Evolving Enterprise Architecture

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Evolutions

- Concern conflicts
- Financing
- Domain drift
- Life cycle
- Modelling tools
- Personnel
- Obsolescence
- Implementation
- New Stakeholders
- Operational concepts
- Environment change

So when and how does Architecture of an Enterprise get created?
Architecting

• Architecting – activity of specifying architecture
  - F. L. Wright, C. Alexander, E. Dijkstra, E. Rechtin
  - ISO/IEC 15288, EN/ISO 19439, TOGAF
  - Transitions from an abstract concept through elaboration of the concepts to descriptions of the form, function, and purpose that the system or enterprise is expected to exhibit.

• IEC/ISO/WD 42010 – architecting
  - process of conceiving, defining, describing, documenting, communicating, certifying proper implementation of, maintaining and improving an architecture throughout a system’s life cycle.
Layers of Architecting

• 1st – applying a meta-architecture (e.g. a framework) to create and use an architecture description for the Enterprise
• 2nd – creating the meta-architecture for use in 1st layer activities
• 3rd – a meta-meta-level that describes evolution of ‘architecture’ and includes changes to the 2nd level meta-architecture
'Meta-' is relative

- Use of meta-meta-data and meta-meta-model

**OMG's 4-Layer Hierarchy**
1st layer evolution of utility

- As architecture description (AD) evolves it serves two distinct stakeholder communities
  - One delivering more abstract concepts that address their concerns
  - One expected to take the elaboration further toward a less abstract, more elaborated specification

- Elaboration evolves architecture from vague concept to formal descriptions for use by designers of enterprise details
Stakeholder community grows

- Line of business manager
  - Market Opportunity Assessment
- Enterprise concept team
  - Business concept of operations
- Enterprise architect
  - Enterprise architecture description
- Business design team
  - Enterprise specification
- Enterprise production implementation team
  - ....
Other architecting layers

• Components of detail need specifying and this too results in more rounds of architecting at the component level.

• Life cycle, detail, and genericity dimensions all involve hand-off from one set of stakeholders to another as architecture evolves.

• A framework informs about expected stakeholders as the elaboration space increases.
Models and architecture

Architectural intent is embodied in enterprise models (EM).
Architectural realization is embodied in instance manifestations of those models.

Models are a utility of architecture
Different perspectives

An enterprise of enterprises and other systems

Software architecture is a sub-type of system architecture
Elaboration Hierarchy

• Decomposing results in new architecture opportunity/specification raising issues of consistency and coherence between levels:
  - Enterprise, family of systems, system, segment, element, subsystem, component, subassembly, parts

• Transformations occur as context shifts focus in use of both meta-architecture for each level and creation of enterprise architecture
Life cycle evolution

• Within a life cycle phase, AD is an artifact of previous phases and serves as a guide for subsequent phases
• Systems and enterprises exhibit common life cycle patterns, not the same life cycle
• Instability is caused by overlap in life cycle phases across meta-levels
• Stability is enhanced by overlap in artifacts across meta-levels
Stability and instability

Architecting enterprise

<table>
<thead>
<tr>
<th>Domain</th>
<th>Concepts</th>
<th>Requirement</th>
<th>Specification</th>
<th>Implement</th>
<th>Operate</th>
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Architecting Procedures Manual

Architected enterprise

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Meta- vs. time

• Meta-architecture specifies system life cycle processes that occur over time
• Tend to think of complete architectures as static but meta-level architecture use changes over the course of a project
• Different meta-levels have different time spectra; lower-level activity is continuous with respect to higher-level activity that is perceived as discrete, i.e. it has a more granular clock
Expressive limits of architecture

The Intension/Locality Thesis (Eden & Kazman 2003)

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Intentional</th>
<th>Non-Local</th>
</tr>
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<tbody>
<tr>
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<td>Intentional</td>
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<tr>
<td>Implementation</td>
<td>Extensional</td>
<td>Local</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Trouble</th>
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</table>
Architecture more formally

A specification is intentional iff there are infinitely-many possible instances thereof. Conversely, all other expressions are extensional.

A specification $S$ is local iff the following condition holds:

If $S$ is satisfied in some design model $m$ then it is satisfied by every design model that subsumes $m$. 

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Stakeholder utility

- Architecture accommodates succession of stakeholders
- Utility of AD is response to intentional concerns of input stakeholders
- Utility of AD is request for extending concerns of new stakeholders
- Utility of architecture is realized by service to stakeholders
AD Meta-model

ISO/WD 42010
(revision of IEEE 1471)
AD as boundary object

**Architecture Description**

**Literature:**
Documentation for current and future generations of users and developers

**Language:**
Medium of communication for achieving common understanding

**Blueprint:**
Specification of the system to be implemented

**Decision:**
Choices about the system to be implemented and rationale
Evolutionary transformations

- Architecting involves executing a methodology to produce a set of artifacts
- The methodology transforms abstractions into more concrete realizations using:
  
  Projection    Instantiation
  Specialization Refinement
  Mapping
Projection

From the set of architectural models, select a sub-set that is useful to a set of tasks during a life cycle phase.
Instantiation

- The fundamental meta-transformation: architecture is an instance of meta-architecture
- Instantiate an architectural model(s) to a particular sub-domain that allows its use for a task during the life cycle phase.
'Meta-' as abstraction

Relationship

Entity

IsA

Party

Department

Employee

works for

specialization

special

general

Did | DName
---|---
35  | Accounting
95  | Manufacturing

Did | Pid
---|---
95  | 47

Pid | PName
---|---
47  | Joe

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Specialization

• Specialize an architectural model by adding further attribute definitions and/or domains, e.g., range of permissible values relevant for a task during a life cycle phase.
Refinement

• Refine an architectural model by addition of significantly more detail to ensure its use for a task during the life cycle phase.
Mapping (other transformations)

- Take elements from different architectural models to satisfy data or decision needs for a task during the life cycle phase.
Meta-mixing

As-Is (analysis)

EBOK

To-Be (realization)

15288 - Stakeholder Requirements Definition Process

Architectural Design Process

Implementation Process

Transition Process

Do C R D I O
Discussion