WICSA/ECSA 2012, Helsinki

Software Architecture: Past, Present, and Future Directions

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Past & Present
- impression from:

- [Dewayne E. Perry](), [Alexander L. Wolf] . **Foundations for the study of software architecture,** ACM SIGSOFT Software Engineering Notes, Volume 17 Issue 4, Oct. 1992, Pages 40 – 52

2. Intuition, Context, and Motivation

2.1   Developing an Intuition about Software
          Architecture

- ~~Computing hardware architecture~~

- ~~Network architecture~~

- Building architecture

Multiple views;
Architectural styles;
Style and engineering;
Style and materials

2. Model of Software Architecture

- Software Architecture = { Elements, Form, Rationale}
    - Elements:
        - processing elements;
        - data elements;
        - connecting elements.

2. Model of Software Architecture

- Example 1:

2. Model of Software Architecture

- Example 2:

Processing elements

Data element

Connecting element

Soccer - Euro 2012 Italy – Germany

5. Some Benefits Derived from Software Architecture

- **SA and Analysis**
  - Consistency and Dependency Analysis
    - Consistency of architectural styles
    - Consistency of architectural constraints
    - ….
    - Establishment of dependencies between SA and design, SA and requirements
    - Implication of changes on SA on design and requirements and vice versa
  - **SA and reuse**
    - Reusing SA components (in contracts to executable components)

Present
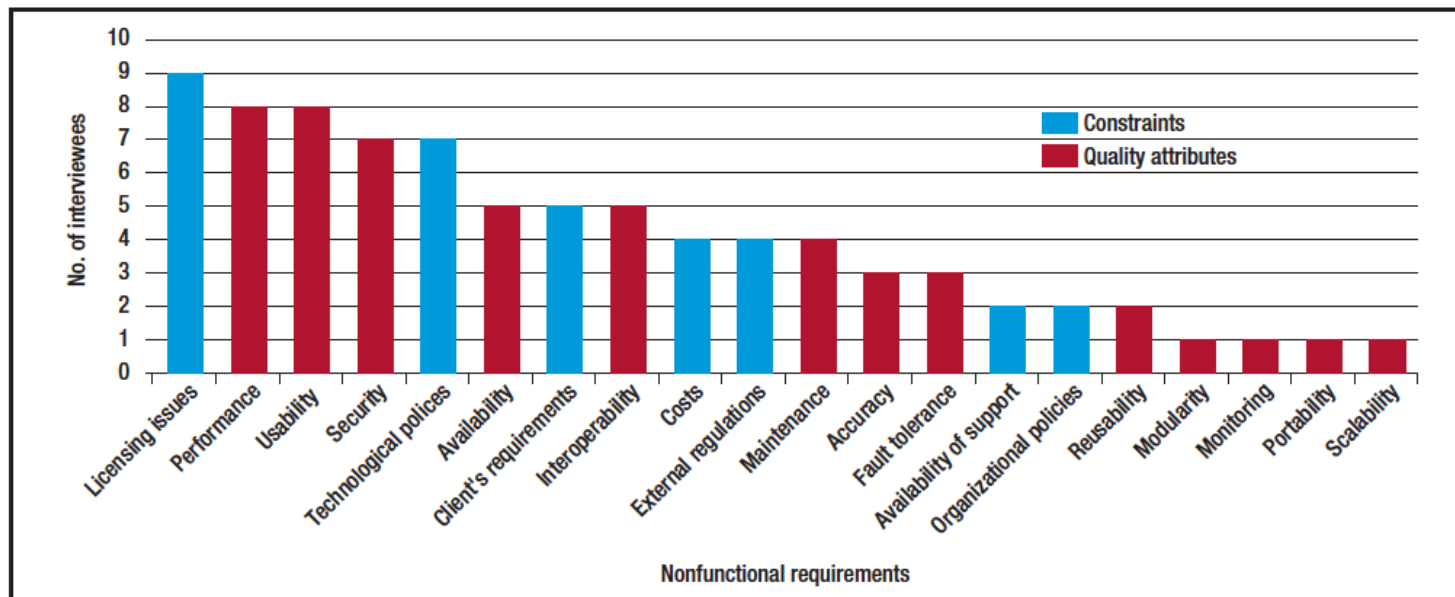
- Software Architecture
  = { Elements, Form, Rationale}

Research
Academia
Theory

Practice

ADLs
UML
…..

Methods, Processes
(ATAM,…)
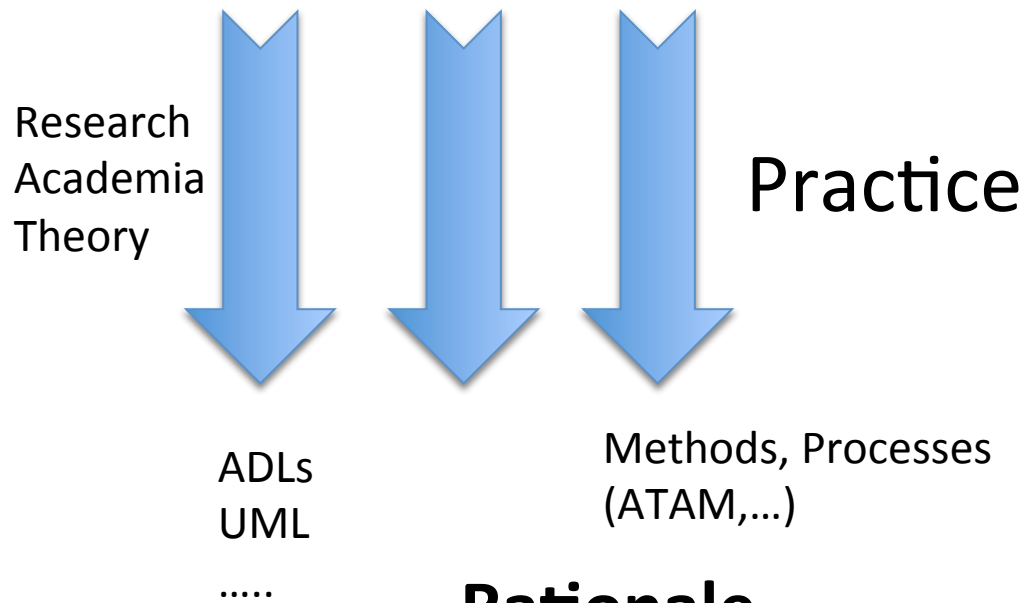
Rationale

Non-functional properties
→ Quality attributes

Present → Future – some questions

- Buschmann, Frank; Ameller, David ; Ayala, Claudia P. ; Cabot, Jordi ; Franch, Xavier:
Architecture Quality Revisited,
Software, IEEE, July-Aug. 2012

- "nonfunctional quality is of little relevance for users and customers, but instead mainly a concern for architects."

Present → Future – some questions

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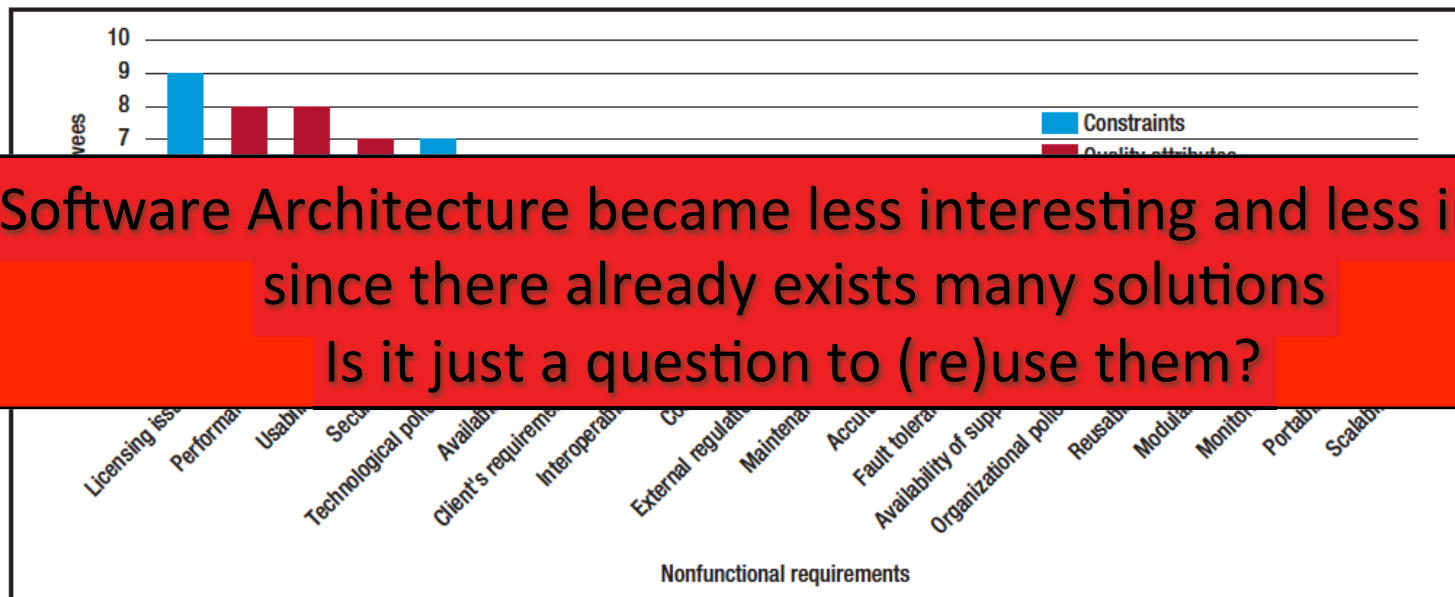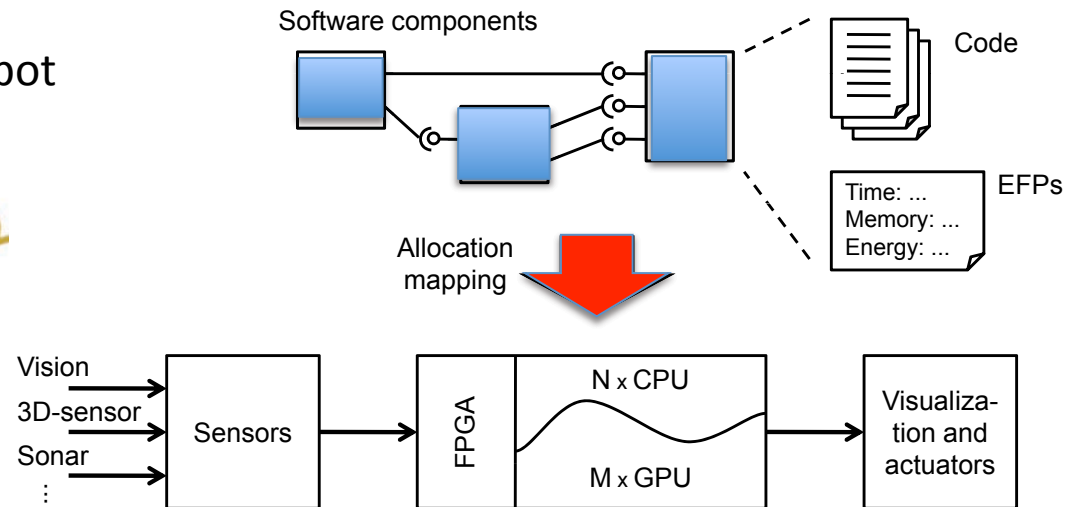

Has Software Architecture became less interesting and less important since there already exists many solutions
Is it just a question to (re)use them?

Present → Future – some questions

- ## SA – What does it mean?
  - ### Software Architecture or System Architecture?

Example: Underwater robot

Software components

Code

Time: ...
Memory: ...
Energy: ...

EFPs

Allocation
mapping

Vision
3D-sensor
Sonar
⋮

Sensors

FPGA

N x CPU

M x GPU

Visualiza-
tion and
actuators

Other examples:
    Systems of Systems
    Software-intensive systems, Social systems,....

Present → Future – some questions

- SA – What does it mean?
  - Software Architecture or System Architecture?

    - Diversity of Hardware
    - Tight integration of Software and Hardware (SW is controlling HW)
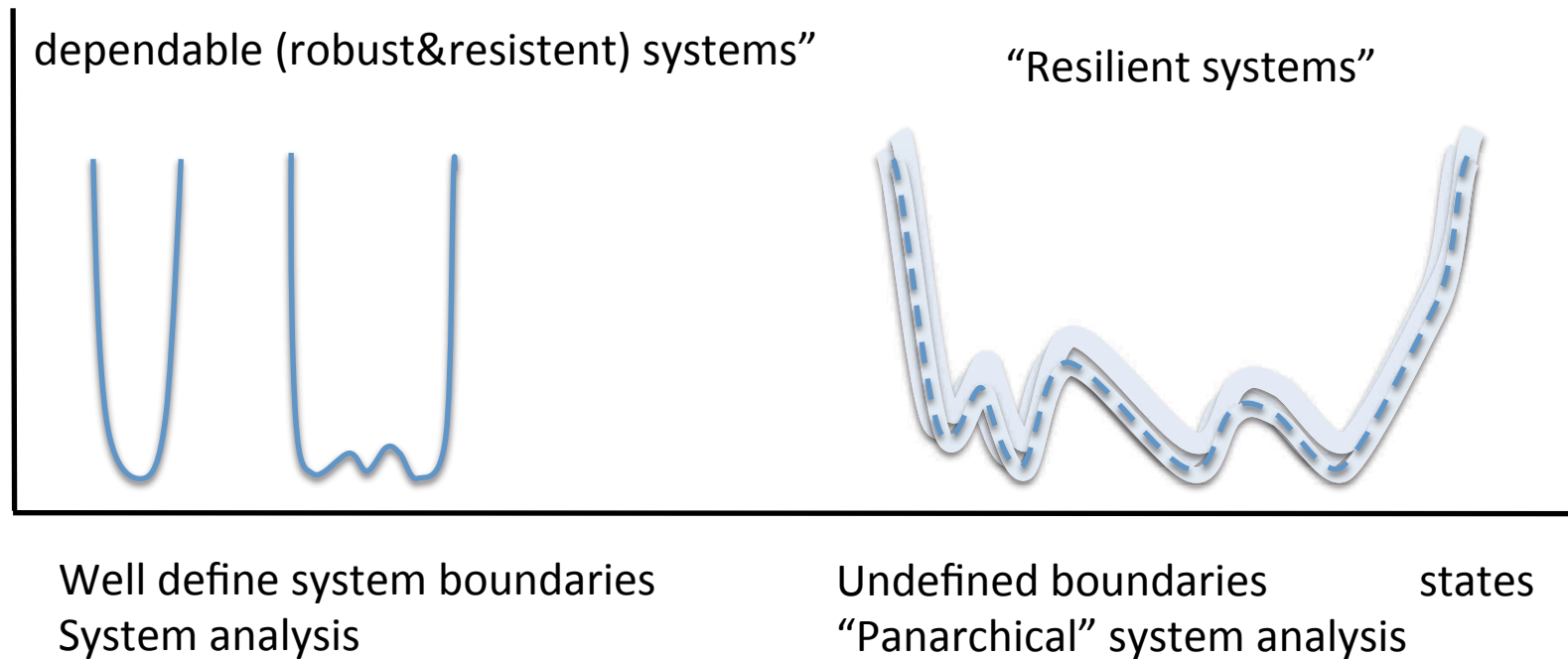   - Changes – system concerns, not software concerns

Present → Future, Challenges

- SA
  - From static SA to dynamic SA
  - From Design Models to Run-time models

  - From upgrading/updating (S(n)-> S(n+1)) to

    continuous change (S(x) = $\int$ f(x)dx)

  - From structure to control
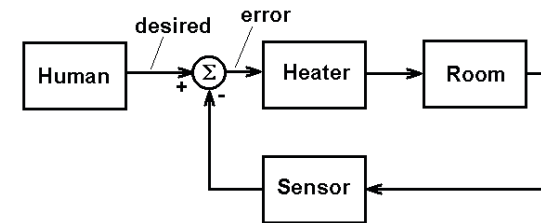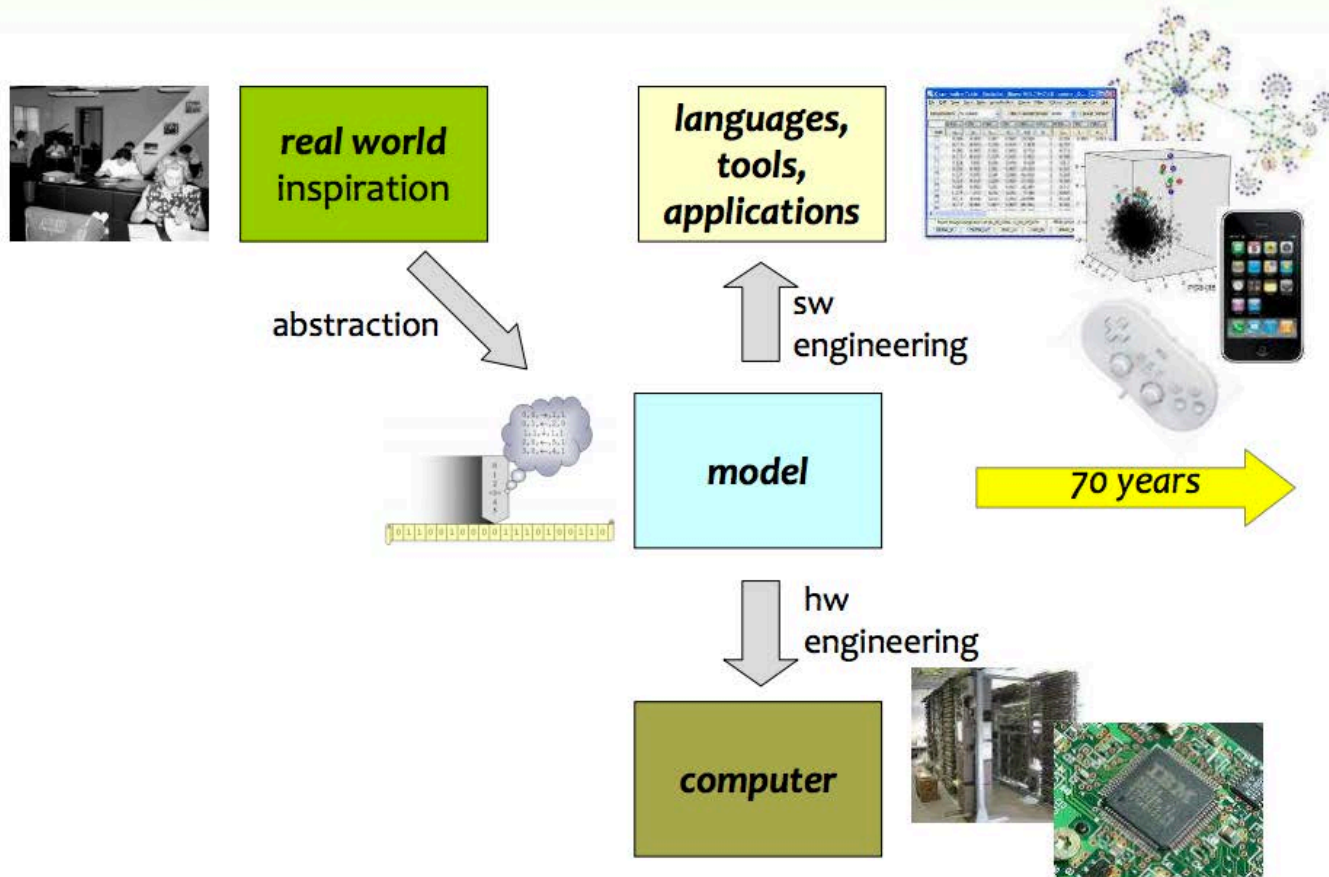
Present → Future, Challenges

- SA
  - From static to adaptive and **resilient** systems
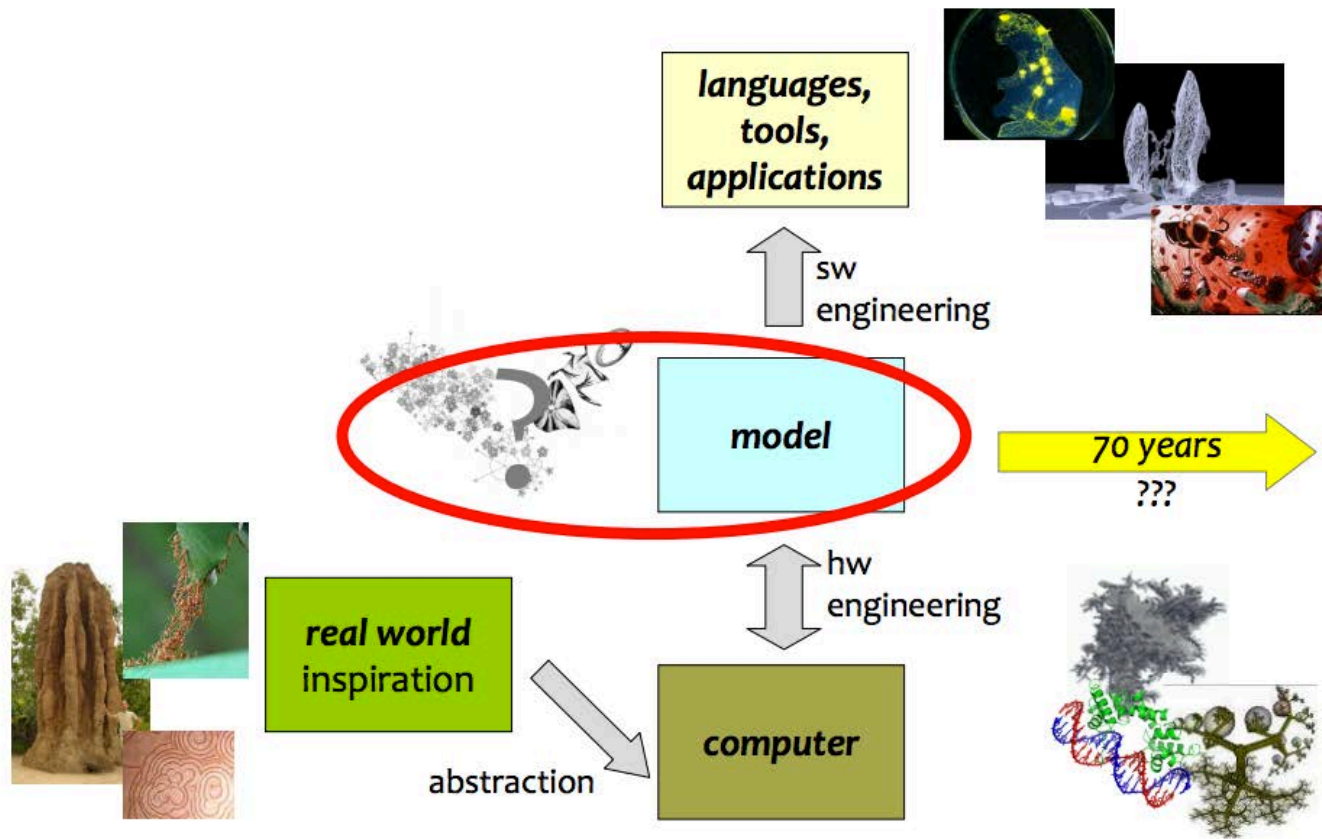 - From isolated to eco systems

dependable (robust&resistent) systems"

"Resilient systems"

Well define system boundaries
System analysis

Undefined boundaries   states
"Panarchical" system analysis

Present –> Future→ Future, challenges

inspiration → model → computation /architecture

real world inspiration

abstraction

languages, tools, applications

sw engineering

70 years

model

hw engineering

computer

*) Susan Stepney, Unconventional Computer Programming

Present –> Future⭢ Future, challenges

inspiration → model → computation /architecture

Future of Software Architecture

- **Future of Software is future of SA**
  - **New unpredictable paradigms**
  - **New models, new languages, new practices**