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Architectural guidance and governance in industrial software ecosystems

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DISTRIBUTED SYSTEMS AND OPERATING SYSTEMS

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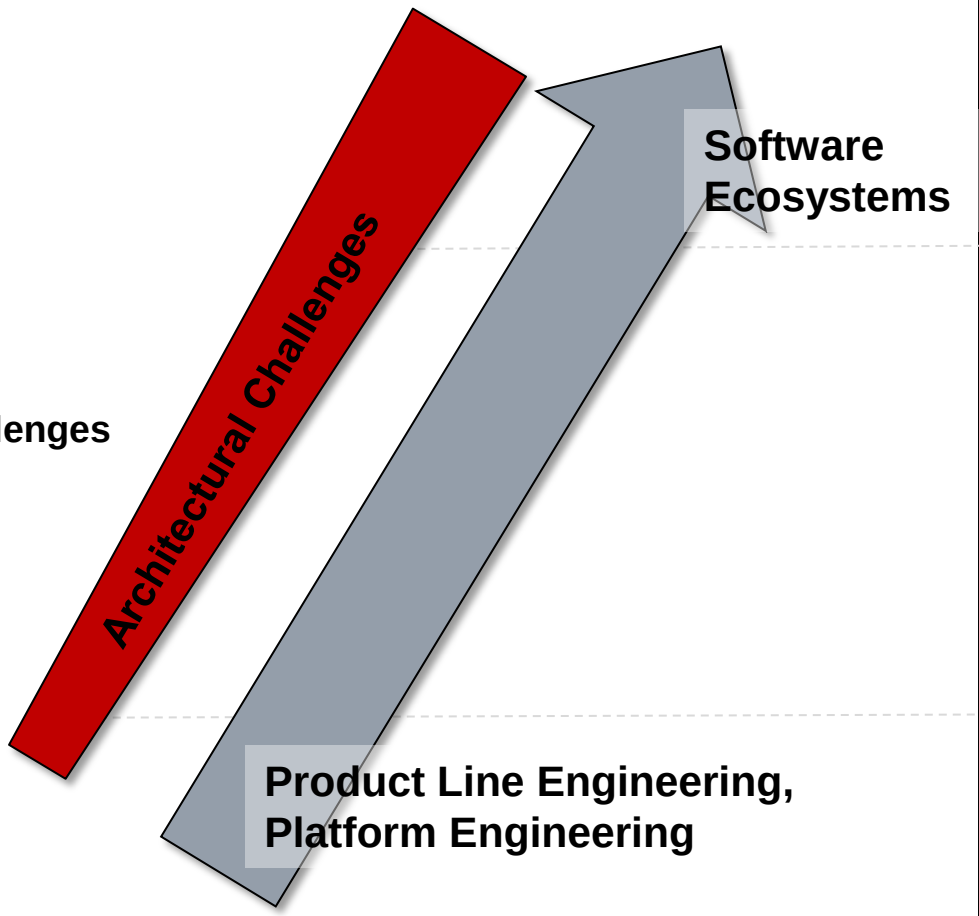
Motivation

Observed Trend:
Moving towards software ecosystems

- **expand technological base**
  outside the organizational boundaries
- involve **external business units**
- **initially not designed** as software ecosystem
- **architecture**, collaboration and business **challenges**
- **software architecture** as central pillar



Architectural guidance and governance to counter architectural challenges

- **elicit** SECO specific **requirements**
- **determine** appropriate **tools and methods**

Architectural guidance and governance for minimizing architectural erosion to keep a healthy and flexible software ecosystem.

Industrial software ecosystems

A **software ecosystem** consists of

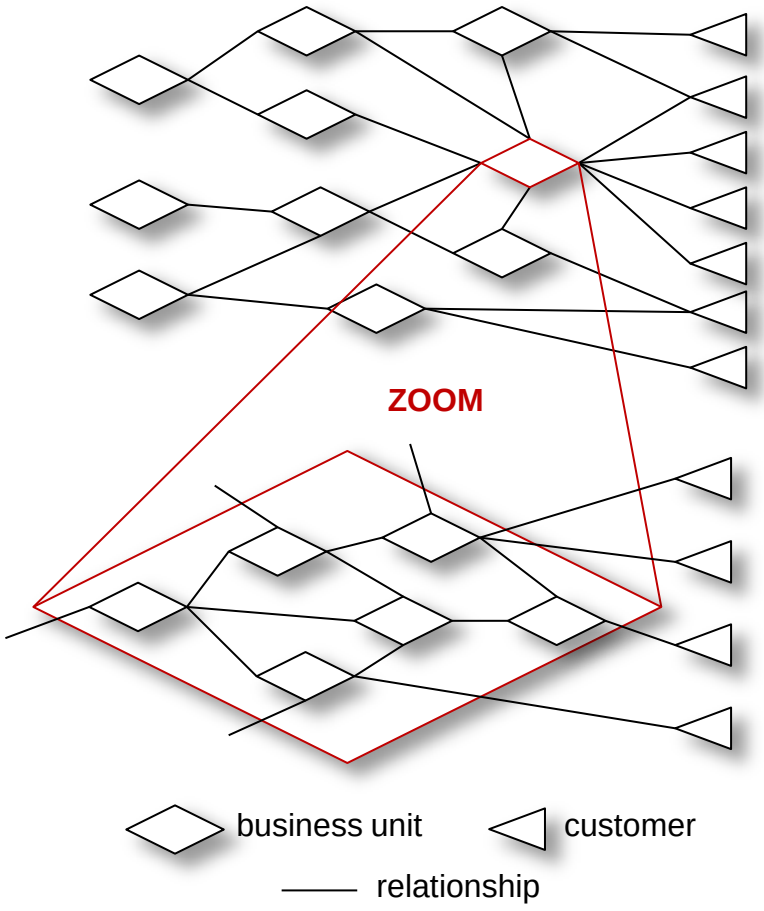
- a set of **co-acting business units**, together with the **relationships** among them
- a **shared market** for software and services
- a **common technological base** comprising a reference architecture, core assets and/or standards

and operates through the exchange of

- information, resources and artifacts. (adapted from [1])

An **industrial software ecosystem** focuses on

- a key company maintaining ultra-large software projects involving mainly **internal business units**
- where the **organizational structure** moves
- from hierarchies towards **decentralized topologies**.



Industrial Software Ecosystems (ISECO)
focus on the interdependency of multiple interacting internal business units.

Elicit guidance and governance requirements (1/3)
Model industrial software ecosystems

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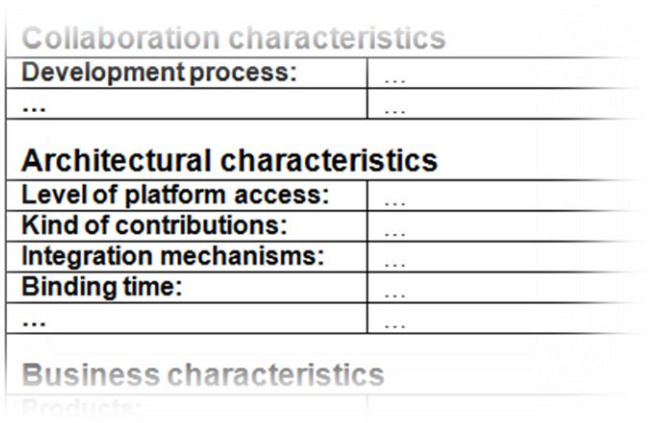
Model an industrial software ecosystem including

- the participating **business units**,
- the **relationships** among them
- and their technical **characteristics** which are crucial for
  - identifying and refining emerging architectural challenges
  - and for determining architectural guidance and governance approaches to address those challenges.



Collaboration characteristics	
Development process:	...
...	...
Architectural characteristics	
Level of platform access:	...
Kind of contributions:	...
Integration mechanisms:	...
Binding time:	...
...	...
Business characteristics	

Case Studies:

We are **modeling two industrial software ecosystems** from the industry and healthcare sectors at Siemens based on

- interviews with involved, well experienced software architects
- and literature and document reviews.

General observations:

- often comprise only a **relative small number** of business units
- often posses a **relative equable distribution** of influence, power and control between some internal business units

Model industrial software ecosystems as enabler to identify and refine architectural challenges and to determine counteractive approaches.

Elicit guidance and governance requirements (2/3) Identify, refine and prioritize architectural challenges

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Birds' eye-view on the observed architectural challenges

- **Evolution**
  - use of interface as intended
  - compliance to interface access rules
  - facilitate commodifications
  - ensure coevolution between platform and applications
- **Interface stability**
  - enable predictable and transparent interface evolution
  - provide significant time to developers to adjust their app.
  - ensure backward compatibility where negotiated
- **Further challenges**

  architecture openness, common quality models, cooperative development models, scoping/variability mgmt., …

Case Studies:

We are **identifying**, **refining** and **prioritizing** abstract challenges based on the two modeled industrial software ecosystems at Siemens in order to **counter them**.

General observations:

- identified architectural challenges are often **similar** to well known software ecosystem specific challenges
- **evolution** and **interface stability** as key challenges
- equable distribution of power demands **consensus rather than normative approaches** to address challenges

Identify, refine and prioritize abstract architectural challenges based on the modeled industrial software ecosystems.

Elicit guidance and governance requirements (3/3)
Answer architectural guidance and governance key questions

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Architectural guidance and governance comprises

- **guidelines** that reflect the reference architecture, design decisions and their rationales,
- a **communication channel** to spread guidelines to developers and
- tools and methods that **instruct** developers **to compliance** to the extent possible.

What should be guided and governed?	How to access guidelines?	How to guide and govern developers?

Goal: counter **architectural challenges**
▪ determine **best practices**
▪ consider **different developers**
▪ **reflect** the architects' **intensions** and critical usage restrictions
▪ determine **reusable guidelines**
	▪ **spread guidelines** in a
	  ▪ easy accessible, unique, consistent and ubiquitous
	  ▪ but non-intrusive manner that integrated smoothly in the development environments
	▪ **tailor guidelines** developer- and context-specific
		▪ **Preventive guidance** provides guidelines to developers
		▪ **Preventive governance** provides automated developer-support without checking for compliance
		▪ **Quality gates** check and inform developers about the degree of compliance with guidelines

Answer architectural guidance and governance key questions to counter architectural challenges – arising in an industrial software ecosystem context.

A method for determining appropriate guidance and governance tools and methods

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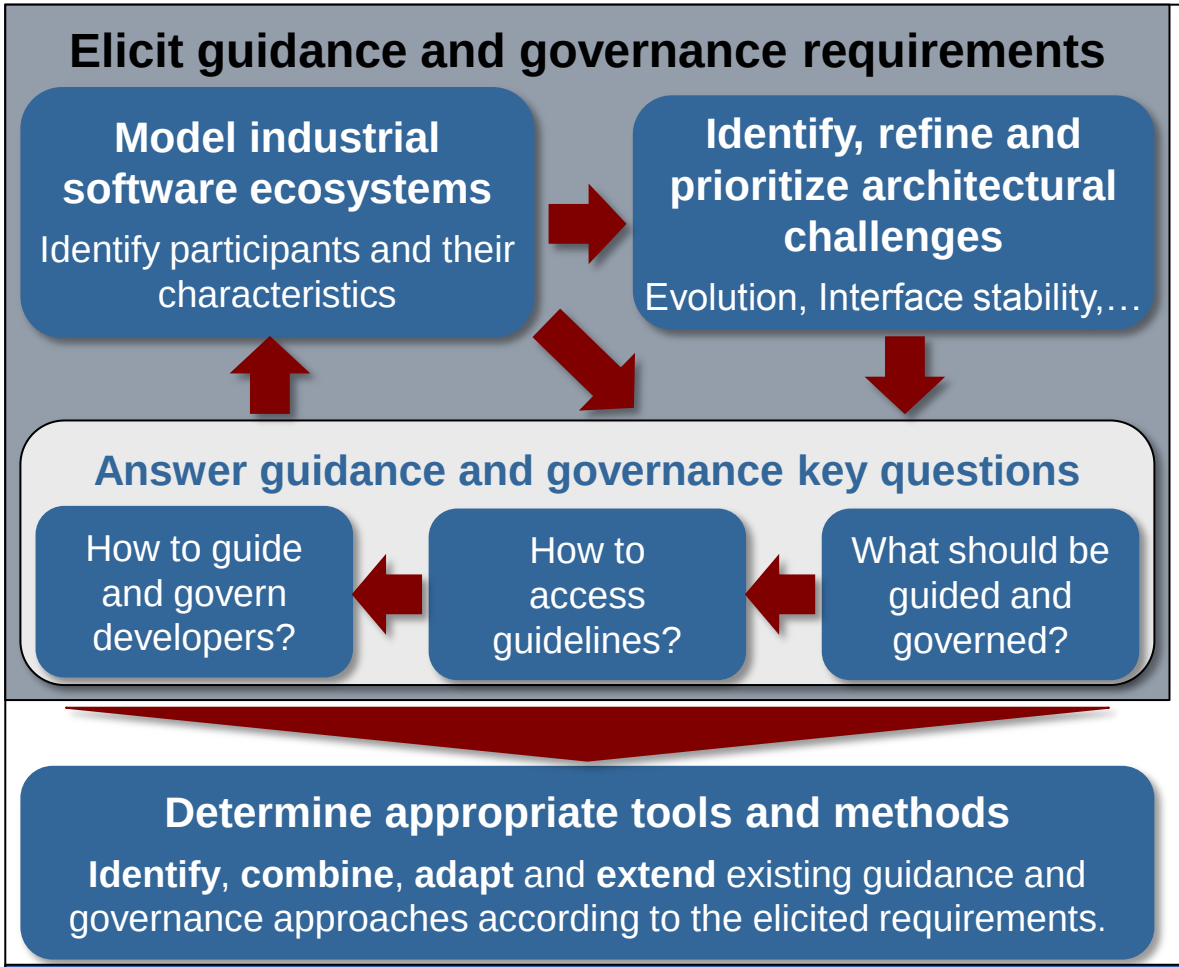

- **Handle general issues** like mindset, transparency of ROI, pragmatism, knowledge within a single person
- **Iteratively elicit and refine requirements** on guidance and governance approaches to counter architectural challenges.
- **Identify, combine, adapt and extend existing approaches** to counter **high prioritized** pain points according to the elicited requirements.
- **Case studies:** We are applying the method on two industrial software ecosystems at Siemens with the input of involved, well experienced software architects.

Currently we are *eliciting requirements* with the goal to provide an ISECO-Metamodel and a method to determine customized consensus-based G&G approaches in an ISECO

Discussion

Do ISECOs and their observed characteristics appear in other organizations?
(e.g. at SAP, Phillips or in further ultra-large organizations)

Are our planned contributions relevant?
(Metamodel for ISECOs, a method to provide customized G&G approaches in ISECO, consensus-based G&G)

Does a validation with two to three ISECOs at Siemens delivers satisfying and transferable results?

References

[1] S. Jansen, A. Finkelstein, and S. Brinkkemper, “A sense of community: A research agenda for software ecosystems,” in Proceedings of the 31st International Conference on Software Engineering – Companion Volume, 2009, pp. 187–190.

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[3] J. Bosch, “From Software Product Lines to Software Ecosystems,” in Proceedings of the13th International Software Product Line Conference, 2009, pp. 111–119.

[4] R. Pereira, C. Maria, and L. Werner, “A Proposal for Software Ecosystems Engineering,” in Proceedings of the Workshop on Software Ecosystems, 2011, pp. 40–51.

[5] O. Barbosa and C. Alves, “A Systematic Mapping Study on Software Ecosystems,” in Proceedings of the Workshop on Software Ecosystems, 2011, pp. 15–26.

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Thank you for your attention!

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