RAModel: A Reference Model for Reference Architectures

Elisa Yumi Nakagawa (University of São Paulo, Brazil)
Flavio Oquendo (University of South Brittany, France)
Martin Becker (Fraunhofer IESE, Germany)
Agenda

- Introduction
- Establishment of RAModel
- Structure of RAModel
- Application of RAModel
- Conclusions
Introduction

- Reference architectures
  - Special type of software architecture
  - Essence of the architectures of a set of software systems
  - Guidance for the development, standardization, and evolution of systems
- Diversity of reference architectures
  - AUTOSAR
  - Contina and universAAL
  - OSGi
  - S3 and OASIS
- Real evidence of the importance of reference architectures for the software development
Introduction

- Motivation
  - Currently, reference architectures are developed without an adequate attention, concern, or an a priori knowledge of what they should contain
  - Different formats regarding elements that they contain
  - Not all important information are presented
    - Examples: architectural decisions and a terminology widely adopted in the domain
  - No models for reference architectures which could be followed
Introduction

• Goal of this work
  ◦ To propose a reference model for reference architectures: **RAModel (Reference Architecture Model)**
  ◦ RAModel presents **possibly all elements**, which could be contained in reference architectures.
  ◦ RAModel intends to be **independent** from the **application domains** or purpose of such architectures.
Establishment of RAModel

- Establishing RAModel

Step 1
- Definitions of Reference Architecture
- Knowledge in Reference Architecture
- Knowledge in Software Architecture
- Generic Software System Structures
- Zachman Framework

Step 2
- Business rules
  - architectural styles
  - communication elements
  - software elements
  - domain terminology
  - best practices
  - architectural decisions
  - domain constraints
  - domain request
- Technical elements
  - business model
  - customer needs
- Problem domain
  - decisions
  - solution fragments
  - systems design
  - implementation
  - concepts
- Application architecture
  - distributed system architecture
  - human interface architecture
  - logical data model
  - processing structure
  - business rules model
  - design rationale
  - architectural elements
  - concepts, rules, principles, and guidelines

Step 3
- RAModel Structure
- RAModel Elements: Descriptions
Establishment of RAModel

- Step 1: Identification of Information Sources

  - Six definitions of reference architecture
  - Result of a systematic review (conducted in July/2011)
  - Zachman Framework and its extensions, DoDAF, and Rossak’s model
  - Result of a systematic review (by Boer and Farenhorst)
  - Definitions of Reference Architecture
  - Knowledge in Reference Architecture
  - Knowledge in Software Architecture
  - Generic Software System Structures
  - Zachman Framework
Establishment of RAModel

- Step 2: Identification of Elements
Establishment of RAModel

• Step 3: Design of the RAModel
Structure of RAModel
Structure of RAModel

Domain
- Legislation, Standard, & Regulation
  - Quality Attribute
  - System Compliance

Application
- Goal & Needs
- Risk
- Constraint
- Limitation
- Domain Data
- Scope
- Functional Requirement

Infrastructure
- Software Element
- General Structure
- Hardware Element
- Best Practice & Guideline

Crosscutting Elements
- Communication
  - Internal Communication
  - External Communication

Domain Terminology

Elements of the group Application

<table>
<thead>
<tr>
<th>Elem</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Demand</td>
<td>Legislation, laws, standards, and regulations existing in the domain that should be present in systems resulted from the reference architecture.</td>
</tr>
<tr>
<td>Quality attributes</td>
<td>Means to verify if systems developed from the reference architecture follow existing legislations, standards, and regulations. Quality attributes, for instance, maintainability, portability, and scalability, that are desired in systems resulted from the reference architecture.</td>
</tr>
<tr>
<td>System compliance</td>
<td>General structure of the reference architecture, represented sometimes by using existing architectural styles.</td>
</tr>
<tr>
<td>Hardware elements</td>
<td>Elements of hardware, such as server and devices, which host systems resulted from the reference architecture.</td>
</tr>
<tr>
<td>Software elements</td>
<td>Elements of software present in the reference architecture, e.g., subsystems and classes, which could be used to develop software systems.</td>
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</tbody>
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Uses of RAModel

• Main perspectives of use:
  ◦ Analysis of reference architectures
  ◦ Comparative analysis of reference architectures
  ◦ Basis for the establishment of reference architectures
  ◦ Support to the design of SPL

• Case study:
  ◦ Analysis of AUTOSAR
Conclusions

• Contribution:
  ◦ RAModel
    • A reference model for reference architectures
    • Interesting instrument to understanding reference architectures
    • Reduction in effort and time and improvement in productivity

• Future work
  ◦ More case studies and experiments
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