Driving Collaborative Innovation across System Engineering Modeling Activities

Enabling Innovative Design Reviews

Sodius Research & Development

Creative Engineering
Plan for this Discussion

1. Our Setting: creative collaborative engineering
2. Attempts to improve design processes
   – Devise design processes that embed innovation practices
3. Practices that foster innovation
   – Which functionality allow us to better create
4. Software architecture and standards
   – How can we implement these practices
5. Experiments and feedback
   – What do customer think and other market validation
Creative Collaborative Engineering

- Distributed collaborative setting that involves **multiple companies**
- Use of diverse artifacts whose authoring requires **several tools**
- Regroup **different engineering** practices such as mechanical, software, etc.
- Design process spans **multiple stages** of the product development cycle
Agile approach to collaboration

We ground our creative collaboration process within agile principles by enable the following characteristics:

- **Active user involvement** in review/comment/update process by providing design annotating tools

- **Team empowerment to make decision** by allowing design change request to be issued from any user feedback

- Provide a **lightweight and visual means to capture requirements**

- Frequent and lightweight reviews are **allows small and incremental design improvements**

- **Testing is integrated** throughout the project lifecycle

- The general approach **foster a collaborative & cooperative approach** between all stakeholders
The basic form of collaborative engineering

- Collaborative design process are essential to support the development of modern products
- Processes are laid out across multiple companies and require to manage artifacts stemming from different tools and format
- Stakeholder interactions have to be coordinated into a business process in order leverage the interaction semantics between participants
Design artifacts federation

- Artifact from different tools are gathered across stakeholders
Coordinated stakeholder interaction

• Coordinated processes with identified stakeholders are ideal to assign semantics to exchange information.
• In the following example, the participants are reviewing a design document (engineering model, requirement document, etc.)
• Each user is sharing designs that were authored with different tools
Practices that foster innovation

- Web-based Semantic-rich feedback
- Sharing and rating new ideas
- Copy, transform, combine, promote
- Increase the number of explorations
- Design maturity and other metrics
- Feedback storage and retrieval
Provide feedback with semantics

• Imagine that your colleague sends an engineering diagram to you, what about being able to
  – Create graphical annotation, highlights parts of the diagram, etc.
  – Create links with other diagrams, other artifacts stored in local or remote repositories
  – Create a discussion thread and debate with a selected set of co-workers

• Feedback types are differentiated using a semantic-rich framework such that they can trigger subsequent manual or automated operations
Sharing and rating new ideas

• Product discussions and stakeholder feedback are clearly a great source of inspiration
• An “idea” is a particular type feedback semantic and is related to operations that users can leverage to foster to engineering innovation process
• When shared about stakeholders, ideas can be rated, voted for a starter
Copy, transform, combine, promote

• To be creative it is important to learn from others, the concept of “everything is a remix” is a great illustration
• Innovation, in particular in engineering, is spurred by copying, transforming and combining existing elements into new products
• A complete engineering innovation framework provide tools to process, work and analysis feedback (e.g. ideas) and promote them
• Feedback promotion into products, services, features allow traceability
Feedback storage and retrieval

- In addition to traditional approaches to manage engineering artifacts, the systematic management of feedback is clearly beneficial.
- The systematic management of engineering and design knowledge is key to preserve or improve competitiveness in fast evolving markets.
Design maturity and other metrics

- Benefits stemming from a semantic-based, systematic management of feedback information is multiple, for example
  - The ability to measure activities around artifacts, productivity
  - retrieve, compare, re-work previously discussed ideas, feedback, etc.
  - assess the amount of feedback that impact products through “promotion” traceability
Increase the number of explorations

- The more design we can explore the more likely we are to get a good solution to solving a problem
- The gathering of semantic-rich feedback should clearly be leveraged into a parametric, semi or fully automated approach to increase design exploration
Software architecture and standards

- Web-standards are an efficient means to trace, store and retrieve stakeholder interactions
  - Standards are designed for scalability
  - Server-client based infrastructure
  - Allows for fast processing, etc.
- In particular, W3C’s Semantic Web Activity project is ideal to assign meaning to business operations in collaborative web-based setting
Resource description framework

• Low-level resources description mechanism

• The Resource Description Framework (RDF) is a core framework to define data graphs (or graph databases)

• RDF triple - breaking of the statement into its three constituent parts: the subject, predicate, and object of the statement.
We show here a set of RDF statements that describe data gathered through the review process of a set of artifacts.

RDF
< dctersms:type>Capability</dctersms:type>

System Architect semantics

Capability is define by OSLC architecture
Management
- what properties are mandatory, optional

OSLC
< oslc:discussedBy rdf:resource="https://showcase:8443/semio/clm/services/..."/>

OSLC
< oslc:instanceShape rdf:resource="https://showcase:8443/semio/clm/..."/>
W3C Linked Data

- **Web of data** is constructed with documents on the web (like web of hypertext)
- Unlike the web of hypertext, where links are relationships anchors in hypertext documents written in HTML, for data they links between arbitrary things described by RDF,

**Four rules**

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 the standards (RDF*, SPARQL)
4. Include links to other URIs so that they can discover more things.
Open Services for Lifecycle Collaboration

• Open community creating specifications for integrating tools
• OSLC allows conforming independent software and product lifecycle tools to integrate their data and workflows in support of end-to-end lifecycle processes
  – defect tracking tools, requirements management tools and test management tools
• OSLC is based on the W3C Linked Data
Artifacts access and domains in OSLC

• In OSLC, artifact (e.g. requirement, defect, test case, source file, or development plan and so on) is an HTTP resource that is manipulated using the standard methods of the HTTP specification (GET, PUT, POST, DELETE).

• Each resource has an RDF representation – OSLC mandates RDF/XML, which is the most widely adopted RDF notation - but can have representations in other formats, like JSON or HTML.

• The OSLC Core specification defines a number of simple usage patterns of HTTP and RDF and a small number of resource types that help tools integrate and make the lifecycle work.

• The OSLC domain workgroups specify additional resource types specific to their lifecycle domain, but do not add new protocol.
Putting it together – Creative review

- When reviewing an artifact, participants are eager to provide feedback, but might also be interested to suggesting ideas for future products.
- An interested metric is to measure the creativeness of the review process by assessing how reviews indeed contribute to corporate innovation.
- Reviewer feedback is transformed into ideas, which are combined further and iterated on across different review processes. Eventually the best ideas are turned into features or new product.
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