Enterprise Architecture Layers

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ESTP Training Course “Enterprise Architecture and the different EA layers, application to the ESS context – Advanced course”
Rome, 11 – 14 October 2016
EA Frameworks

- IEEE 1471-2000 / ISO/IEC 42010
- Zachman framework
- TOGAF - The Open Group Architecture Framework
IEEE 1471-2000 / ISO/IEC 42010

- IEEE Standard 1471 approved in 2000 as a theoretical base for the definition, analysis, and description of system architectures
- Adopted by ISO in 2007 as ISO/IEC 42010
- IEEE 1471 does not try to standardise the process of developing architectures, and therefore does not recommend any modelling languages, methodologies, or standards
IEEE 1471-2000 / ISO/IEC 42010

- IEEE 1471 provides recommended practices and concepts definitions
Six architecture description practices

1. Architectural documentation referring to identification, version, and overview information
2. Identification of the system stakeholders and of their concerns, established to be relevant to the architecture
3. Selection of architectural viewpoints, containing the specification of each viewpoint that has been selected to organise the representation of the architecture and the reasons for which it was selected
Six architecture description practices

4. Architectural views corresponding to the selected viewpoints
5. Consistency among architectural views
6. Architectural rationale for the selection of the current architecture from a number of considered alternatives
Zachman Framework

- First and best known EA framework introduced in 1987

Roles in design processes

Products abstractions
Zachman Framework

- Rules
  1. Columns have no order
  2. Each column has a simple basic model
  3. Basic model of each column is unique
  4. Each row represents a distinct view
  5. Each cell is unique
  6. Combining the cells in one row forms a complete description from that view
Zachman Framework – Row 1 - Scope/Planner’s View

- **Motivation/Why**
  - Business goals, objectives and performance measures related to each function

- **Function/How**
  - High-level business functions

- **Data/What**
  - High-level data classes related to each function

- **People/Who**
  - Stakeholders related to each function

- **Network/Where**
  - Locations related to each function

- **Time/When**
  - Cycles and events related to each function

![Business Functions modelling](chart)
Zachman Framework – Row 2- Enterprise Model/Owner’s View

- **Motivation/Why**
  - Policies, procedures and standards for each process

- **Function/How**
  - Business processes

- **Data/What**
  - Business data

- **People/Who**
  - Roles and responsibilities in each process

- **Network/Where**
  - Locations related to each process

- **Time/When**
  - Cycles and events related to each process
Zachman Framework – Row 3- System model/Designer’s View

- **Motivation/Why**
  - Policies, standards and procedures associated with a business rule model

- **Function/How**
  - Logical representation of information systems and their relationships

- **Data/What**
  - Logical data models of data and data relationships

- **People/Who**
  - Logical representation of access privileges constrained by roles and responsibilities

- **Network/Where**
  - Logical representation of the distributed system architecture

- **Time/When**
  - Logical events and their triggered responses constrained by business events and their responses

![Zachman Framework Diagram](image-url)
Zachman Framework – Row 4 - Technology Model/Builder’s View

• **Motivation/Why**
  - business rules constrained by information systems standards

• **Function/How**
  - Specifications of applications that operate on particular technology platforms

• **Data/What**
  - Database management system (DBMS) type requirements constrained by logical data models

• **People/Who**
  - Specification of access privileges to specific platforms and technologies

• **Network/Where**
  - Specification of network devices and their relationships within physical boundaries

• **Time/When**
  - Specification of triggers to respond to system events on specific platforms and technologies
Zachman Framework – Row 5 - Detailed representations/Sub-contractor’s View

- **Motivation/Why**
  - business rules constrained by specific technology standards

- **Function/How**
  - Programs coded to operate on specific technology platforms

- **Data/What**
  - Data definitions constrained by physical data models

- **People/Who**
  - Access privileges coded to control access to specific platforms and technologies

- **Network/Where**
  - Network devices configured to conform to node specifications

- **Time/When**
  - Timing definitions coded to sequence activities on specific platforms and technologies
Zachman Framework: Pros and Cons

• Pros:
  • Easy to understand
  • Addresses enterprise as a whole
  • Independent of tools and methodologies

• Cons:
  • Large number of cells
  • Relations btw cells not well specified
TOGAF: Generalities

• The Open Group Architecture Framework (TOGAF) is a framework for enterprise architecture which provides a comprehensive approach for designing, planning, implementing, and governing an enterprise architecture.

• TOGAF is a registered trademark of The Open Group in the United States and other countries.
TOGAF: Layers

• Divides enterprise architecture into four layers:
  1. **Business architecture** - Describes the processes the business uses to meet its goals
  2. **Application architecture** - Describes how specific applications are designed and how they interact with each other
  3. **Data architecture** - Describes how the enterprise datastores are organized and accessed
  4. **Technical architecture** - Describes the hardware and software infrastructure that supports applications and their interactions
TOGAF: Components

4 Main Components:
- Architecture Capability Framework
- Architecture Development Method
- Architecture Content Framework
- Enterprise Continuum
TOGAF: Architecture Capability Framework

• Addresses the organisation, processes, skills, roles and responsibilities required to establish and operate an architecture function within an enterprise

Notion of capability as an asset to be managed
TOGAF: Architecture Development Method - 1

- It is the core of TOGAF
- Provides architects a way of working
- Stepwise cyclic approach for the development of the overall EA
TOGAF: Architecture Development Method - 2

- At each iteration a new decision must be taken as to:
  - The breadth of coverage of the enterprise to be defined;
  - The level of detail to be defined;
  - The extent of the time horizon aimed at;
  - The architectural assets to be leveraged in the organisation's enterprise;
  - Continuum, including assets created in previous iterations of the ADM cycle within the enterprise and assets available elsewhere in the industry.
TOGAF: Architecture Content Framework - 1

- Considers an overall enterprise architecture as composed of four closely interrelated architectures:
  - Business Architecture
  - Data Architecture
  - Application Architecture
  - Technology (IT) Architecture
## TOGAF: Architecture Content Framework

### Architecture principles, Vision and Requirements

<table>
<thead>
<tr>
<th>Architecture Principles, Vision, and Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preliminary</strong></td>
</tr>
<tr>
<td>- Architecture Principles</td>
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<tr>
<td><strong>Architecture Vision</strong></td>
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<tr>
<td>- Business Strategy</td>
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<tr>
<td>- Technology Strategy</td>
</tr>
<tr>
<td>- Business Principles, Objectives, and Drivers</td>
</tr>
<tr>
<td>- Architecture Vision</td>
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<tr>
<td>- Stakeholders</td>
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<tr>
<td><strong>Architecture Requirements</strong></td>
</tr>
<tr>
<td>- Requirements</td>
</tr>
<tr>
<td>- Constraints</td>
</tr>
<tr>
<td>- Assumptions</td>
</tr>
<tr>
<td>- Gaps</td>
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</tbody>
</table>
TOGAF: Architecture Content Framework: Business Architecture
TOGAF: Architecture Content Framework: Information Systems architecture
TOGAF: Architecture Content Framework: Technology architecture

- **Technology Architecture**
  - Platform Services
  - Logical Technology Components
  - Physical Technology Components
### TOGAF: Architecture Content Framework: Architecture Realization

<table>
<thead>
<tr>
<th>Opportunities, Solutions, and Migration Planning</th>
</tr>
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<tbody>
<tr>
<td>Capabilities</td>
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<table>
<thead>
<tr>
<th>Implementation Governance</th>
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<tr>
<td>Standards</td>
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TOGAF: Enterprise Continuum

- Enterprise Continuum: the concept
- Various reference models
  - Technical Reference Model
  - The Open Group’s Standards Information Base (SIB)
  - The Building Blocks Information Base (BBIB)
Enterprise Continuum

- Enterprise Continuum is as a *view of the repository of all the architecture assets*
  - Including architecture descriptions, models, building blocks, etc.
  - that exist both within the enterprise and in the IT industry at large, which the enterprise considers to have available for the development of architectures for the enterprise
Enterprise continuum classifies assets as:
- Requirements repository
- Architecture repository
- Design stores

And the Enterprise Continuum can also classify solutions (as opposed to descriptions or specifications of solutions)
Architecture Continuum: consistent way to define and understand the generic rules, representations, and relationships in an architecture, including traceability and derivation relationships (e.g., to show that an Organization-Specific Architecture is based on an industry or generic standard).

Represents a structuring of Architecture Building Blocks (ABBs) which are re-usable architecture assets. ABBs evolve through their development lifecycle from abstract and generic entities to fully expressed Organization-Specific Architecture assets.
Solutions Continuum: provides a consistent way to describe and understand the implementation of the assets defined in the Architecture Continuum. It defines what is available in the organizational environment as re-usable Solution Building Blocks (SBBs).
TOGAF: Technical Reference Model

- Provides a model and taxonomy of generic platform services

High Level View
TOGAF: Technical Reference Model

- Three entities:
  - **Application Software**: infrastructure + business
  - **Application Platform**
  - **Communications Infrastructure**

- Two interfaces:
  - Application Programming Interface
  - Communications Infrastructure Interface
TOGAF: Standard Information Base

- Database of facts and guidance about information systems standards
- Standards (de iure or de facto) structured according to the Technical Reference Model
TOGAF: Standard Information Base

- Data Interchange Services
- Data Management Services
- Graphics and Imaging Services
- International Operation Services
- Location and Directory Services
- Network Services
- Object-Oriented Provision of Services

- Operating System Services
- Security and Risk Services
- Software Engineering Services
- System and Network Management Services
- Transaction Processing Services
- User Interface Services
- Quality of Service
<table>
<thead>
<tr>
<th>Standard</th>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDF</td>
<td>1993</td>
<td>Portable Document Format (PDF) is a file format created by Adobe Systems in 1993 for document exchange. PDF is used for representing two-dimensional documents in a manner independent of the application software, hardware, and operating system. (Now an ISO standard.)</td>
</tr>
<tr>
<td>REC_CSS1</td>
<td>2008</td>
<td>This document specifies level 1 of the Cascading Style Sheet mechanism (CSS1). CSS1 is a simple style sheet mechanism that allows authors and readers to attach style (e.g., fonts, colors, and spacing) to HTML documents. The CSS1 language is human-readable and writable, and expresses style in common desktop publishing terminology.</td>
</tr>
<tr>
<td>RFC_1945</td>
<td>1996</td>
<td>The Hypertext Transfer Protocol (HTTP) is an application-level protocol for distributed, collaborative, hypermedia information systems that has been in use by the World-Wide Web since 1990. It is a generic, stateless, object-oriented protocol, a feature of which is the typing and negotiation of data representation, allowing systems to be built independently of the data being transferred. RFC 1945 reflects common usage of the protocol referred to as HTTP/1.0.</td>
</tr>
<tr>
<td>RFC_2068</td>
<td>1997</td>
<td>The Hypertext Transfer Protocol (HTTP) is an application-level protocol for distributed, collaborative, hypermedia information systems. It is a generic, stateless, object-oriented protocol which can be used for many tasks, such as name servers and distributed object management systems, through extension of its request methods. HTTP/1.1 includes more stringent requirements than HTTP/1.0 in order to ensure reliable implementation of its features. It is not backwards-compatible with HTTP/1.0.</td>
</tr>
</tbody>
</table>

*Extracted from SIB*
TOGAF: Building Blocks Information Base

- A building block is:
  - either an *architecture construct* such as a blueprint diagram or computer component description that is re-usable in the architecture process. Or
  - a solution construct, such as a brick or piece of software that is re-usable in the implementation process. A solution building block is an implementation of an element of the architecture
TOGAF: Building Blocks Information Base

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TOGAF: Building Blocks Information Base

• Architectural Building Blocks (ABBs):
  • Define what generally is needed
  • Capture business/technical requirements
  • Are technology aware
  • Direct and guide solution building blocks
TOGAF: Building Blocks Information Base

- Solution Building Blocks (SBBs):
  - Define the “how”
  - Are the implementation
  - Fulfill business requirements
  - Are delivered as products
TOGAF: Building Blocks Information Base

- Building blocks make either the architecture process or the implementation process easier by enabling reuse.
- However in order for building blocks to be useful in these processes, they must be stored and accessible in ways conducive to the processes. Building blocks that are unknown are useless.
- Hence the need for a *Building Blocks Information Base* making them accessible.
TOGAF Architectures (Contextualized to OS)

From strategy

Level of abstraction

Contextual
Conceptual
Logical
Physical
Detail

What

Vision 2020 (Business direction)

Business Architecture
A description of the structure and interaction between the business strategy, organization, functions, business processes, and information needs.

Application architecture
A description of the structure and interaction of the applications that provide key business functions and manage the data assets.

Information architecture
A description of the structure and interaction of the enterprise's major logical and physical data assets, and data management resources.

Information system architecture
A description of a discrete and focused business operation or activity and how information technology supports the operation.

Technological architecture
A description of the structure and interaction of the platform services, and logical and physical technology components.

One solution

More - All solutions
## Standards placed on EA layers

<table>
<thead>
<tr>
<th>EA Layer</th>
<th>Standards involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer Business Architecture</td>
<td>GSIM, GSBPM, CSPA, GAMSO</td>
</tr>
<tr>
<td>Layer Application Architecture/Information Architecture</td>
<td>CSPA, SDMX, DDI, Linked Metadata standards</td>
</tr>
<tr>
<td>Layer Technological Architecture</td>
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