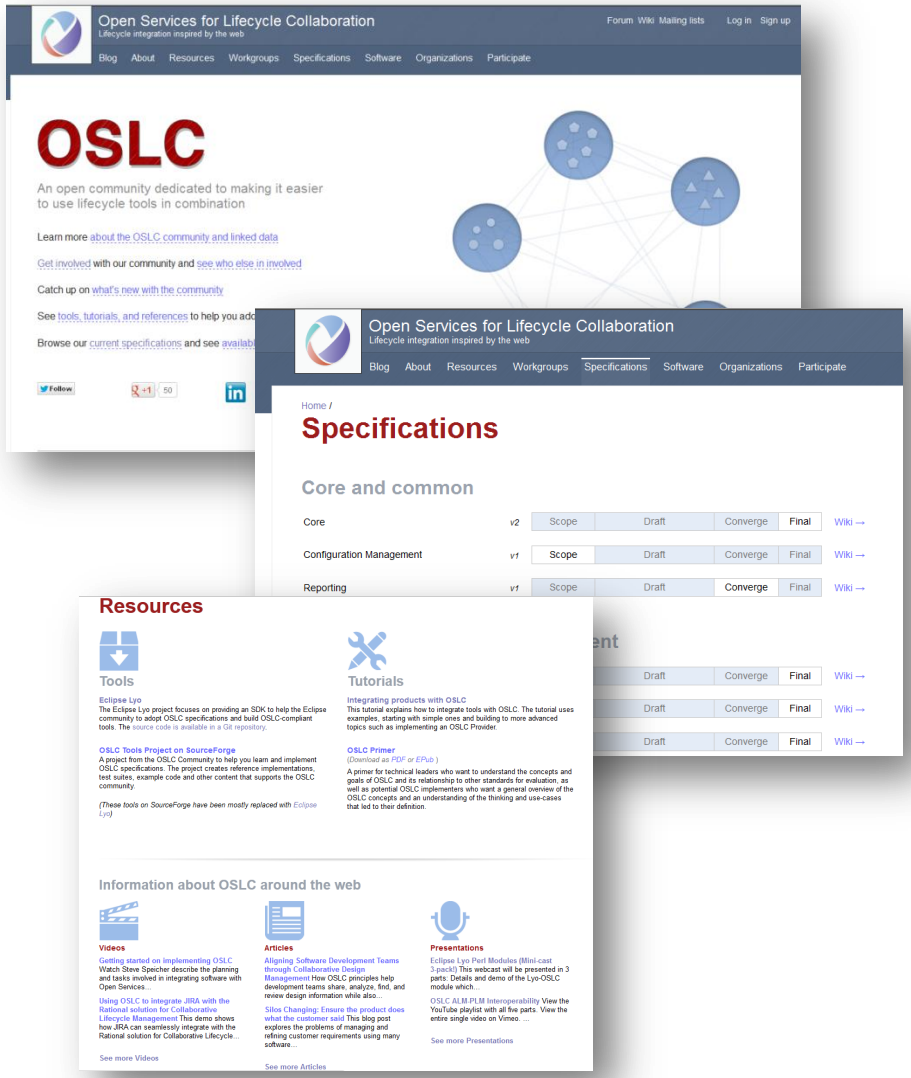
•We have enough evidences that past integration approaches have limited value:

- •Single repository
- •Peer-to-peer import/export/transformation integration
- •A single schema/metadata standard
- •A single implementation platform

•We have a great example of the most successful, flexible, scalable, easy to use and well adopted system that was ever created by mankind …

Call for action !

OSLC website at http://open-services.net

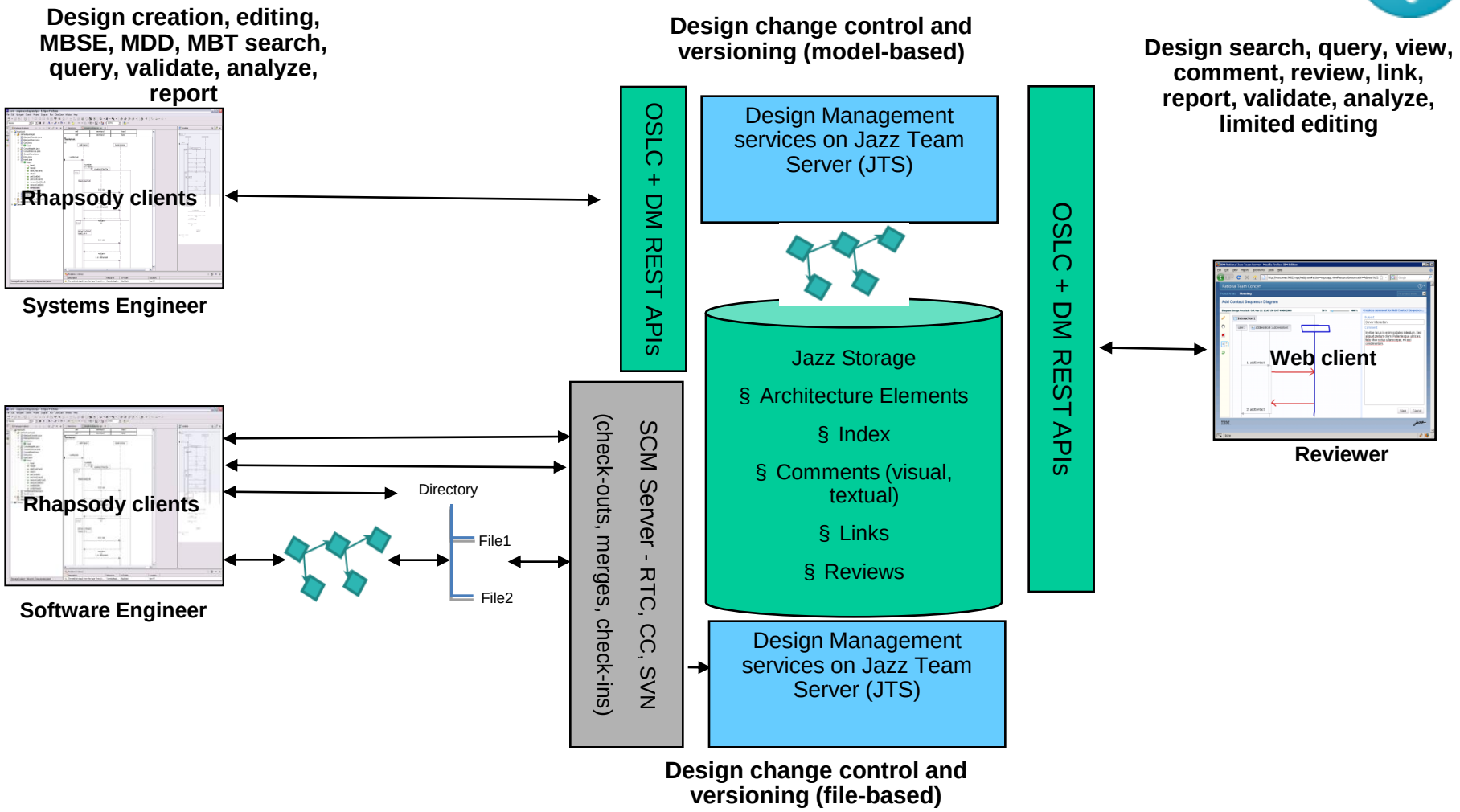


W3C Linked Data Platform Working Group website at: http://www.w3.org/2012/ldp

www.ibm.com/software/rational

Additional slides

Work together with SCM and DM model management



- Systems Engineers work directly from the database for design change control and versioning
- Software Engineers work with their Software Configuration Management system for design change control and versioning