OSLC-KM

A Knowledge Management specification for OSLC-based resources

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Context

- **Multiple domains**
  - Different types of artifacts
- Need of **intra-operability**
  - **Intra-domain**
- Need of i**nteroperability**
  - **Inter-domain**

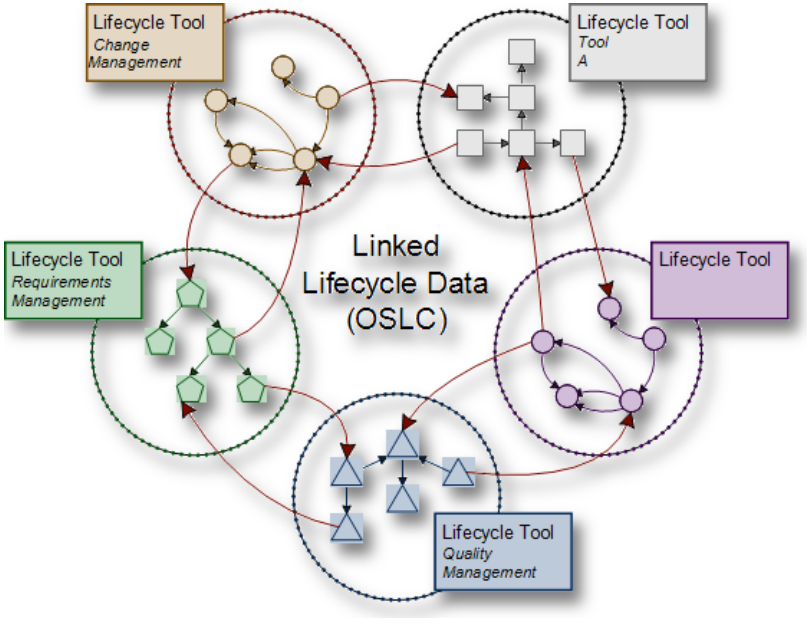
Intra-operability

OSLC

Open Services for Life-cycle Collaboration

Interoperability

Purposed solution by existing OSLC specs.



OSLC resource to

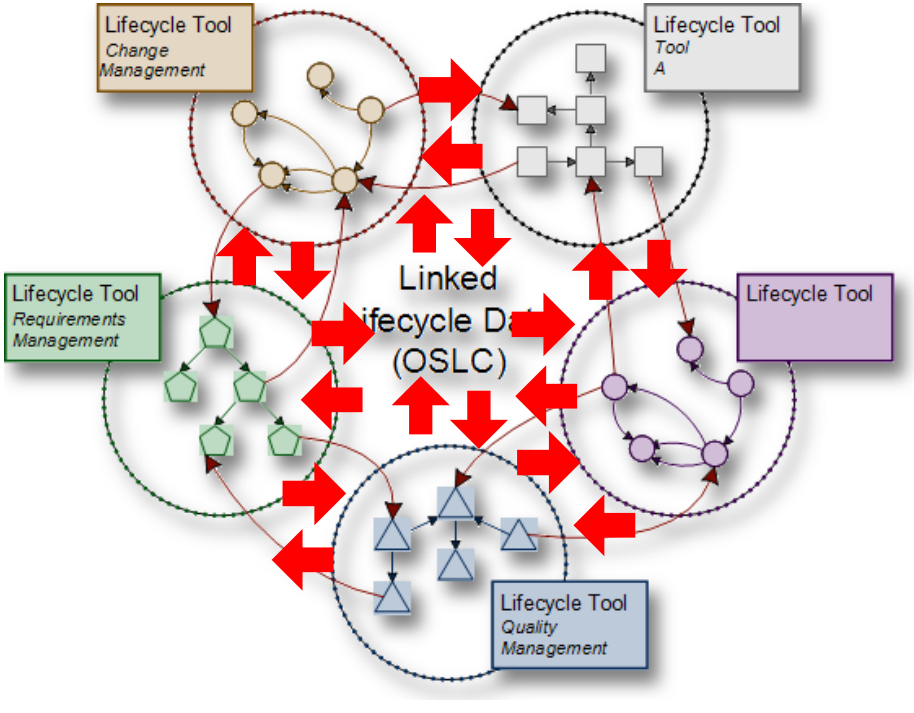
OSLC resource

individual problem solving

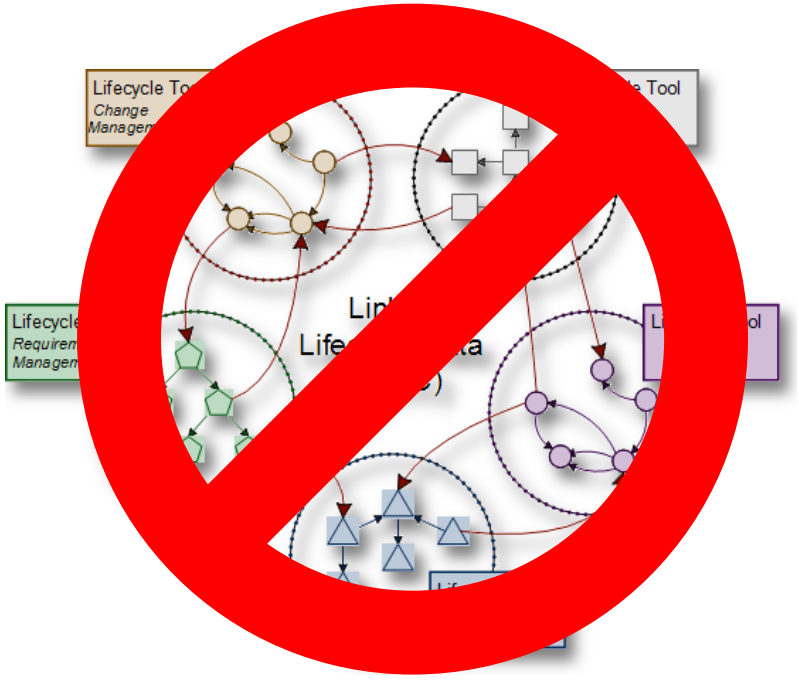
Source: http://open-services.net/

Real Situation

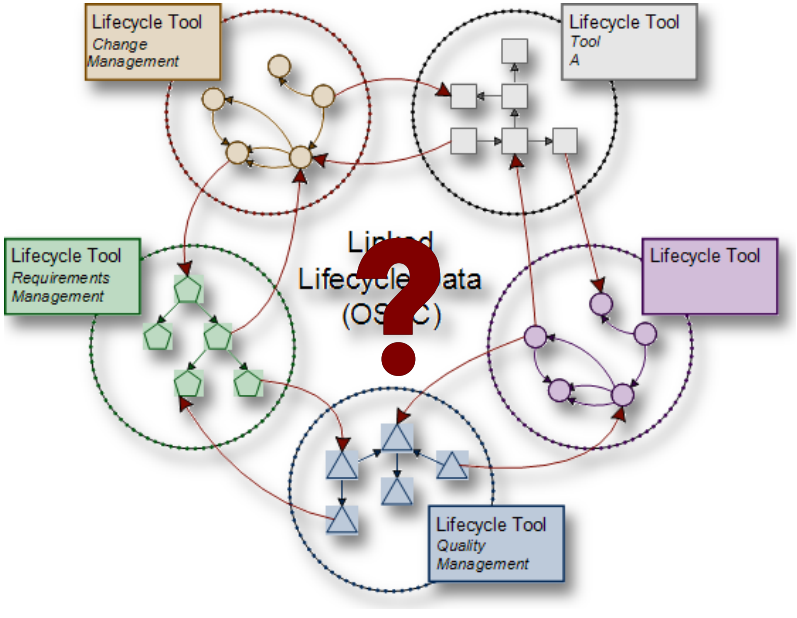
Point to point connections-> Combinatorial explosi
on



A barrier for the full application of the OSLC view



...so What to do?


Lifecycle Tool
Change Management
Lifecycle Tool
Tool A
Lifecycle Tool
Requirements Management
Linked Lifecycle Data
(OSLC)
Lifecycle Tool
Lifecycle Tool
Quality Management

OSLC

Preliminary Evaluation

- **Great effort on interoperability**
- **Community (industry) effort**
- Different types of artifacts (**resource shapes**)
- **OASIS standards** (Core, Change Management, etc.)
- ...

Challenges (among others)

- Increase of **interoperability complexity** when new domains are defined
- Provision of services to all the resource shapes

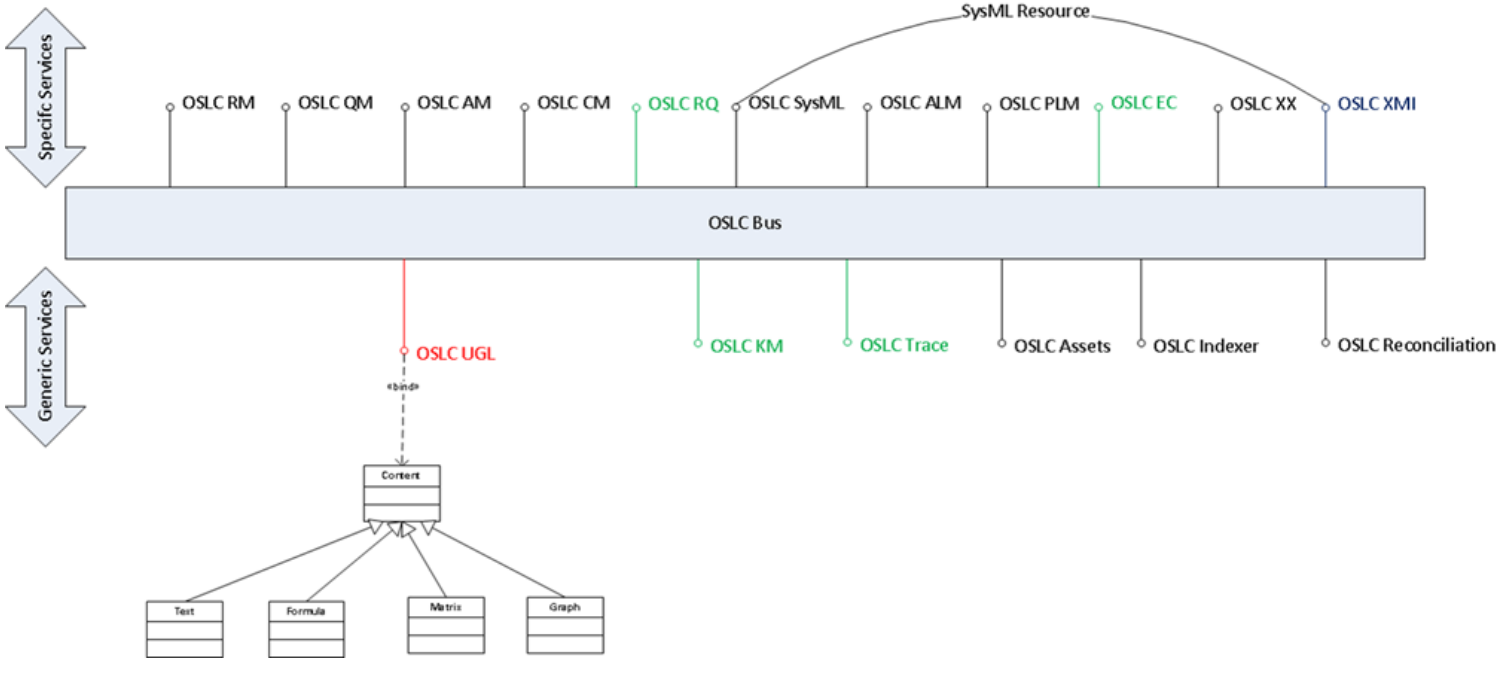
which leads to the need of a

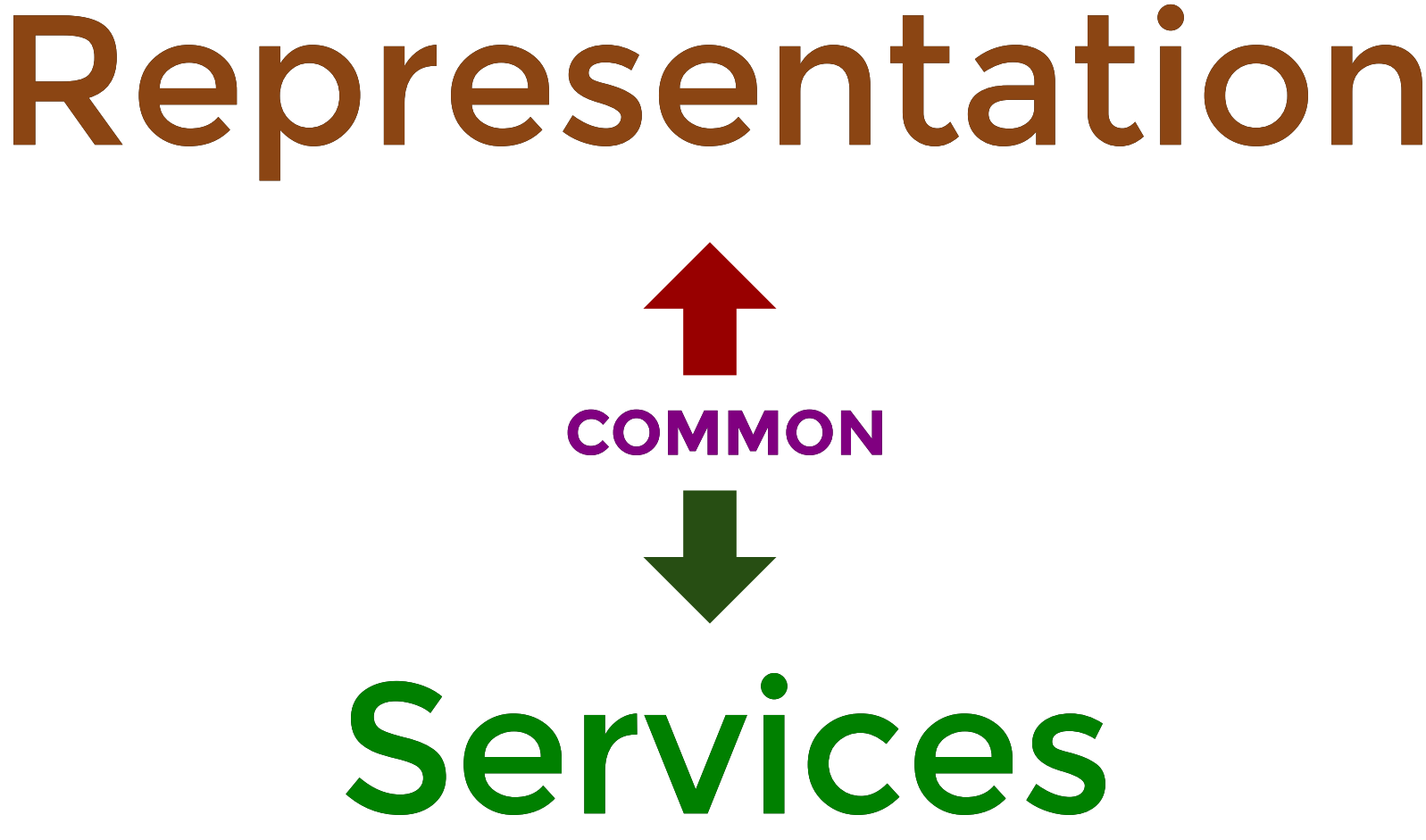
more universal approach

KCSE

Knowledge-centric
Systems Engineering

KCSE: notion of an OSLC bus




Representation
COMMON
Services

Representation

How many different **types** of **artifacts** are generated during the **development life-cycle**?

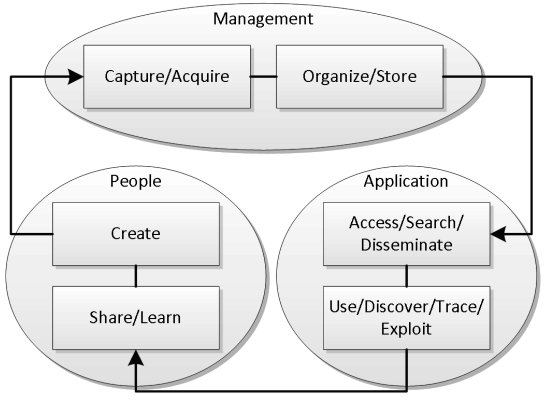
tools, formats, protocols, **query languages**, etc.

Needs and Challenges

- A **common representation model**
- **Interoperability**
- ...

Services

- Language Uniformity
- Quality checking
- Visualization
- Traceability
- Human machine interface
- …



Needs and Challenges

- A **common representation model**
- **Interoperability**
- **Knowledge Management** processes
- **Natural language** to express queries
- ...

OSLC-KM

New domain

New resource shape

RDF

Resource Description Framework

- **Common & shared Data model**
- **Triples**
  - (subject, object, predicate)
- **Binary relationships**
- Underlying **Directed Graph**
- **W3C Recommendation** (2004)
- **Query languages**

RDFS

RDF Schema

- **Data modeling** for RDF data
- **Classes**
- **Properties** (domain & ranges)
- **RDF serialization**
- **W3C Recommendation** (2004)

OWL

Ontology Web Language

- Vocabulary for defining **formal ontologies**
- **Logic-oriented**
- **RDF serialization**
- Flavours (2.0): EL, QL, RL
- **W3C Recommendation** (2012, v2.0)

RIF

Rule Interchange Format

- **Exchange of business rules**
- **Rule-oriented**
- Flavours: Core, PRD, BLD, etc.
- **XML serialization**
- **W3C Recommendation** (2013, v2.0)

RSHP

Relationship *"arship"*

- **Property Graph**
- Any kind of **relationship**
  - Arity and Cardinality
- **Industry-oriented**
- **Native tool support**
- Queries based on **natural language**
- First publication 2004

Others

- SBVR
  - Semantics of Business Vocabulary and Rules
- ODM
  - Ontology Definition Metamodel
- RAS
  - Reusable Asset Specification

Preliminary **Evaluation**

- **RDF** good option for **exchange data on the web**
  - Restrictions: arity and cardinality of relationships, lack of native tools, logics, etc.
- **RDFS and OWL**
  - Oriented to define formal ontologies
- **RSHP**
  - High level of Expressivity
  - Native tool support
  - ...

A comparison among the main approaches for knowledge representation using an underlying semantic network.

Feature	RDF	RDFS	OWL	RIF Core	RSHP
Full Name	Resource Description Framework	Resource Description Framework Scheme	Ontology Web Language	Rule Interchange Format	Relationship
First Version	1.0 (February 2004)	1.0 (February 2004)	1.0 (February 2004)	First edition (December 2012)	v1 (January 2004)
Last version	1.1 (February 2014)	1.1 (February 2014)	2.0 (December 2012)	Second edition (February 2013)	v14 (January 2015)
Designed for	Representation of logical statements	Data modeling vocabulary for RDF data	Formal ontology design	Definition of Horn rules	Representation of relationships between knowledge items
Target use	Data exchange of facts, rules and ontologies	Data model	Ontology creation	Rule interchange	Universal knowledge representation and re-use
Data model	Directed graph	Directed graph	Directed graph	Object Model	Undirected (property) graph
Underlying semantics	RDF formal semantics	RDFS Semantics	OWL 2. Direct Semantics and RDF-based Semantics	RIF Core Semantics	Explicit metamodel
Expressivity	Simple RDF triples (**s, p, o**) to represent binary relationthips.	Classes (sub and super classes) and Properties (domain and ranges)	OWL 1.1: • DL (Description Logic), • Lite, • Full OWL 2.0: • EL (Expressions Language) • QL (Query Language) • RL (Rule Language)	• RIF-Core (Core Dialect) • RIF-BLD (Basic Logic Dialect) • RIF-PRD (Production Rule Dialect) • RIF-FLD (Framework for Logic Dialects) • RIF-OWL 2 RL and RIF RDF • RIF XML	Any kind of relationship (**SVP**). • N-ary relationships. • Non logic formalism. • Knowledge containers. (reification)
Validation	RDF Data Shapes: • OSLC Resource Shapes, SHACL (Shapes Constraint Language) • SheX (Shape Expressions) • SPIN (SPARQL Inferencing Notation) and SPARQL Rules	Semantic reasoning + see RDF	Semantic reasoning + see RDF	Metamodel conformity	Metamodel conformity
Inference	Not at graph level.	Yes but restricted to type inference and super/sub	Yes depending on the underlying logic	Yes	Not at graph level.

		classes and properties	formalism: First Order Logic, F-Logic, DL, etc.		
Identifiers	URIs (HTTP URIs if Linked Data). Unique Name Assumption (UNA).	See RDF	See RDF	Internal IDs and UNA.	Internal IDs and UNA.
Access protocol	HTTP-based (REST resources)	See RDF	See RDF	See RDF and native APIs	Native API
Query language	SPARQL and RDQL	See RDF	SWRL	XPATH (if XML is used as serialization format)	RSHP query language
Storage	RDF repository (native RDF repositories, graph-based databases, and wrappers on top of existing relational databases)	See RDF	See RDF	Native API	SQL or NonSQL database
Formats (syntax)	RDF/XML, JSON, Turtle, N3, Manchester	See RDF	See RDF	XML	RDF/XML, ISO 25964-"The international standard for thesauri and interoperability with other vocabularies", etc.
Visualization	RDF visualization libraries such as Allegro graph or RDFgravity and other general-purpose graph visualization frameworks Graphviz, Touchgraph, Gephi, Cytoscape, D3.js.	See RDF	See RDF	Native Rule IDEs	RSHP visualization language and the aforementioned general-purpose graph visualization frameworks.
Application	Integration of databases, applications and services through a common and shared data model.	See RDF	See RDF	Interchange of business rules and connection with existing ontologies	Semantics-based information retrieval using a natural language interface to support other services such as traceability or quality.
Status	W3C recommendation	W3C recommendation	W3C recommendation	W3C recommendation	Industry-oriented
Tools	Protégé, SWOOP or Terminae, (ontology editors)	See RDF and RDFS reasoners such as Pellet, Racer or Jess	See RDFS	JRules, Drools or Jess (mainly exporters not importers)	knowledgeMANAGER (a complete suite for knowledge management with RDF import/export capabilities)

http://trc-research.github.io/spec/km/

Our approach

OSLC

(Data Exchange)

RSHP*

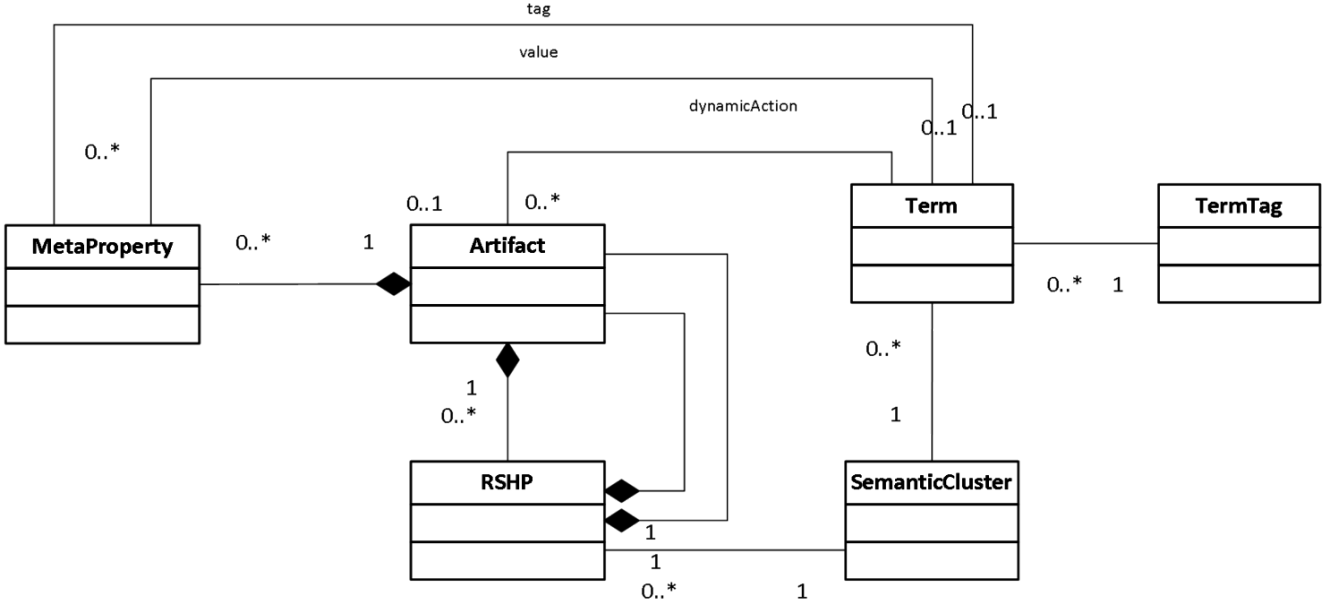
(Internal representation: metadata+contents and services)

The Specification

Shape for KM resources

Metadata+Contents

Resource Shape



Based on the W3C SKOS Recommendation

Simple Knowledge Organization System

Summary of Properties

OSLC Core

Provenance*

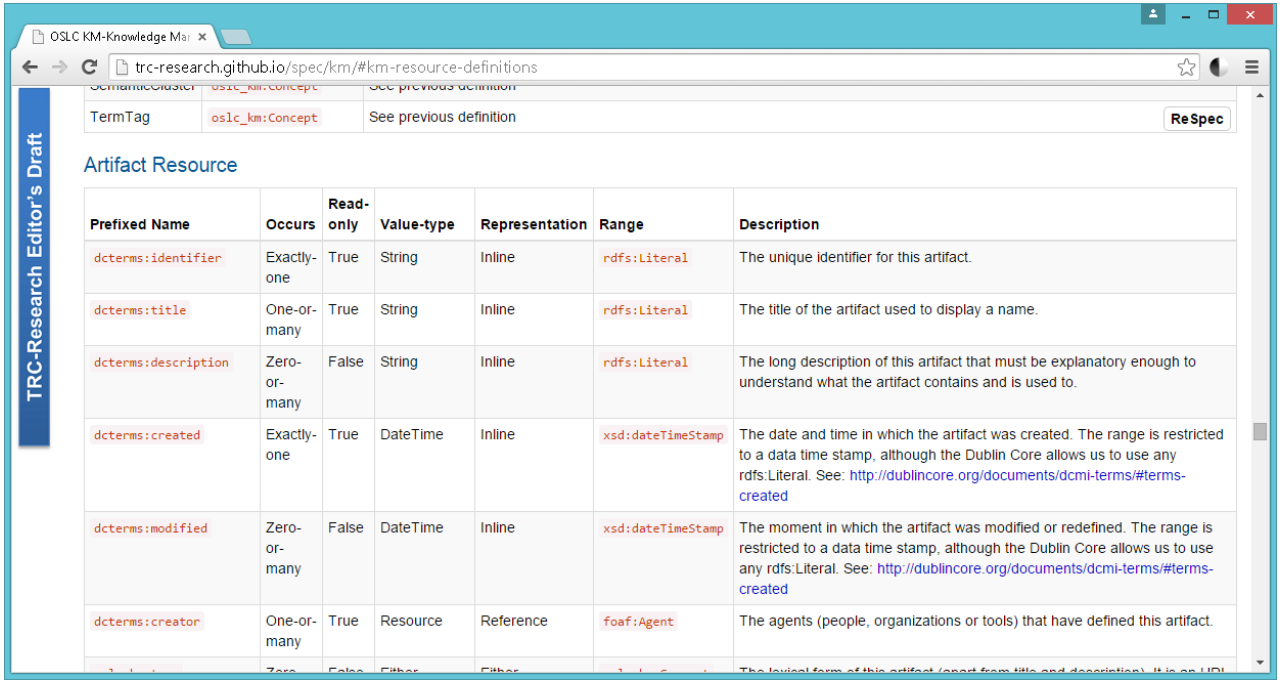
Access (W3C HTTP Access)

Metadata (Dublin Core, traces, etc.)

Contents (resource shape)

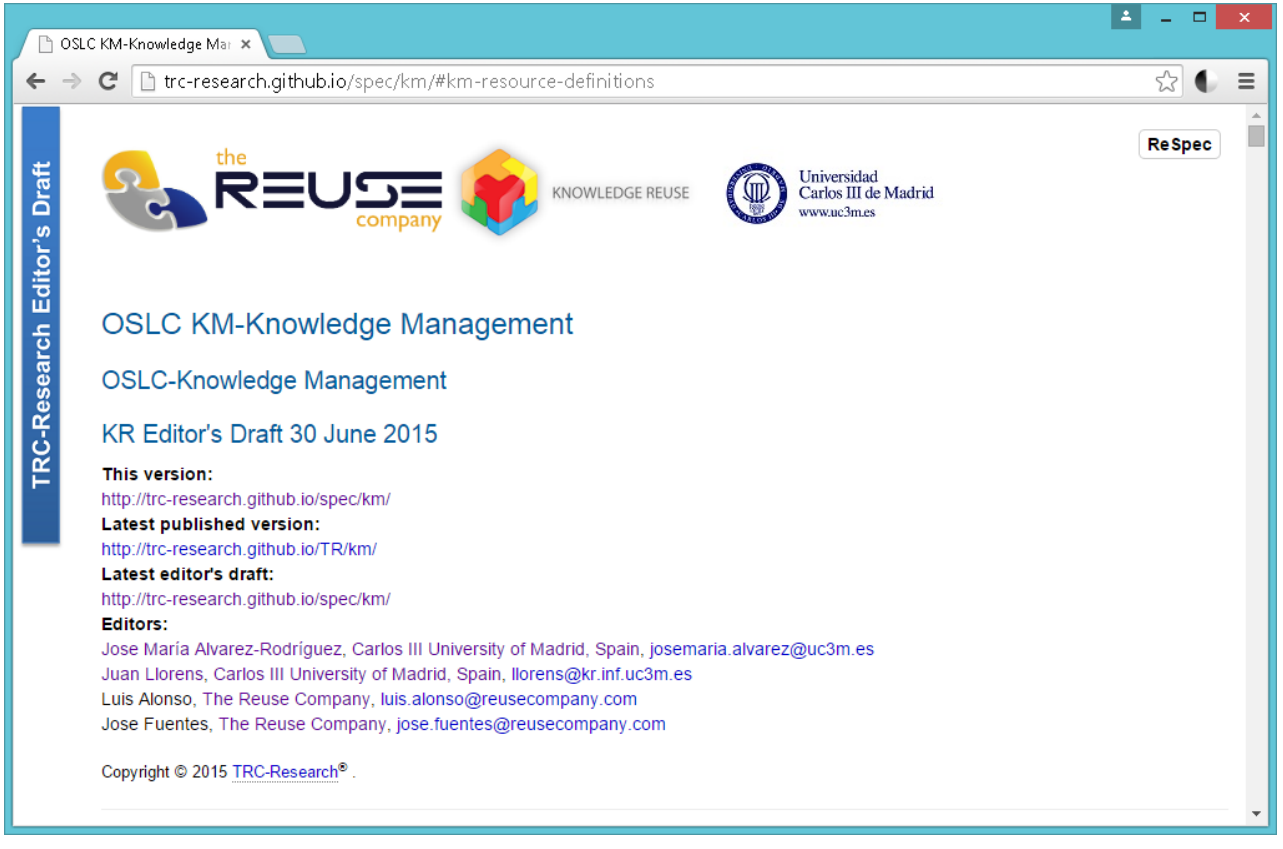
Visualization (SVG)

Properties



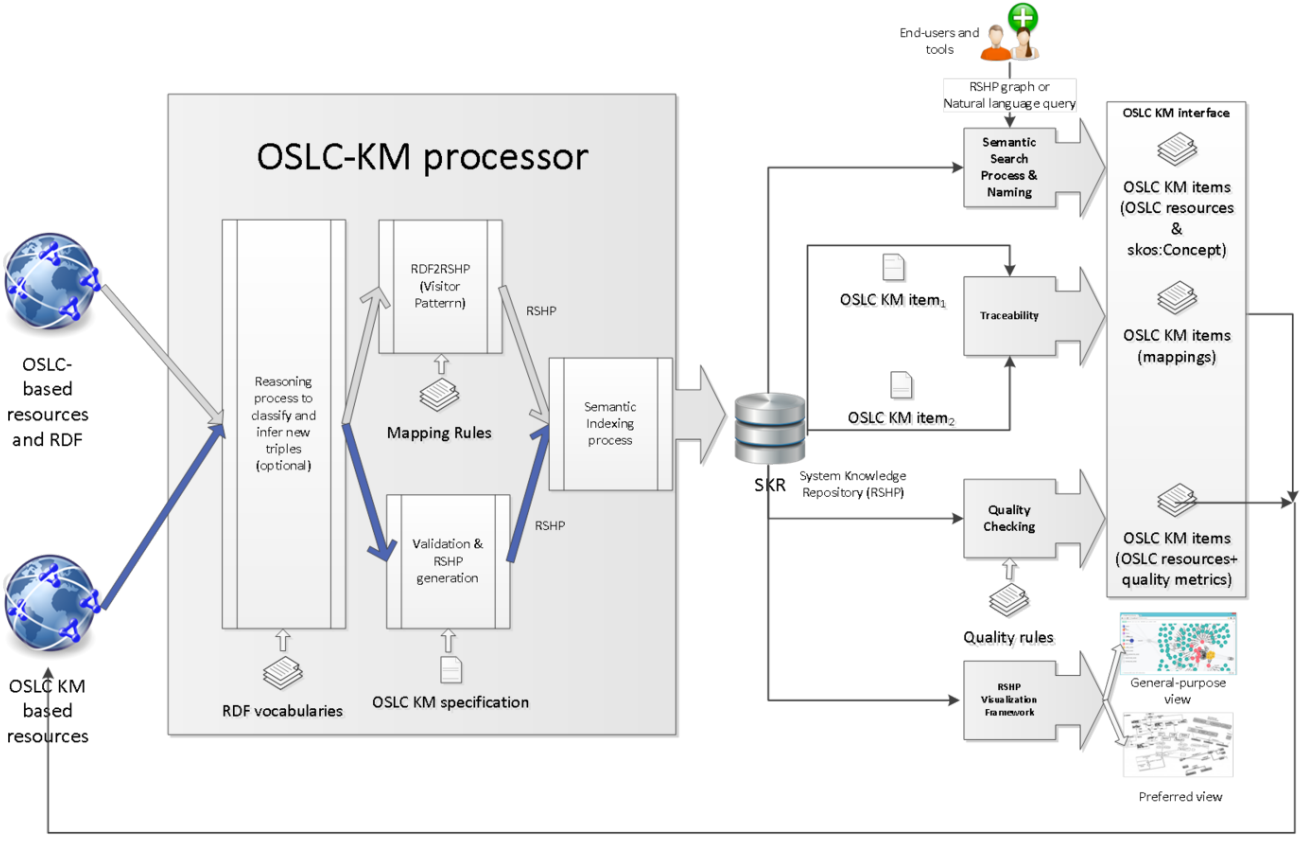
http://trc-research.github.io/spec/km/#km-resource-definitions

All in one...



http://trc-research.github.io/spec/km/

One implementation



...on top of...

Vocabulary

& Conceptual Model

- Normalization
- Standardization
- Suggestions
- X Breakdown Structures
- ...

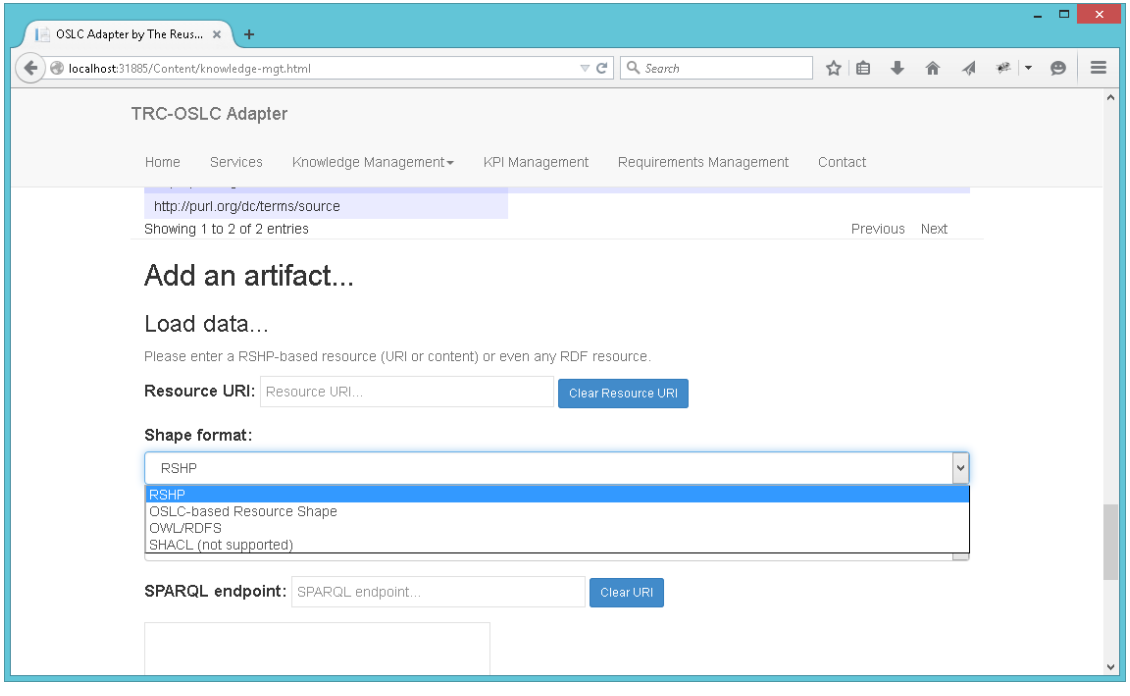
Patterns

- Restrictions
- Examples
- Suggestions

Knowledge Manager by

The REUSE Company

On-going work...



Process any kind of **OSLC Resource** or **RDF data**...

E.g. **Modelica**

Summary

- Use of the **W3C Recommendations**
- **Concepts and relationships** are the entities to be exchanged
- **Services** for: search, trace, naming, visualize, etc.

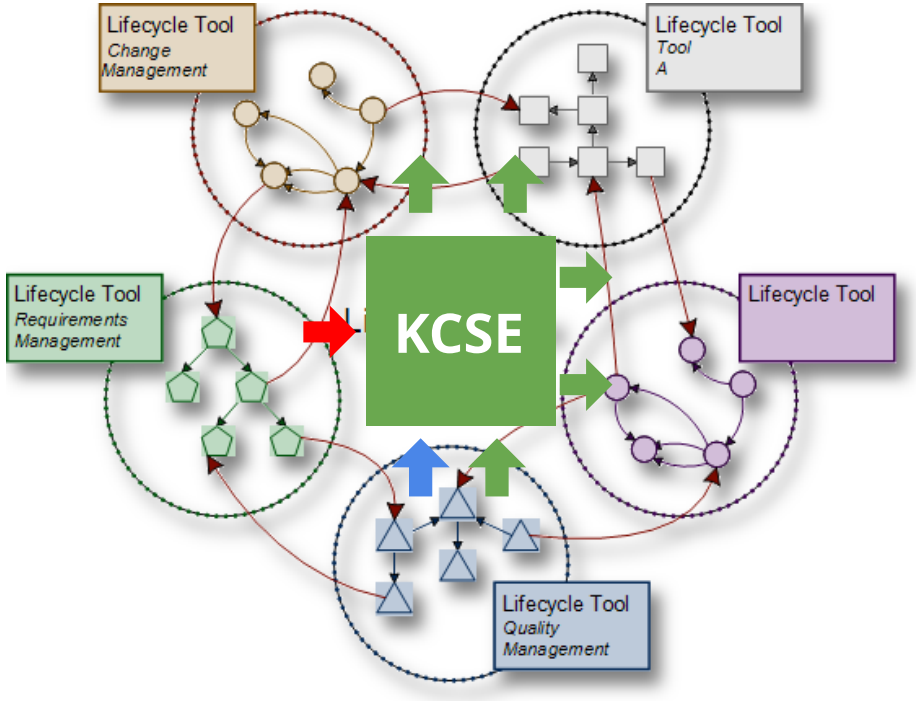
Metadata+Contents

Artifact

OSLC KM

Knowledge Centric Systems Engineering to gov
ern the development lifecyle

Inputs



Representation

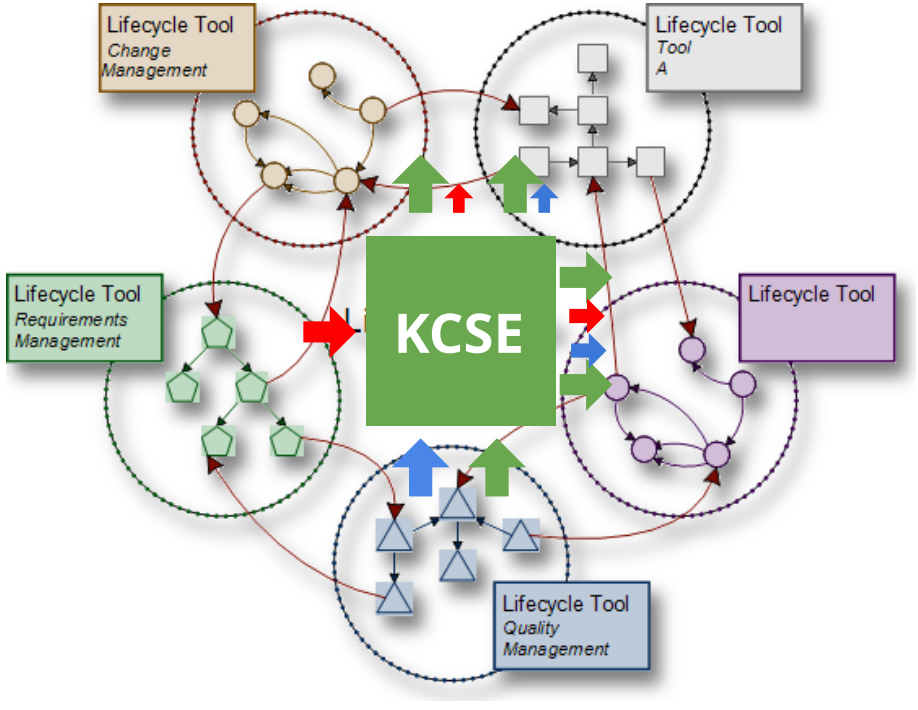
Outputs

Common services

OSLC KM

Not a dream!

Inputs



Representation

Outputs

Common services

Advantages

- Standard exchange of data: **OSLC**
- Enhance **expressiveness** (**RSHP**)
- Reuse of **existing standards** and vocabularies
- **Native Tool support** (Knowledge Manager)
- **Cross-cutting services (semantic-based)**
- Elastic approach
- ...

Drawbacks

- **Scope** of knowledge management **(needs)**
- **Potential overlapping** with other tools and specs
- Need of **spread the approach**

Conclusions

- Knowledge Management: **a key process**
  - **REUSE!**
- Need of:
  - Reuse of **standards and service-oriented** functionalities (OSLC)
  - Take the most for **data exchange** (OSLC) and **representation** (RSHP)
  - Bring technology to a **human-oriented environment** (NLP)
- Technical issues
  - **Completeness** of the specification?
  - Implementation

Future work

- **Merge and extend** the spec with other knowledge standards
  - E.g. STEP, Industrial Internet activities
- **Refine** of the resource shape
- **Full implementation** and support to all services
- **Integration patterns** governed by knowledge
- ...

Industrial Linked Data

OSLC applications

- Semantic Impact Analysis
- Risk Analysis
- Continuous Engineering
- ...

Speakers

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    - **Personal site**


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