

Achieving the digital thread through PLM and ALM integration using OSLC

Purdue PLM Meeting Spring 2018

Axel Reichwein
March 29, 2018
Koneksys

Axel Reichwein

- Developer of multiple data integration solutions based on Open Services for Lifecycle Collaboration (OSLC)
- Background in aerospace engineering
- Since PhD, focus on data integration
- Since Koneksys, focus on OSLC
- Previously involved in standardization efforts related to SysML (Systems Modeling Language)
- Presented OSLC at multiple conferences: INCOSE, OMG, SAE International Automotive, North American Modelica Users Group, IBM InterConnect, IBM Innovate, NoMagic World Conference, CIMdata Systems Engineering Workshop



Status Quo of Collaboration

According to David Meza, Head of Knowledge Management at NASA

“Most engineers have to look at 13 different sources to find the information they are looking for”

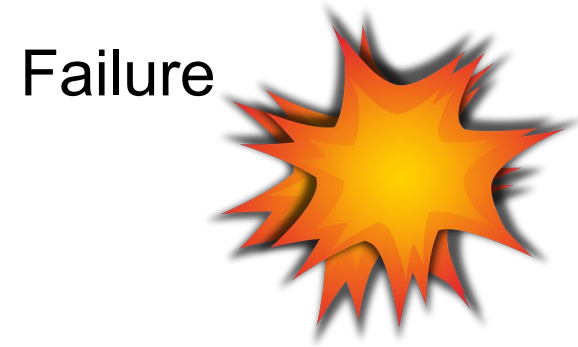
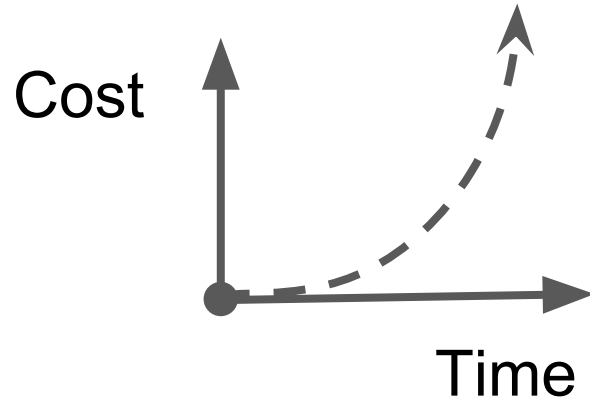
“46% of workers can’t find the information about half the time”

“30% of total R&D funds are spent to redo what we’ve already done once before”

“54% of our decisions are made with inconsistent, or incomplete, or inadequate information”

<https://www.youtube.com/watch?v=QEBVoultYJg>

Consequences of Bad Collaboration



Distributed Engineering Information

One technical system
described from different
perspectives

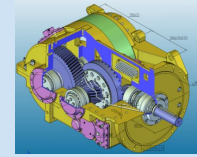
One technical system, but a lot
of distributed information

Distributed information is
challenging for collaboration

Requirements

```
«requirements»
Static Stability Factor (SSF)
Id = "1.1"
Text = "SSF shall be higher
than 1.3. SSF is a factor
based on a vehicle's track
width and center of gravity
height"
```

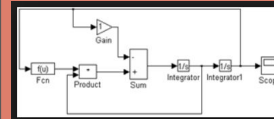
3D Geometry



Test cases

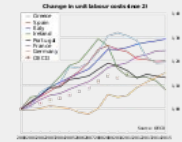
```
«testCase»
Vehicle Fishhook Maneuver Simulation
```

Behavior



Technical System

Costs



Software



Reports



Spreadsheets

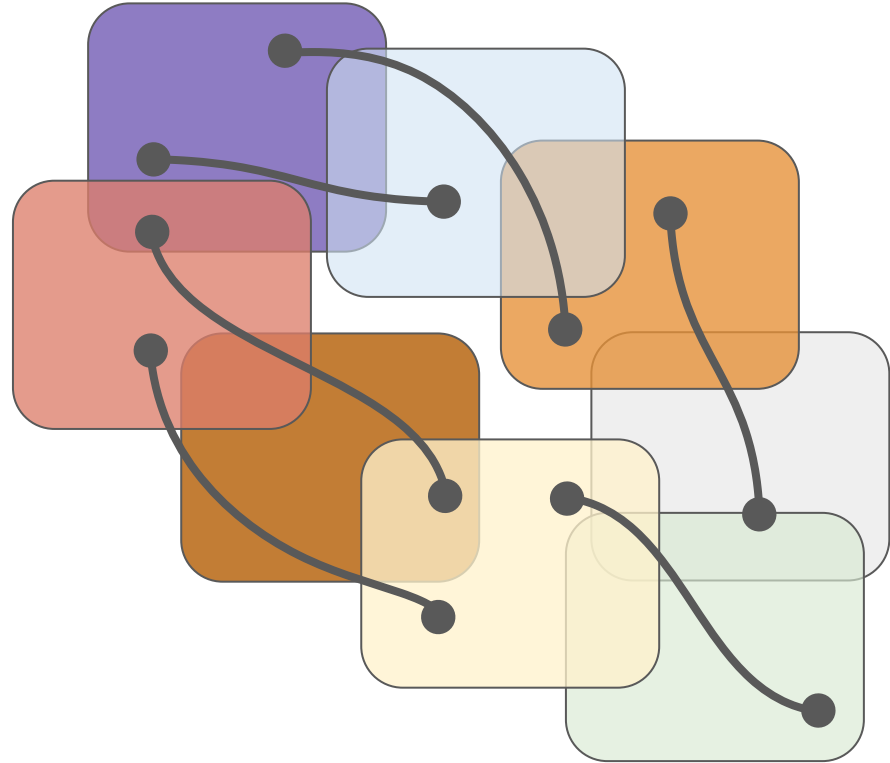
	A	B	C	D	E
1	N°	PRODUCTO	CANTIDAD	PRECIO UNITARIO	SUBTOTAL
2	01	Prod-1	80 kg	50.00	
3	02	Prod-2	85 kg	49.50	
4	03	Prod-3	90 kg	49.00	
5	04	Prod-4	95 kg	48.50	
6	05	Prod-5	100 kg	48.00	
7	06	Prod-6	105 kg	47.50	
8	07	Prod-7	110 kg	47.00	
9	08	Prod-8	115 kg	46.50	
10	09	Prod-9	120 kg	46.00	
11	10	Prod-10	125 kg	45.50	

Overlaps and Relationships in Engineering Information

Overlaps due to data duplication
(e.g. same parameter used in
different models or reports)

Logical relationships such as a
requirement verified by a test
case

The more complex a system is, the
more relationships exist between
engineering information



Problem: Rollover Risk of SUVs

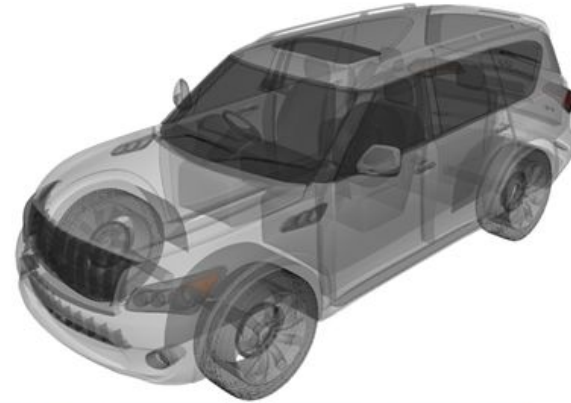
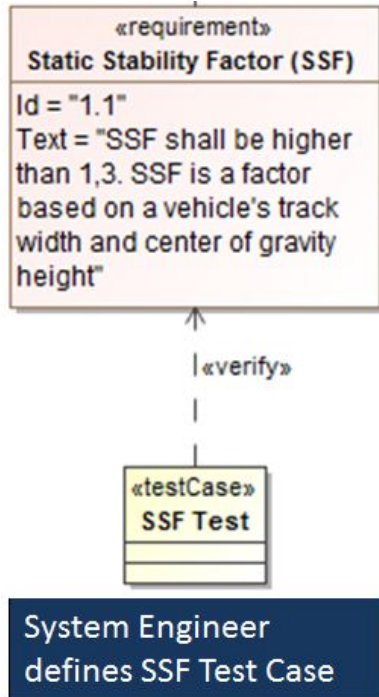
Higher center of gravity -> higher risk of rollover

More than a third of all fatal crashes in the US are rollovers!



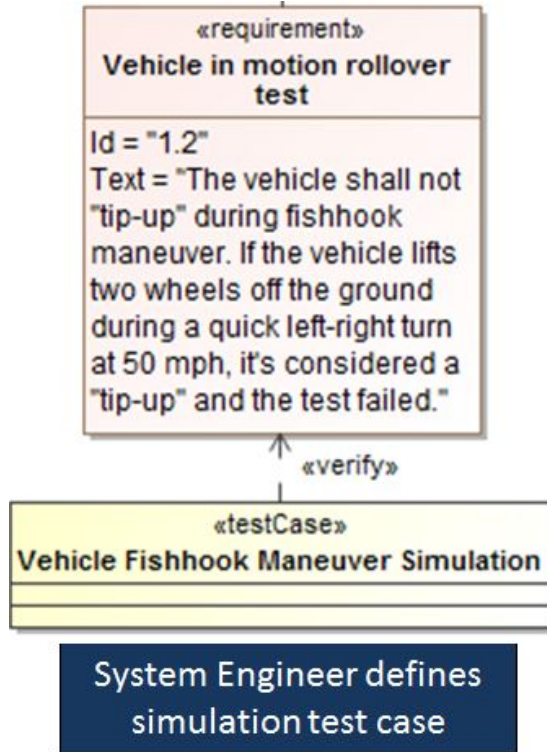
<http://www.cars.com/go/crp/buyingGuides/Story.jsp?section=SUV&story=suvSafe2012&subject=stories&referer=&year=New>

Static Stability Factor Test

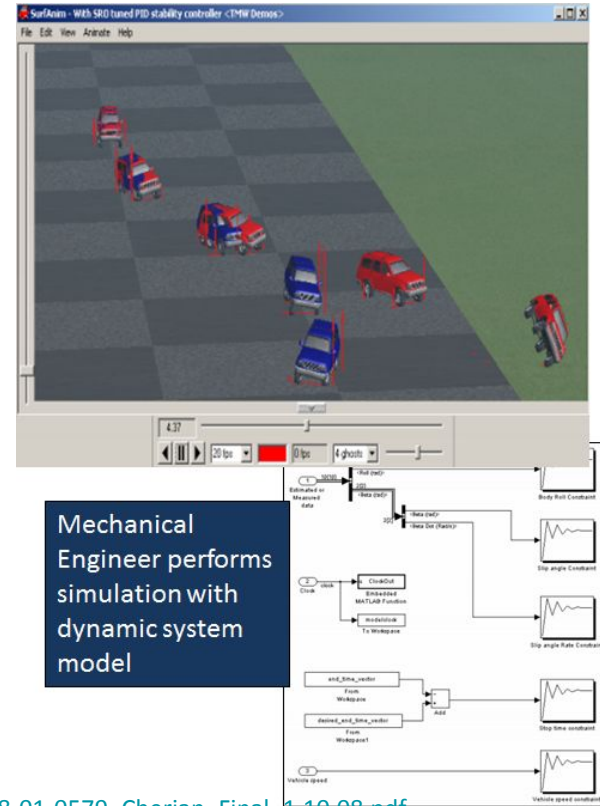


Mechanical Engineer computes center of gravity height of new vehicle through geometric model

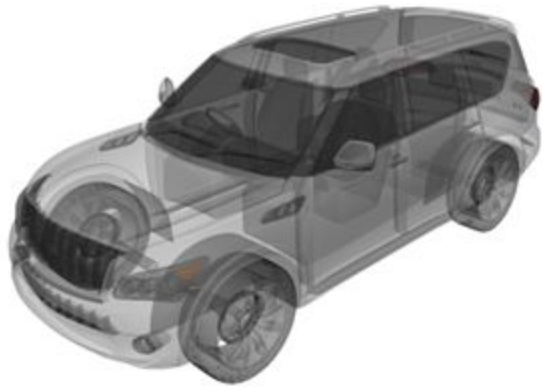
Fishhook Maneuver Simulation



http://www.mathworks.com/tagteam/49380_2008-01-0579_Cherian_Final_1.10.08.pdf

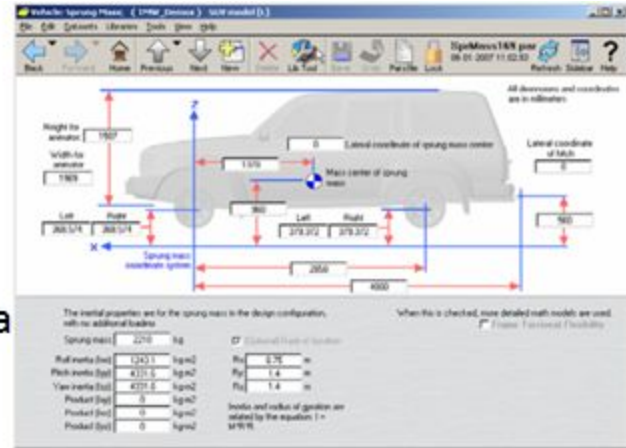


Link between COG Parameter of different models



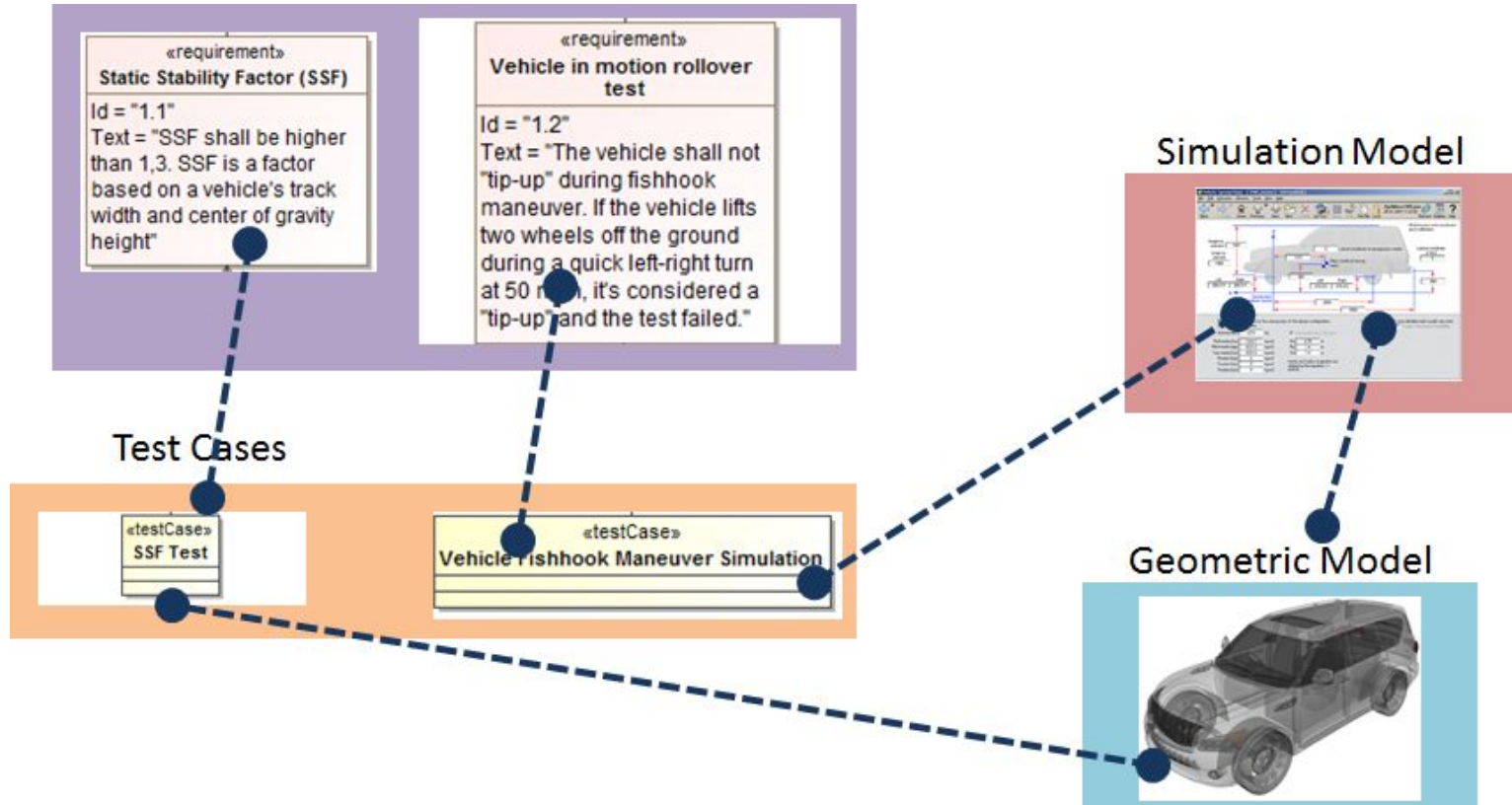
Center of Gravity
→
+ Moments of Inertia

Center of gravity in geometric model

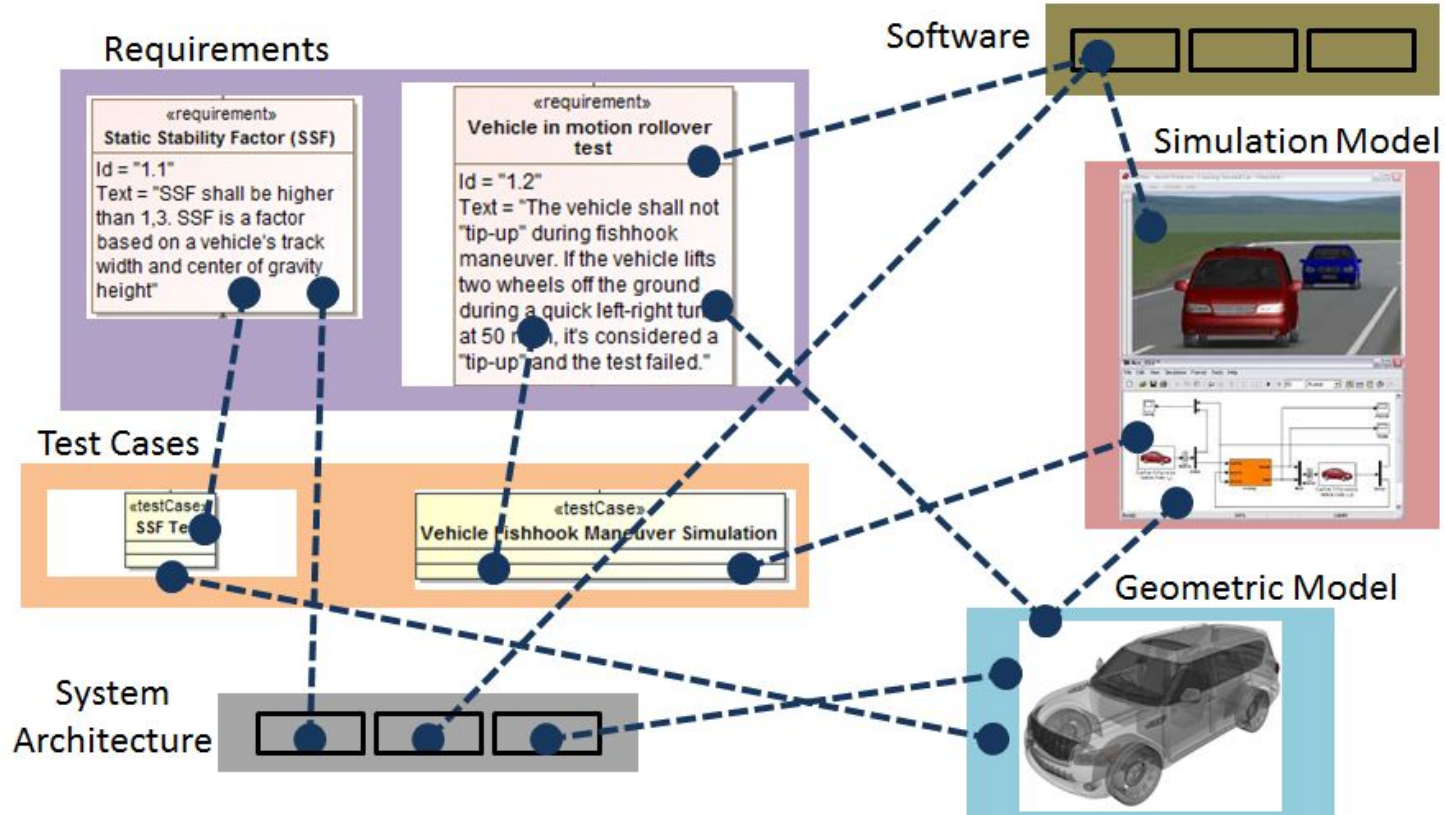


Center of gravity in simulation model

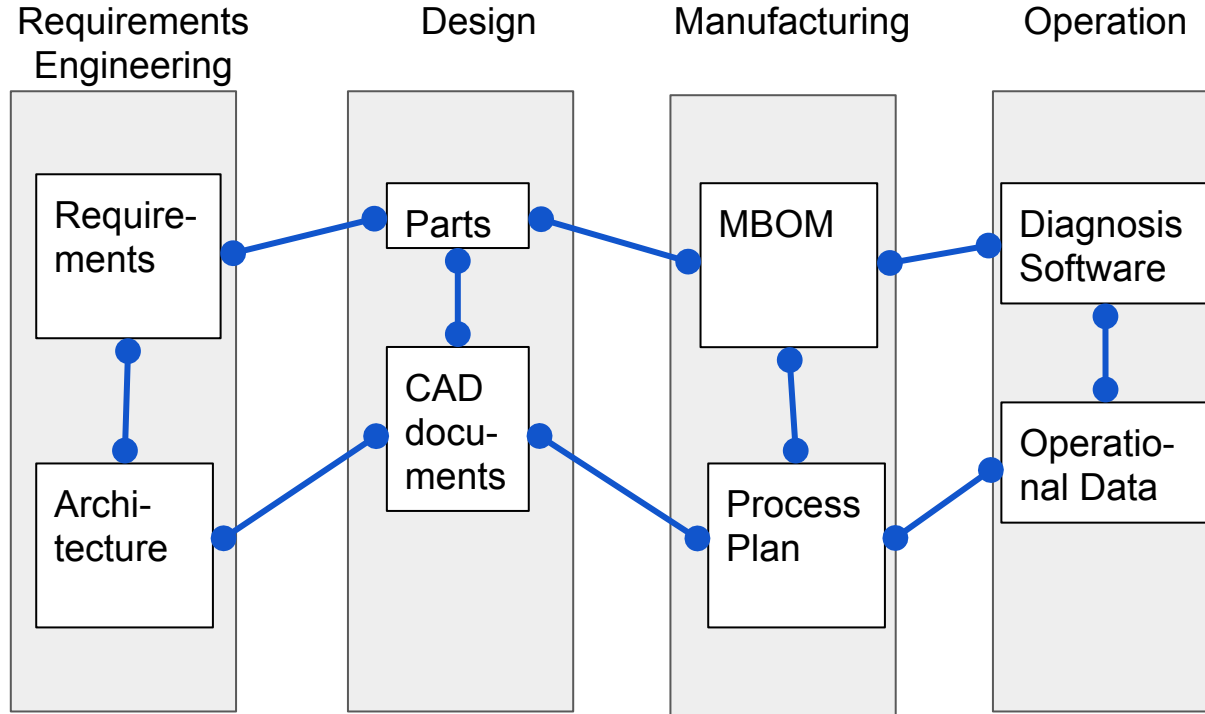
Relationships between Engineering Data



Reality: Many Relationships between Engineering Data



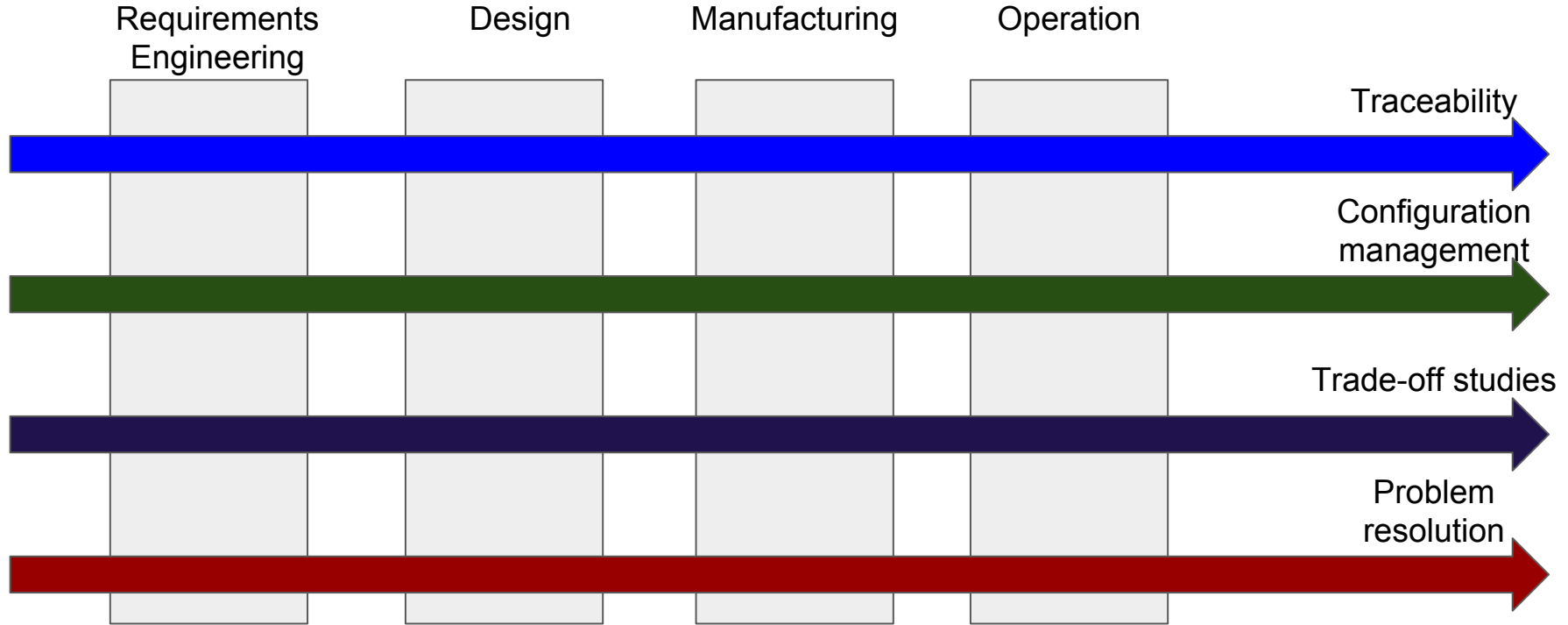
Example Digital Thread of PLM vendor



Problems

- **Limited integration** of specific disciplines and software applications
- **No mix-n-match** as needed by your organization (No ad-hoc integration)
- **Custom integration development is expensive**
- **Locked in by vendor**

Crosscutting Concerns Across Disciplines



Collaboration Challenges in Designing Systems



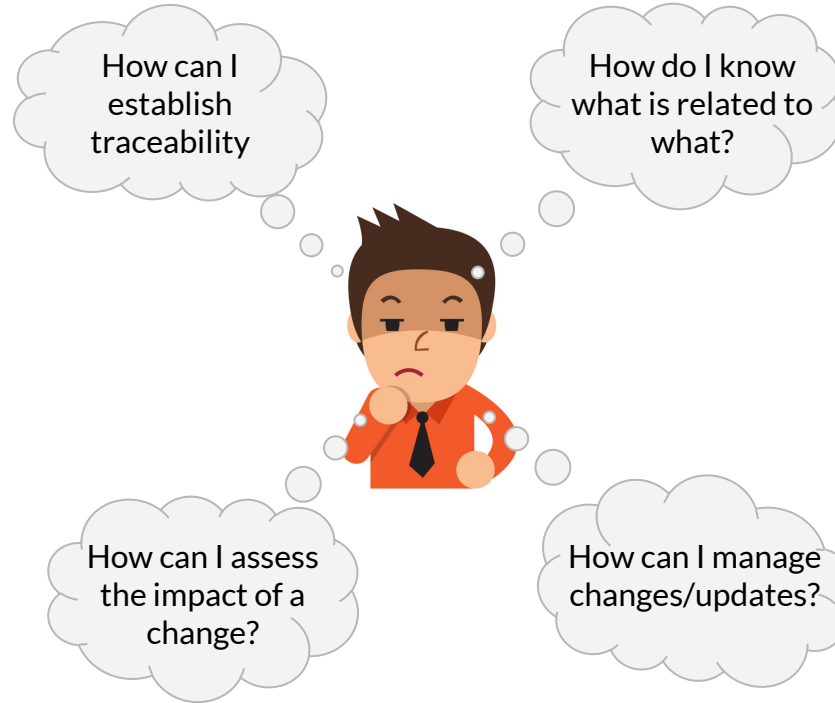
Increasing
system
complexity



Increasing
number of
partners



Increasing
number of
versions of data



Increasing
number of
meetings



Increasing
costs



Increasing
frustration

Data Integration Benefits



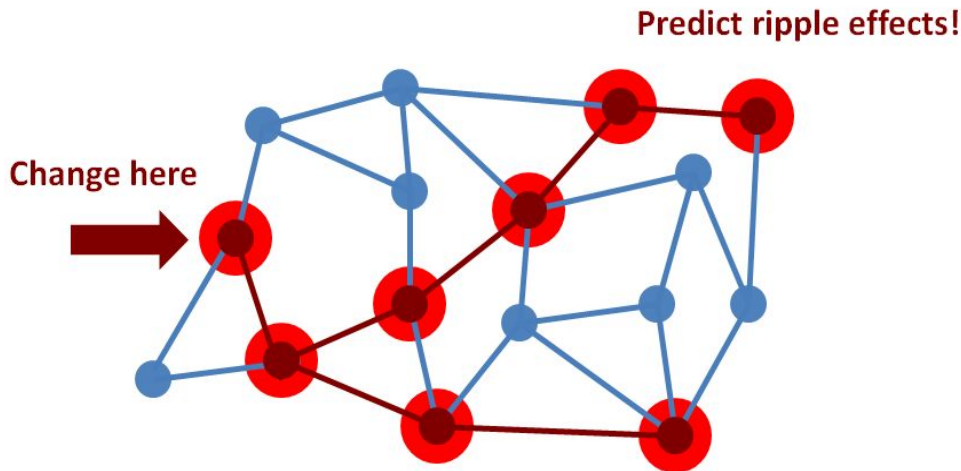
Understanding the context of information



Understanding the ripple effects of changes



Understanding the origin of product failures



Performing consolidated reporting



Performing data analysis



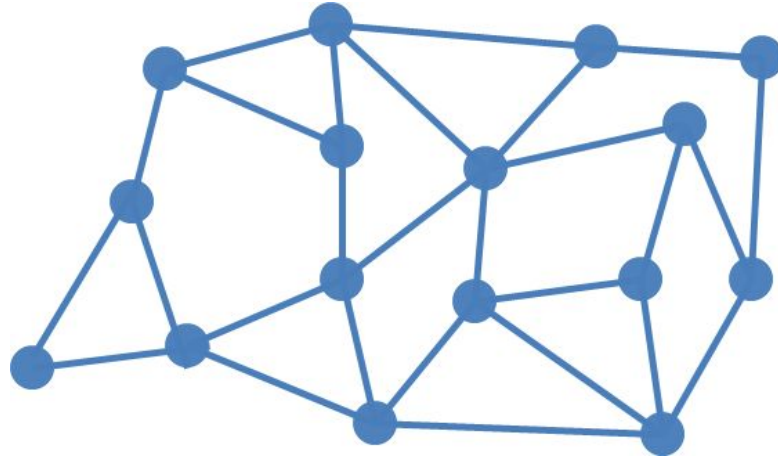
Performing better decisions

Key Data Integration Concepts and Standards

1. Standard machine-readable data format = **RDF**
2. Standard to identify data = **URL**
3. Standard to access data = **HTTP**

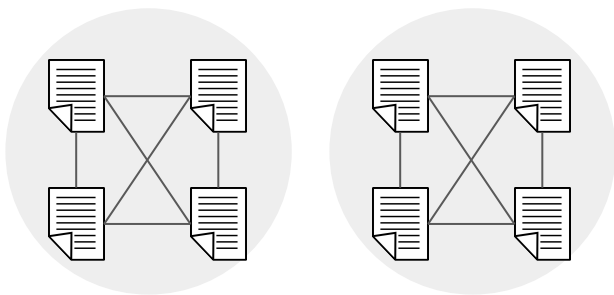


- No license costs
- No vendor lock-in
- Mature and widely adopted infrastructure
- Abundance of Web specialists/developers



Hypertext + Internet = Web

BEFORE THE WEB

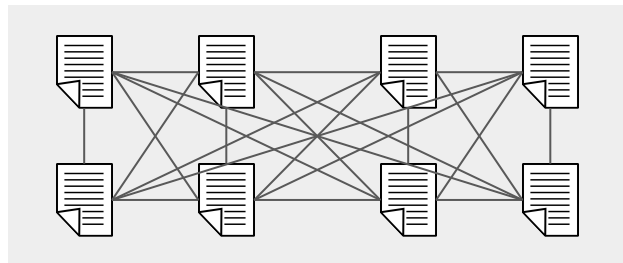


Hypertext System 1

Hypertext System 2

Problem: No Compatibility between
hypertext systems + different protocols to
access and connect documents on the
internet (Gopher, WAIS, etc...)

WITH THE WEB



One global hypertext system = Web
One protocol to access and connect
documents

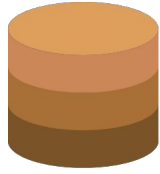
Extending Web of documents to a Web of Data

Web of Documents

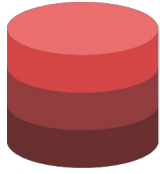
Documents spread across multiple machines



Facebook Server



Wikipedia Server

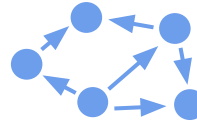


Gmail Server

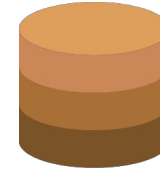
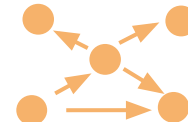
Note: a lot of information accessible through the Web is private!

Web of Data

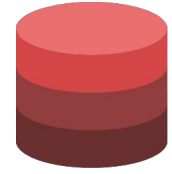
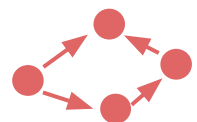
Data spread across multiple databases



Requirements



PLM



ERP

URLs = Common Global Information Identifiers

Web of Documents

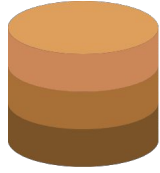
wikipedia.org

facebook.com

myblog.com



Data Repository 1



Data Repository 2



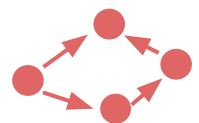
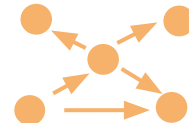
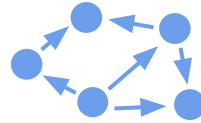
Data Repository 3

Web of Data

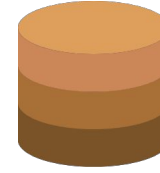


<https://private.myorg.com/req123>

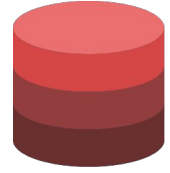
<https://private.supplier.com/part123>



Data Repository 1



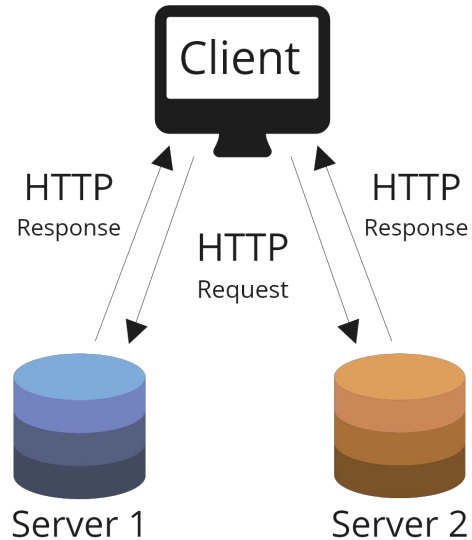
Data Repository 2



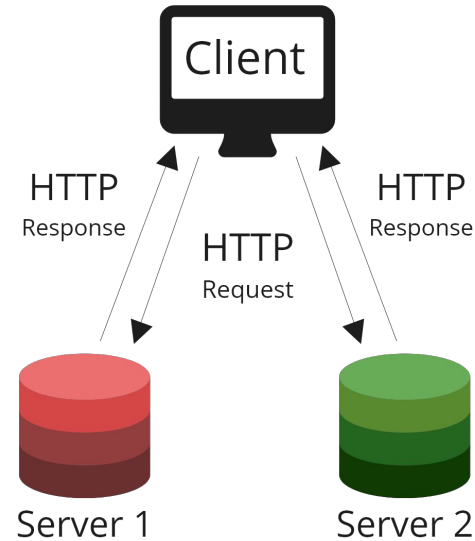
Data Repository 3

HTTP = Common Protocol to Access Information

Web of Documents



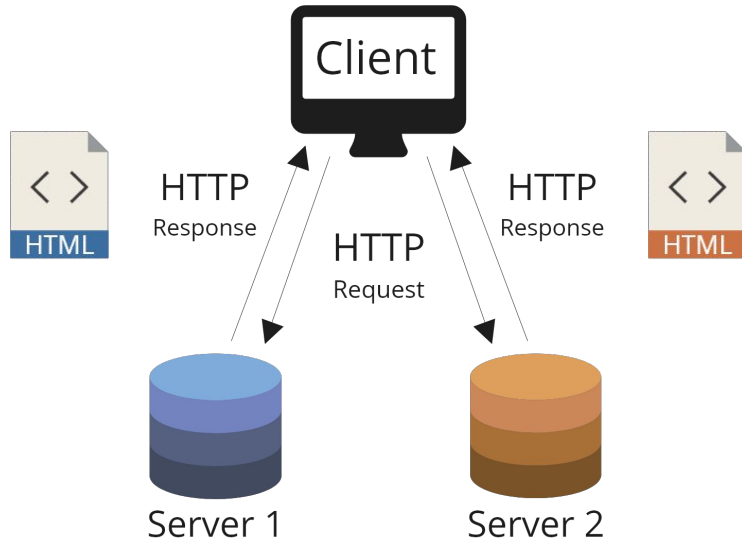
Web of Data



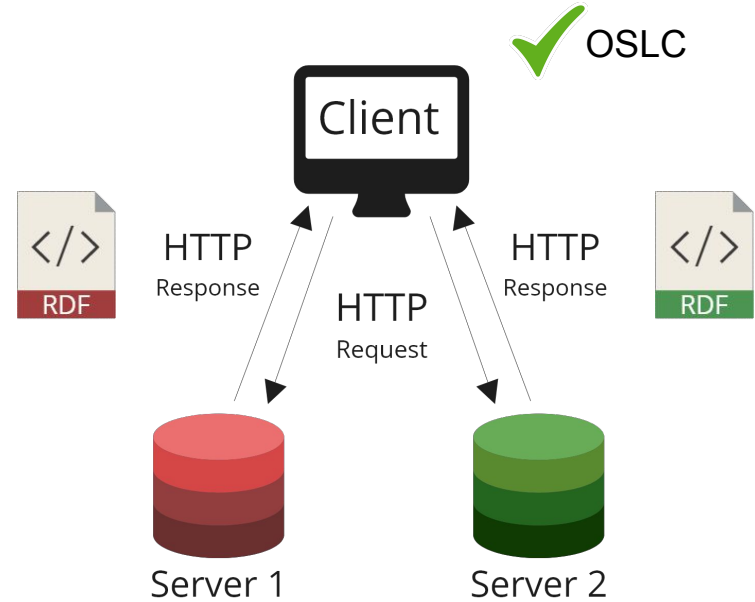
OSLC specifies how to perform CRUD operations on data using HTTP

HTML + RDF = Common Web Data Formats

Web of Documents



Web of Data

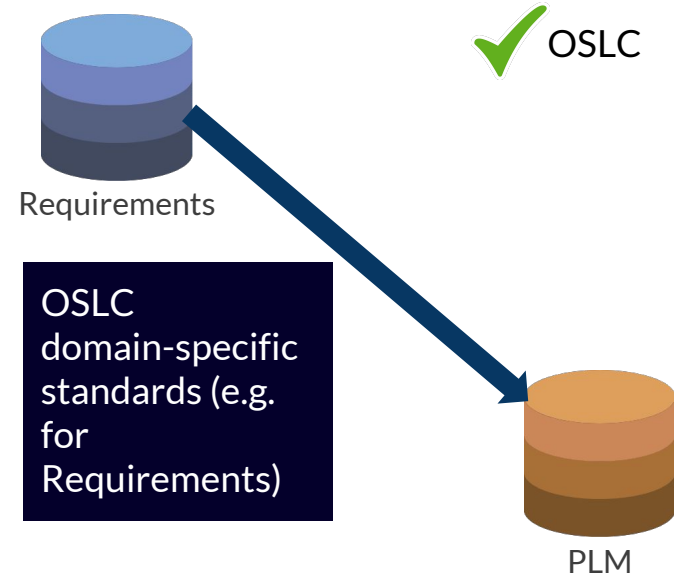


Schemas for Data Interoperability

Web of Documents



Web of Data

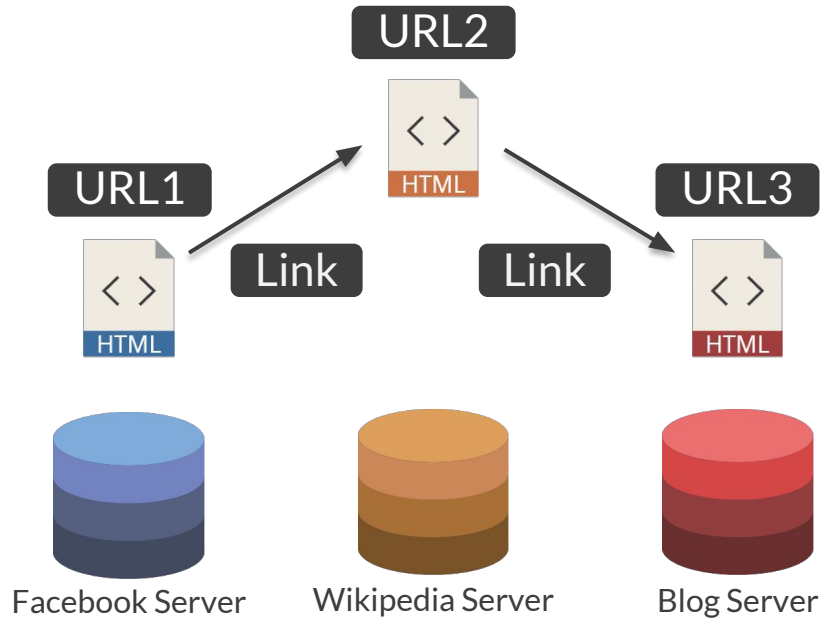


OSLC Domain-specific Standards

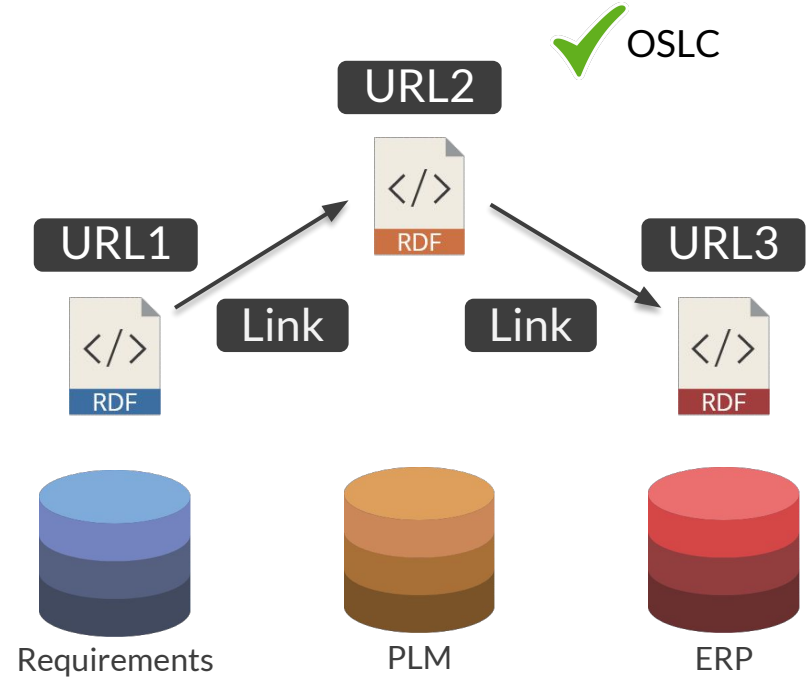


Links for Data Integration

Web of Documents



Web of Data



Mashup Applications

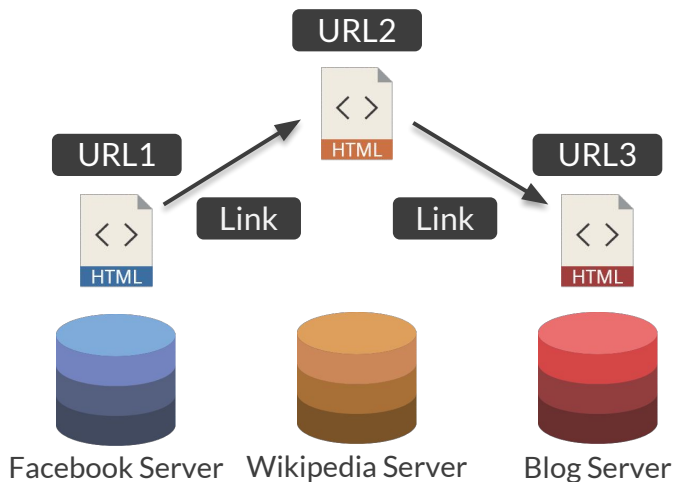
Web of Documents

Search

(e.g Google, Bing)

Visualize

(e.g Chrome, Firefox)



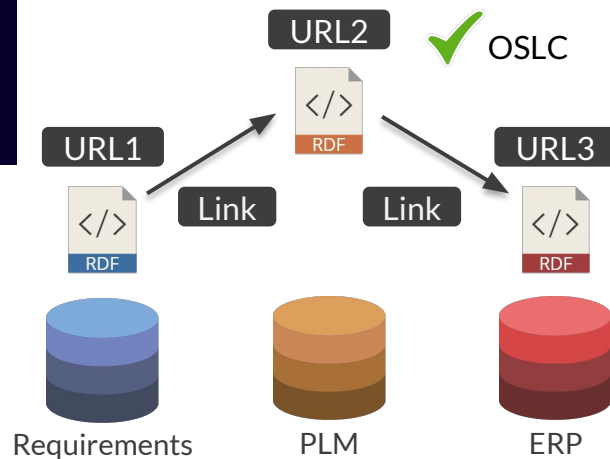
Equal access to
information - more
competition amongst
data management
solutions

Web of Data

Search

(e.g. IBM Lifecycle Query Engine and Mentor
Graphics Context)

Visualize



Mashup Application Example

Google-like Search

The screenshot shows a search interface with a search bar at the top containing the word "Assembly". Below the search bar, there are filters on the left and search results on the right.

Filters:

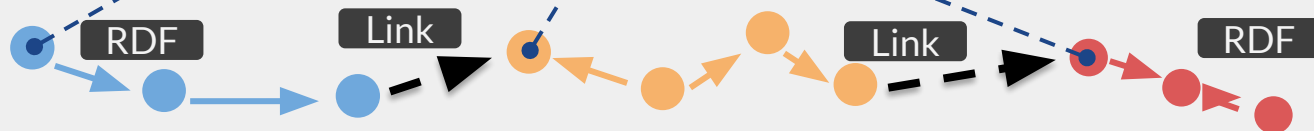
- Type:
 - ☒ Assembly
 - ☐ ItemPart
 - ☐ DesignPart
 - ☐ TraceLink
- Origin:
 - ☐ Supplier1-PLM1
 - ☐ Supplier2-PLM2
 - ☐ OEM-PLM1
 - ☐ OEM-PLM2

Results (5 of 5):

RESOURCES ▲	TYPE ▲	ORIGIN ▲
Assembly_1	Assembly	Supplier1-PLM1
Assembly_2	Assembly	Supplier1-PLM1
Assembly_3	Assembly	Supplier1-PLM1
Assembly_B1	Assembly	OEM-PLM1
Assembly_B2	Assembly	OEM-PLM2

Dashed blue lines connect the search results to the data repositories below. Specifically, Assembly_1 connects to Data Repository 1, Assembly_2 connects to Data Repository 2, and Assembly_B1 connects to Data Repository 3.

Private/public
Data Web

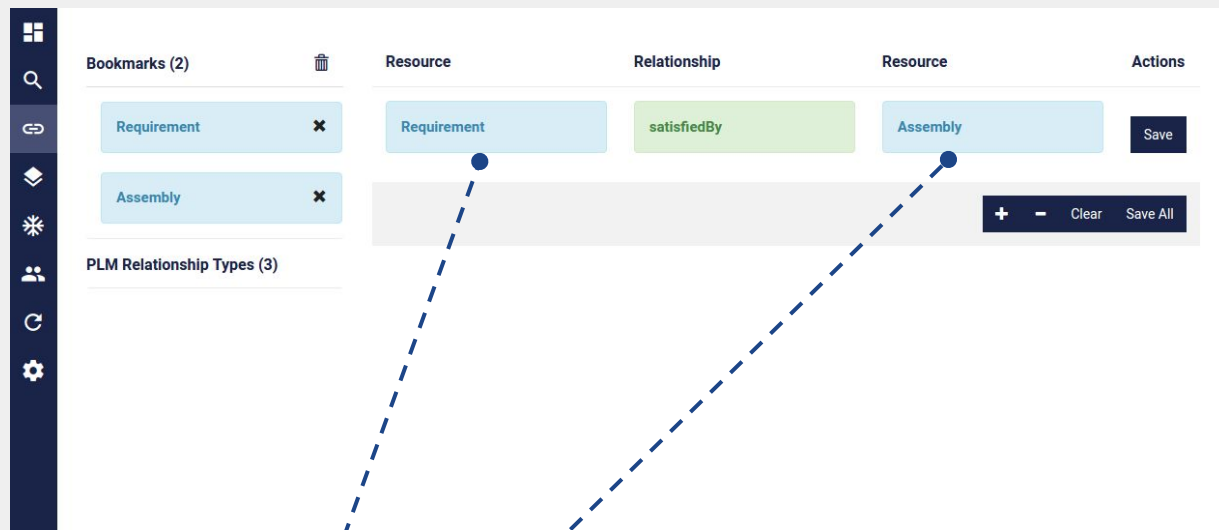


Distributed
Data Silos

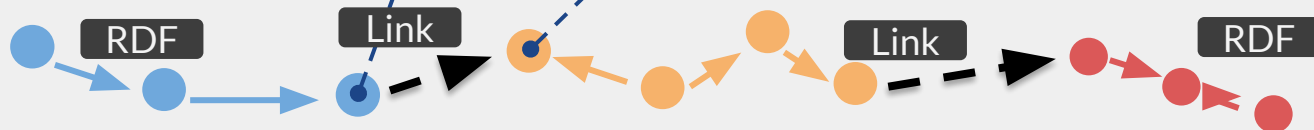


Mashup Application Example

Link Editor



Private/public
Data Web



Distributed
Data Silos



Mashup Application Example

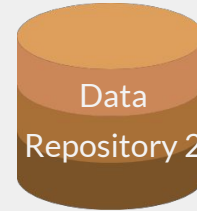
Tree (BOM-like) Viewers

	Revision	Type	Origin	
Assembly1-DB1	A	Job	Supplier1 [Aras]	<input type="checkbox"/>
Part1-DB1	A	Location	Supplier1 [Aras]	<input type="checkbox"/>
Assembly2-DB1	A	Job	Supplier1 [Aras]	<input type="checkbox"/>
Part2-DB1	A	Location	Supplier1 [Aras]	<input type="checkbox"/>
Assembly3-DB2	A	Job	Supplier2 [Teamcenter]	<input type="checkbox"/>
Part3-DB2	A	Location	Supplier2 [Teamcenter]	<input type="checkbox"/>
Assembly4-DB3	A	Job	Supplier3	<input type="checkbox"/>
Part4-DB3	A	Location	Supplier3	<input type="checkbox"/>
Part5-DB3	A	Location	Supplier3	<input type="checkbox"/>

Private/public
Data Web



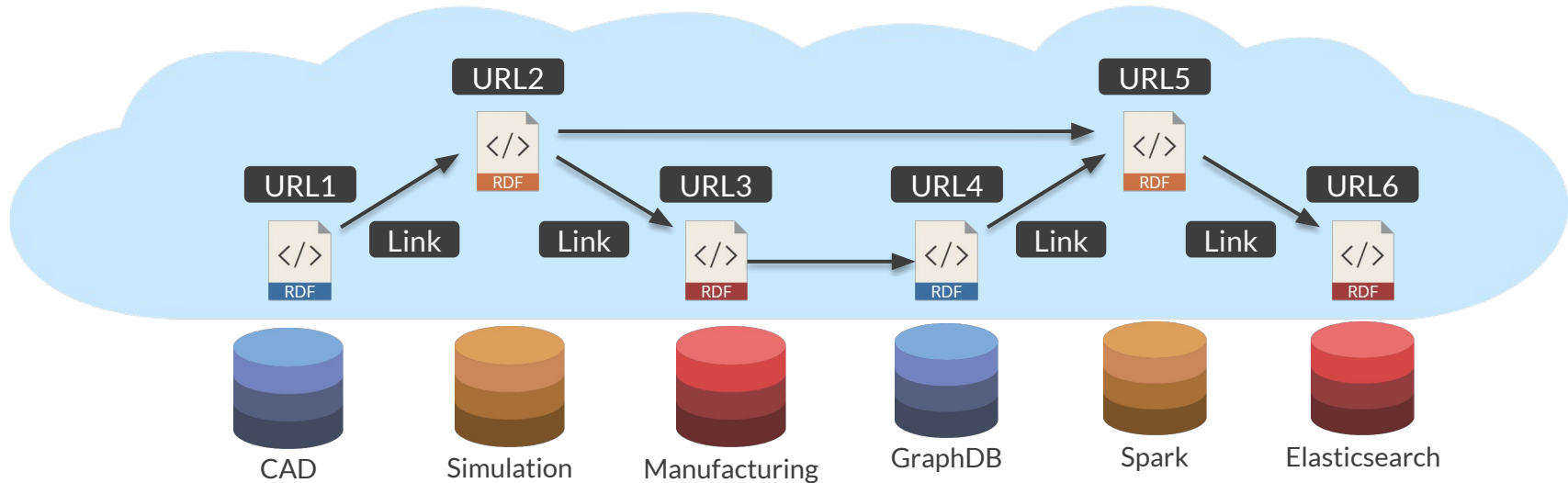
Distributed
Data Silos



Mashup Applications for AI

AI for Generative Design

Equal access to information -> more data available
to AI algorithms -> more interesting AI results



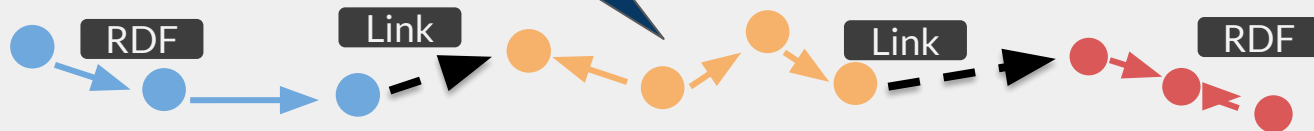
Mashup Application Challenge

Scalability

What happens if the private data Web consists of 10 billion resources? Can you still query it?

Solution: use scalable big data solutions used for example by Google and Amazon (e.g. Elasticsearch, Amazon Neptune)

Private/public
Data Web



Distributed
Data Silos



Mashup
Application
Challenge

Global
Configuration
Management

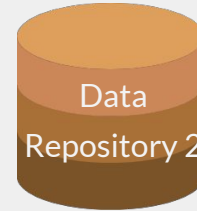
Which version of a resource is linked with which version of the linked resource? Can you do version management at a global level?

Solution: use OSLC Config management standard for global version management

Private/public
Data Web



Distributed
Data Silos



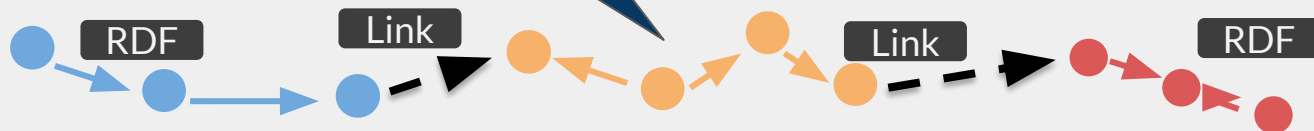
Mashup Application Challenge

Security

How can I make sure that certain resources can only be accessed by certain users? How can the access management be more secure?

Solution: data access management at a global level + blockchain to record who gets access to what

Private/public Data Web



Distributed Data Silos



What does Koneksys do?

We offer **consulting services**:

- Create OSLC APIs for software applications and data stores not supporting OSLC natively
- Create integrations for OSLC-enabled applications (e.g. IBM DNG)
- Create mashup applications for OSLC data
- Offer OSLC training to developers and project managers

What does Koneksys do?

We perform internal **research** to address the challenges of future OSLC-based mashup applications:

- Running queries on OSLC data with Spark GraphFrames ([https://github.com/koneksys/SPARQL to GraphFrames](https://github.com/koneksys/SPARQL_to_GraphFrames))
- Configuration management of OSLC data (<https://github.com/koneksys/Git4RDF>)
- Managing information in the blockchain using smart contracts (<https://github.com/koneksys/Blockchain4LinkedData>)

What does Koneksys do?

We **help grow the OSLC community**:

- Releasing open-source OSLC solutions (<https://github.com/ld4mbse> + <https://github.com/oslc/>)
- Creating new OSLC web site (<http://oslc.co/>)
- Promoting OSLC at conferences (<https://koneksys.com/blog/>)

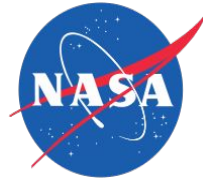
Koneksys

Koneksys helps organizations create data integration solutions using

- Linked Data
- Open Services for Lifecycle Collaboration (OSLC)
- Big Data frameworks
- Graph Databases

Located in San Francisco. In business since 2012.

Koneksys Clients



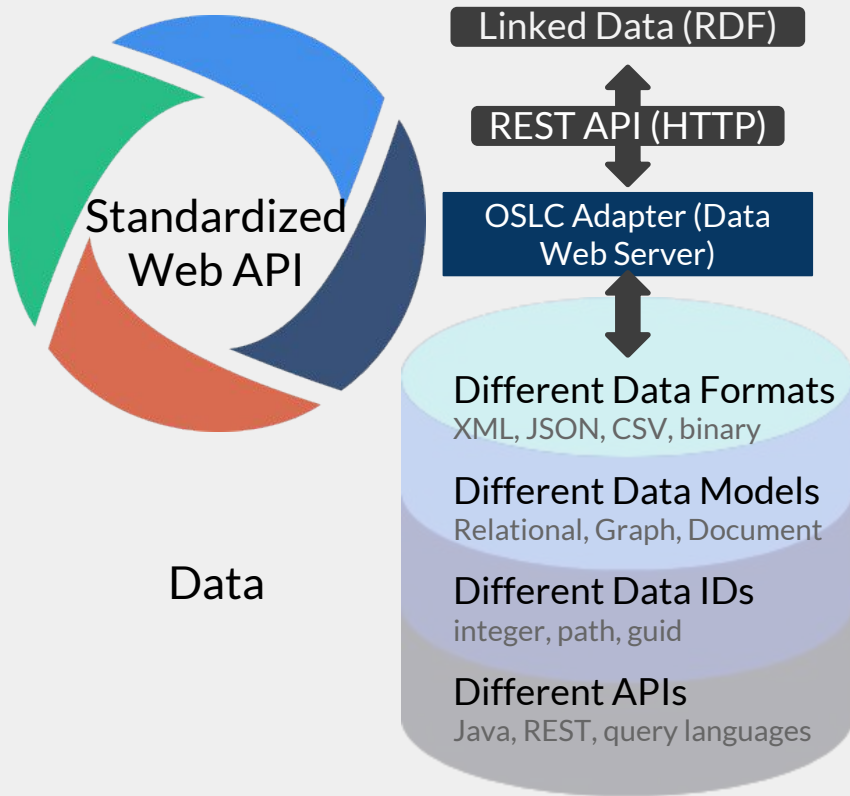
Open Services for Lifecycle Collaboration (OSLC)

Standards for servers hosting data (Hypermedia REST API + Linked Data REST API)

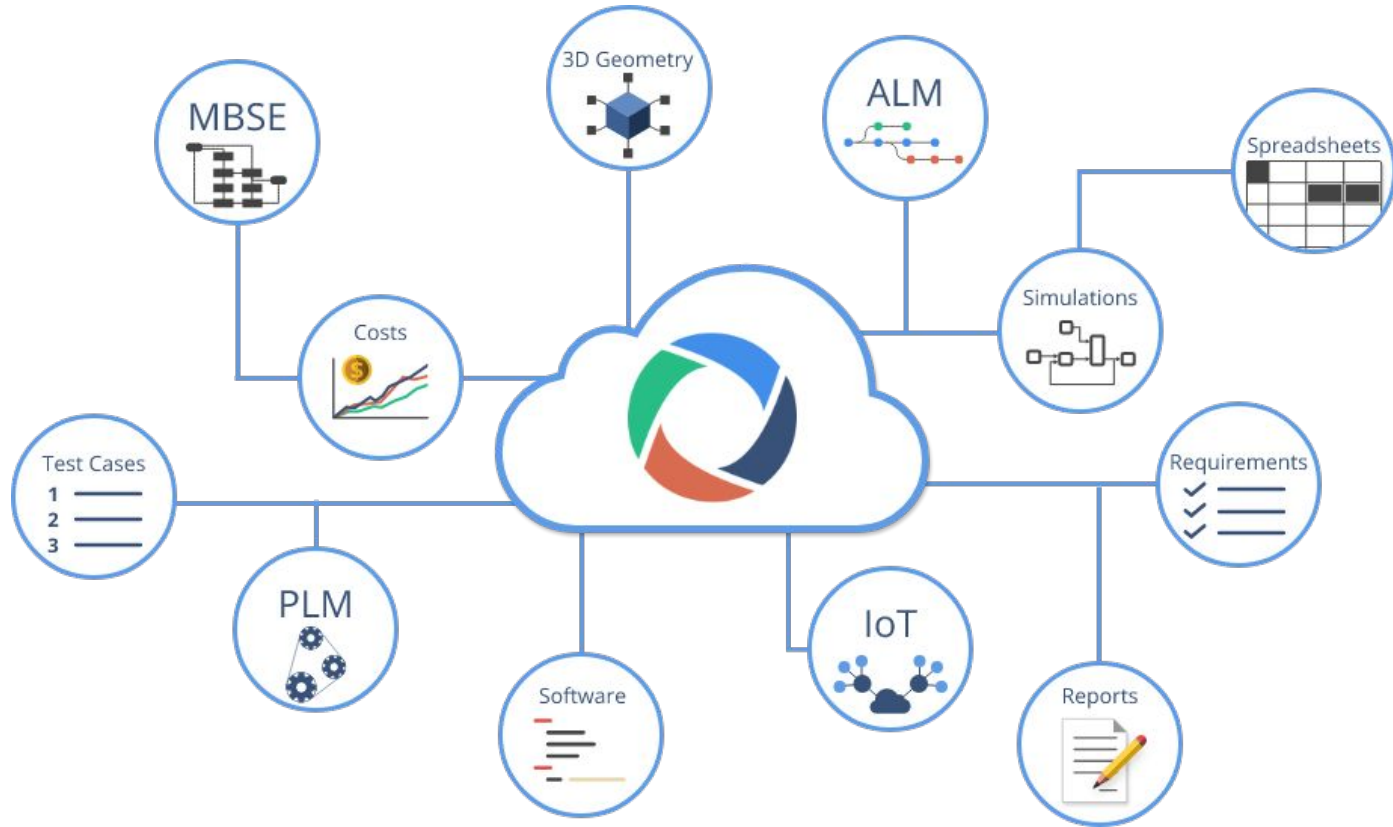
Standards for web-based data interoperability

Adopted so far mainly for Application Lifecycle Management (ALM), systems and requirements engineering

Open Community



OSLC to achieve the Digital Thread



We need you to help promote OSLC!

New OSLC Web site: <http://oslc.co/>

Adding your company logo to the list of supporters on the web site helps the OSLC community grow

If end user organizations show support for OSLC, then vendors, consultants, and developers will offer more support for OSLC

Open Services for Lifecycle Collaboration

Creating standard REST APIs to connect data

The background of the slide is a dark blue color. It is decorated with a network of small, light blue dots connected by thin, light blue lines. These lines and dots form various geometric shapes, including triangles and polygons, scattered across the entire slide. The text is centered in the middle of the slide.

Thanks and get in touch!

axel.reichwein@koneksys.com