

# Software Architecture Theory and Practice: Status and Challenges



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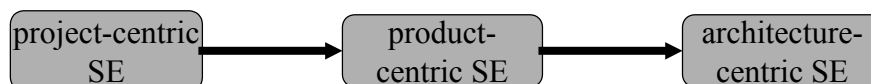
## Software Architecture

- software architecture

*Architecture is the fundamental organization of a system embodied in its components, their relationships to each other and to the environment and the principles guiding its design and evolution.*

[IEEE Standard P1471]

- Definition contains two main parts:
  - structural part – components and connectors
  - principles part – principles, design rules, design constraints, etc.



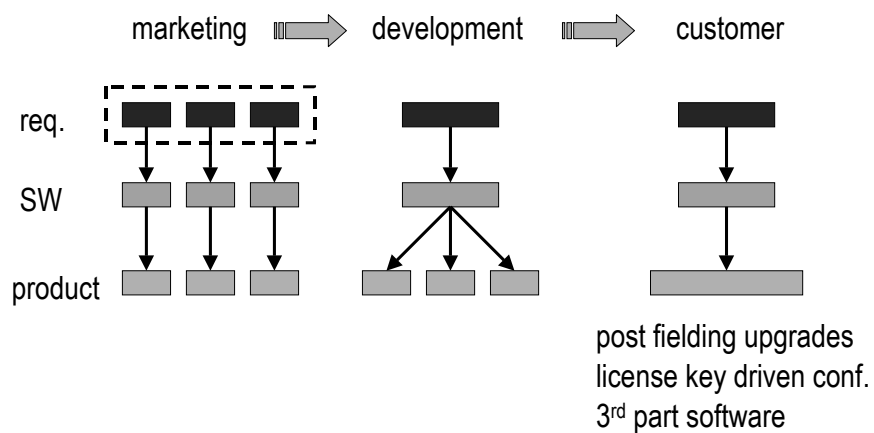
# Architecture-centric SE

software engineering community has evolved through

- project-centric SE
- product-centric SE
- architecture-centric SE

*software architecture is core to modern software development and evolution*

# Software Variability Management



## Architecture-centric SE

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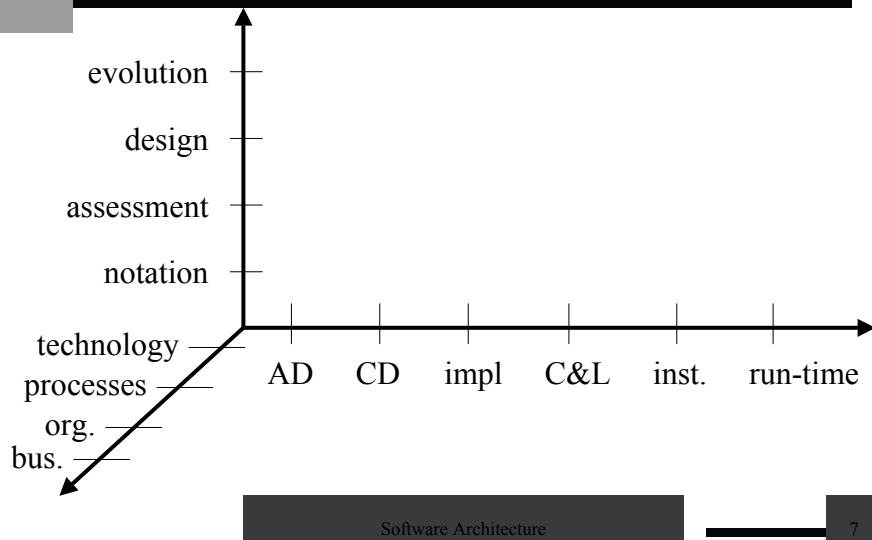
## Why software architecture?

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*first class* representation of SA during

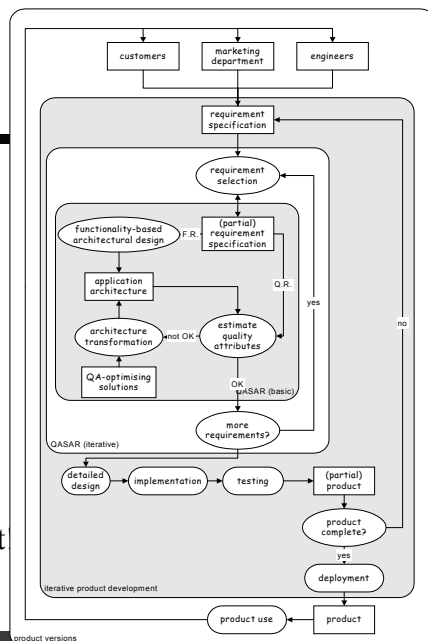
- design
  - stakeholder- or expert-based evaluation
  - assessment of and trade-off between quality attributes
- implementation
  - configuration management
  - enforcement of architectural principles
  - software product lines
- run-time
  - dynamic software architectures, post-fielding upgrades, dynamic reorganization, etc.

# Software Architecture

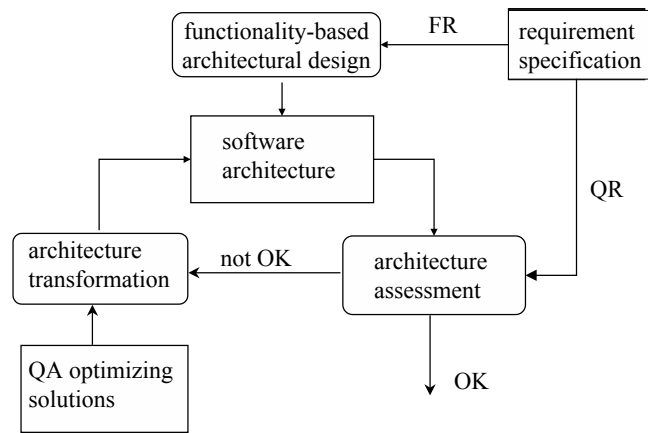


# SAD Context

- product versions
- iterative product development
- iterative architecture design
- iterative architecture assessment and transformation
- role of the software architect



# Software Architecture Design



# Issues

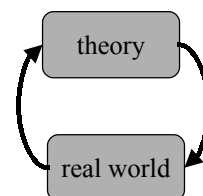
- unsatisfied quality attributes of systems
- stakeholder involvement and acceptance
- integration of COTS software
- modifiability of software
- reuse of existing software artefacts
- etc.

## Some Research Topics

- software architecture design
- software architecture in software development
- architecting hierarchically
- different organizational “maturity” levels
- software variability management

## Research Methods

- analytical methods
  - formal models, theories, proofs, etc.
- *empirical methods*
  - experiment (quantitative)
  - survey (quantitative)
  - case study (qualitative or quantitative)
  - action research (qualitative)



industry – academia cooperation crucial!!!

## International Research Community

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- (bi-)annual Working IEEE/IFIP Conference on Software Architecture (1999, 2001, 2002, 2004)
- special issues in journals, e.g. Journal of Systems and Software, Annals of SE, etc.
- research labs at companies (Philips, Nokia, Siemens, Bosch, etc.) and governmental organizations (SEI)
- IFIP WG2.10 Software Architecture Handbook

## WICSA-3 Sessions

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- dynamic software architectures
- architecture analysis
- architecture description
- architecture reconstruction and evolution
- component-based architectures

## Main Themes

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- role of software architecture throughout lifecycle
- relate architectural design decisions to functional and quality requirements
- increased use of quantitative assessment

## IFIP WG2.10 Architecture Handbook

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- Software architects
- Software developers
- Managers (with a business perspective)
- Vendors
- Acquirers (of systems) (the “customers”)
- Students
- Teachers
- Researchers
- Systems architects

## IFIP WG2.10 Architecture Handbook

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- Areas of interest
  - Representation
  - Evaluation
  - Design
  - ....
- Concepts/definition
- Practice
- Example
- Reference (pointers to other things...)
- Architecture guidelines/methods
- Related disciplines
  - Standard
  - Technologies
  - Common mistakes
  - Quality attributes
  - Questions
  - Scenarios
  - Stakeholders
  - Tutorial, courses
  - Discussion/review
  - Type of systems/domains
  - Libraries/components/assets

## Conclusion

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- architecture-centric software engineering
- software architecture
- Software architecture conference (WICSA 3)
- IFIP WG2.10 activities
- trends
  - amount of variability increases, binding phase is delayed
  - move from rigid control (strict system paradigm) to mutual coordination and adaptation (loose system/ecology paradigm)
  - role of software architecture throughout lifecycle
  - relate architectural design decisions to functional and quality requirements
  - increased use of quantitative assessment