Successfully Integrating MBSE Data Without Replication Using OSLC

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PROSTEP Inc
Agenda

About PROSTEP

MBSE Integration Needs and Challenges

What is OSLC and What Can it Do?

Connecting PLM, ALM, SDM with OSLC

Implemented Customer Solutions
Company Overview

A vendor neutral / independent engineering services and software company since 1993

Over 24 years experience with engineering interoperability, migration, intelligent documents, benchmarking, more
Approximately 250 employees and consultants based from international locations throughout Europe and in North America
More than 500 Customers that are leading companies across most industries

Shareholders
PROSTEP - Strength in Partnership

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1. About PROSTEP
2. MBSE Integration Needs and Challenges
3. What is OSLC and What Can it Do?
4. Connecting PLM, ALM, SDM with OSLC
5. Implemented Customer Solutions
Concept Meets Reality - Enabling MBSE

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- Data is mastered in multiple sources
- One solution is not desired or preferable
- MBSE needs the impact of system changes across multiple sources
- The manual maintenance of traceability is a huge time investment in the process.
- Integration is the solution to providing complete and comprehensive information
Integration Solves Lots of Problems – A Business Case

- **Efficiency from Modern Engineering Practices**
  - Traceability in Systems Engineering (MBSE)
  - Configuration Lifecycle Management
  - Digital Twin / Digital Thread / Digital Master
- **Manual integration of data can be quantified by the operation of synchronization**
  - Speed that the data is available
  - Time the manual process takes for the data to be synchronized
  - Accuracy of the duplicated data and costs of failures (wrong production revision?)
- **Elimination of software licenses for integrated systems**
  - Data is available in the primary system of that user and additional license not needed
  - Duplicate functionality only needs to be utilized in one system
  - Integration can enable migration and eliminate other system entirely
- **Consolidation, Quality, Training, Maintenance, Support and Knowledge**
  - Less utilization of different systems means less overhead
Integration Comes with Challenges

- **Point-to-point solutions** do not scale and typically become unmanageable.
- **Full centralization** is neither feasible nor desirable.
- **Data Duplication** comes with data model compatibility issues, data mastery issues and synchronization processing time.
- **Remastering** data means duplication.
- **MBSE** only requires reference, not data mastery!

- Integrations don’t scale.
- Monocultures lock you in.
- Maintenance, management, and change costs go up over time.
- Ongoing and unexpected costs drain resources.
- End-user productivity suffers: Either stuck with the wrong tool, stuck doing manual integration; often stuck doing both.

Integrations consume more of the IT budget: integration failures are the top 2 causes of software project delays*.

* Commissioned study conducted by Forrester Consulting on behalf of IBM.
Standards Enable hub-and-spoke Integration at a Cost

- **Point-to-Point Integration** at MBSE scale is **unmaintainable**
- Standards are introduced to have a “neutral format” to read from and write to
- Many need to **pre-define all semantics** beforehand in a closed world approach (like STEP 10303 AP 214)
- **Traditional standards** everything is known ahead of time.
- **OSLC** allows for a standard **simplified** interface (mix of both)
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Model the Internet for “Just Enough” Integration (OSLC)

- Open Services for Livecycle Collaboration
- Open Standard, Open Community
- Proposed by IBM et. al. in 2008
- Motivated by Rational Team Concert (RTC)
- Data is stored at single location and simply linked. No replication!
- Emerging standard for Tool integrations in ALM domain
- Loosely Coupled
- Semantic Web Linked Data
- Based on Architecture of Web – HTTP, RDF

- RDF (Resource Description Framework)
- JSON / XML for transfer
- REST Service for requests
- OAuth for authorisation
- UI Integration

- Slim Data model
  - Granular to one attribute at a time
- Enhanced Data models available for Change- and Document Management
- Easy to define your own data types

“Just Enough” integration

http://open-services.net
**Open Standards & Open Resources**

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*The Resource for OSLC Implementers*

*Eclipse Lyo: Enabling tool integration with OSLC*

*W3C: Linked Data Platform Working Group*

*OASIS: Advancing open standards for the information society*

**Open Services for Lifecycle Collaboration**

Lifecycle integration inspired by the web

- Scenario-driven & Solution-oriented
- Generally applicable: specs available for many domains covering ALM, DevOps, ISM, and PLM
- Leading choice for strategic integration technology
- Proven, Open, Innovative
- Free to use and share
- Tests, Libraries, Samples, Examples, Reference Implementations

**OSLC:**

Inspired by the web
OSLC’s Simple Solution

Architecture of the Web
Linked Data
Increased reuse
Decreased maintenance costs

Standard Interfaces
“Just Enough” integration
Increased traceability
MBSE Visibility

OSLC is an open and scalable approach to lifecycle integration. It simplifies key integration scenarios across heterogeneous tools.
OSLC Uses an RDF Graph Data Model

Adapted from:
Everything is an RDF triple (subject-predicate-object)

**Subject** = Resource = always a URI

**Predicate** = Relationship or property = Always a URI

**Object** = Could be a URI (which could refer to a resource) or a literal value (value to work with and show users)

Example triple:

- **Subject**: `<http://...requirement28465_improve_remote_steering>`
- **Predicate**: `<http://...validatedby>`
- **Object**: `<http://...testcase35645_test_steering>`

Additional value:

- `<http://...priority>``High`
MBSE – Integrating Data in Different Silos

Which requirements are related to test cases that failed?

Does every requirement have a test to validate it?
OSLC Allows for Different Vendor Data to be Linked Together
How does OSLC Work?

1. Discovery of capabilities
2. HTTP C.R.U.D. for resources
3. Standard resource representations
4. Querying for resources
5. Delegated UI for Create and Select
6. UI Previews for Resource Links
1. Discovery of Capabilities

example: IBM Rational Team Concert

example: IBM Rational Team Concert project area

example: Change Management capability

example: work item (bug, defect, enhancement request)
2. HTTP CRUD for Resources

• OSLC allows manipulation of resources using standard HTTP C.R.U.D

<table>
<thead>
<tr>
<th>HTTP</th>
<th>SQL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>POST = INSERT</td>
</tr>
<tr>
<td>Request</td>
<td>GET = SELECT</td>
</tr>
<tr>
<td>Update</td>
<td>PUT = UPDATE</td>
</tr>
<tr>
<td>Delete</td>
<td>DELETE = DELETE</td>
</tr>
</tbody>
</table>
3. Standard Resource Representations

Turtle

```turtle
@prefix oslc_qm: : https://open-services.net/ns/qm# .

<http://example.com/TestCases/1> a oslc_qm:TestCase ;
```

JSON

```json
{
  "rdf:about": "http://example.com/TestCases/1",
  "rdf:type": [ {
    "rdf:resource": "http://open-services.net/ns/qm#TestPlan"
  } ],
  "oslc_qm:validatesRequirement": {
    "rdf:resource": "http://example.com/Requirements/1"
  }
}
```

RDF/XML

```xml
<oslc_qm:TestCase rdf:about="http://example.com/TestCases/1">
  <oslc_qm:validatesRequirement rdf:resource="http://example.com/Requirements/1"/>
</oslc_qm:TestCase>
```
4. Query For Representations

• Query capability has base URI

• Clients form query URI and HTTP GET the results

• OSLC services MAY support OSLC Query Syntax
  » [http://open-services.net/bin/view/Main/OSLCCoreSpecQuery](http://open-services.net/bin/view/Main/OSLCCoreSpecQuery)

• Example: Find high severity bugs created after April fools day

5. Delegated UI for Create or Select

A delegated UI renders the source application UI in the target application. This example shows the contributed/delegated Rational Team Concert Work Item search dialog being rendered in an OSLC Quality Management application.

1. Click to launch delegated UI

2. iframe's src set to delegated UI's URL

3. Selection made

4. Click OK. Sends message (link+label) to parent window
6. UI Previews for Resource Links

- Scenario supported: hover over link to get in context preview of resource
- Simple resource format defined and retrieved using HTTP

Hover over link
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What is OSLC and What Can it Do?

Solution for Integrating Systems with OSLC

Implemented Customer Solutions
How can I leverage OSLC for MBSE?

- OSLC UI integration is OOTB for many ALM and MBSE solutions
  - Enterprise Architect Pro Cloud Server
  - IBM Rational Rhapsody (and all of RTC)
  - PTC Integrity Modeler
  - PROSTEP OpenCLM (Prototype)
- OpenPDM offers OOTB Connectors for all types of systems
- Low complexity Standards Based COTS solution
  - Install connectors
  - Generate the mappings
  - Data is federated to your MBSE system
MBSE Utilizing OSLC with OpenPDM

Rational Rhapsody

Delegated UI

Delegated UI

Delegated UI

OpenPDM

CAX

Others...

Dassault CATIA 3DX/V6
Dassault CATIA V5
Siemens NX
PTC Creo
PROSTEP PDFGen3D
PROSTEP OpenDXM GlobalX
...
Data Bases
Your Legacy System

Web Services
OSLC
ASCII
XML
STEP

PDM / PLM

Dassault ENOVIA 3DX/V6
Dassault VPM V4
PTC Windchill
Siemens Teamcenter
Siemens Teamcenter Enterprise
Oracle
Autodesk
Aras
Aras Innovator

Ansys
ERI
MSC
Sim Manager
...
OpenPDM OSLC Adapter

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- The OpenPDM OSLC Adapter enables OSLC access for non-OSLC systems
  - Authentication against backend
  - Query UI / Properties Display UI
  - REST Resources and resource links
  - Local Document Download from the backend system via OpenPDM
  - Query Service maps OSLC queries onto backend

- Supports Change Management 2.0 + custom attributes
- Support for modern schema (new 2017)
More Than MBSE – CLM, Digital Master | Thread | Twin

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Compliance (and CLM) Tracability at Bombardier Transport

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Diagram showing the integration of DOORS, RTC, OpenPDM, and Teamcenter Enterprise.
OpenPDM Use Cases

- DOORS – Agile e6 – SAP Integration
  - Linking requirements to documents and materials
- Process Improvement
  - Traceability
  - Impact Analysis (RFQ Assessment)
  - Integrated change management
  - Integrated release management
  - reuse
  - Improved auditability (SPICE)
  - quality management
SDM - Test & Requirements Integration at Auto OEM

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Simulation Application

TCSim

Simulation / Test Correlation Application

Requirements Repository

DVPlan

Test Meta-Data OSLC Compliant Datastore

Test Data Files

Test Data

Requirements Repository

DVPlan

Test Meta-Data OSLC Compliant Datastore

Test Data Files
OpenPDM – Linking with OSLC and More

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Challenges in the PLM Environment
One Solution for all Use Cases

**INTEGRATION**
- Synchronization of data of various systems and domains
- Consistent and automated processes

**LINKING**
- Linking of product data of various disciplines
- Traceability of the whole product development process
- Creation of reports and realization of audits

**MIGRATION**
- Controlled migration of huge data volumes
- Minimized risk by parallel operation of old and new system
- Lower complexity by splitting into packages

**COLLABORATION**
- Integration of data from partners, customers and suppliers
- Reliable and transparent processes
- Check of data quality
Questions?
THANK YOU!

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