LECTURE 1.1: Enterprise Architecture

The Enterprise: A Definition of Some Terms

- Any collection of corporate or institutional task-supporting functional entities with a set of common goals/s single mandate. (Minoli, 2008)
  - **Architect**: One designing of an architecture & creating an architectural description
  - **Architecture**: Basic system org embodied in its components, their relationships to each other & the environment, and principles guiding its design and evolution
  - **Enterprise architecture**: Arch where system is whole enterprise, especially its BPs, technologies, and info systems.
  - Some (Enterprise) Architectural definitions:
    - **Artefact**: A report, analysis, model etc. contributing to an architectural description
    - **Description**: A collection of artefacts documenting an architecture
    - **Framework**: A skeletal structure defining particular artefacts, describing how they are related and providing generic definitions for what those they might look like
    - **Methodology**: Generic term for any structured solution to problems on architectures
    - **Arch taxonomy**: A methodology for organizing and categorizing artefacts
What is Enterprise Architecture?

Enterprise Architecture

- A blueprint defining the structure and operation of an organization.
- Object: to assess how org can best reach current, future objectives
- Contains:
  - a permitted structure;
  - configuration;
  - capabilities
  - functional groupings;
  - interfaces, data, protocols;
  - logical functionality;
  - the integration and technology of IT resources;
  - to support an org, business function or mission (Minoli, 2008).
- Focus is on the human element: how to ‘architect’/plan org for optimum human performance & output

What is The Point of Enterprise Architecture?

Why Business and EA?

Because architects deeply understand business.

- Mission & Vision
- Business Goals
- Business Objectives
- Value Propositions
- Strategies & Tactics
- Technology & Resources

Biz. Motivation

Value Discipline

Orientation

Capabilities

People, Processes & Technology

Biz. Models

Why Business and EA?
An Enterprise Architecture (EA) Case-Study: The Rise & Fall of MedAMore

- MedAMore is a pharmacy chain, started as a US regional chain in 1960.
- In 1995 it developed an IT system (MedAManage or MAM) with some innovative business ideas allowing it to run chemists very efficiently.
- MAM consisted of three programs
  - MAM/Store which ran on a small computer in a chemist;
  - MAM/Warehouse running on a server in a regional Warehouse;
  - MAM/Home which ran on a large server in the Home Office.
- By 2000 MedAMore was doing well:
  - Due to cost cutting enabled by MAM, it expanded by buying three regional chains.
  - With these purchases MedAMore extended its reach thro SE US
- However by 2002, clear that IT systems that fuelled MedAMore’s success now hampered it’s future – MAM modules comprised $10^6$ lines of code!
MedAMore : The Rise & Fall

• Some problems MedAMore were running into included:
  1. MAM/Store needed regional specialisations: e.g. different insurance plans had to be supported in different regions, needing to MAM/Store’s module

  2. Newly-acquired regional warehouses each had own different ways:
     a. to receive orders from the retail stores &
     b. to order supplies from wholesalers,
     all needing changes to the MAM/Warehouse module

  3. For info sharing MedAMore used File Transfer. When company was
     – 30 pharmacies, 1 regional Warehouse & 1 home office worked well;
     – 200 pharmacies, 4 regional Warehouse, 2 Geographic offices and one
       home office, worked badly.
     => files were:
        – delivered late, sometimes never occasionally multiple times
        – hard for home office to get reliable up-to-date financial info especially in the areas of sales and inventory

MedAMore (/3): A Company in Crisis

• Problems, problems...
  – All functions accessed one db
  => one record change could cause chaos...
  – Business wanted more acquisitions but IT already struggling...

• By 2005
  – Irma not seen as executive team member anymore
  – Brett tried to bypass IT section at every opportunity
  – Little input by business into IT, costly IT projects ignored & scrapped

• By 2006, crisis!
  – Cath met with Irma, Brett to announce an EA initiative to save MedAMore
  – MAM-EA had to unite IT, business & give full business value for investment
Approach 1: Zachman’s Enterprise Architecture (EA) ‘Framework’

- Zachman’s ‘Framework’ is a widely used approach for developing or documenting an enterprise-wide architecture.
- EA dates to “Framework for information systems architecture” paper in 1987
- Main goal: logical constructs to manage increasing complexity of IS in orgs.
- The framework is a two dimensional matrix representing the viewpoints on the Y axis; and the views on the X axis.
- In this framework viewpoints are represented by:
  - different stakeholders; and
  - clearly defined deliverables;

  * Actually, more of a taxonomy than a framework
### Zachman Framework

<table>
<thead>
<tr>
<th>Perspective</th>
<th>DATA</th>
<th>FUNCTION</th>
<th>NETWORK</th>
<th>PEOPLE</th>
<th>TIME</th>
<th>MOTIVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SCOPE</strong></td>
<td>Raw</td>
<td>Plan</td>
<td>Raw</td>
<td>Raw</td>
<td>Raw</td>
<td>Raw</td>
</tr>
<tr>
<td>Planner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENTERPRISE</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
</tr>
<tr>
<td>Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYSTEM</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
</tr>
<tr>
<td>Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TECHNOLOGY</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
</tr>
<tr>
<td>Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DETAIL</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
<td>Model</td>
</tr>
<tr>
<td>Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Zachman Framework**

- **3 suggestions from Zachman:**
  1. Each architectural artefact should be in only 1 cell. If unclear in which cell a particular artefact lives, the problem is with the artefact itself.
  2. Architecture is complete **only** when every cell is complete:
     - i.e. cell has **enough artefacts to fully define the system** for a player looking at one specific descriptive focus, so each player knows all system aspects;
     - with all cells full we have enough detail to **fully describe the system from each SH’s perspective**, so company knows they can all talk in parallel;
  3. Cells in columns are related to each other e.g. the first (data) column:
     - from business owner’s (Brett) perspective, data is info about business;
     - from the db admin’s perspective it’s db rows & columns.
How Zachman Can/not Help MedAMore

• Can Help:
  – Ensure every SH’s perspective is examined for every descriptive focal Point
  – Improve the MAM-EA artefacts themselves by sharpening each of their focus points to one particular concern for one particular audience
  – Ensure all of Brett’s business needs are traceable to some technical impln
  – Convince Brett that Irma’s IT team won’t plan on building useless functionality
  – Convince Irma that the business team will include her IT team in their planning

• But not full answer for org - many issues for MAM-EA success unaddressed:
  – No step-by-step way to create a new architecture provided
  – Little help given in deciding if our future architecture is the optimal possible
  – No approach given to show the future architecture is necessary!
  – For these and others we are going to need to look at other methodologies

SECTION 1.2: A SECOND ENTERPRISE ARCHITECTURE FRAMEWORK
1. **Business Architecture**: the BPs the org uses to meet its goals
2. **Application Architecture**: design of specific apps & how they interact
3. **Data Architecture**: organization of & access to enterprise datastores
4. **Technical Architecture**: h/w, m/w, s/w infrastructure supporting the interacting apps

**Key part**: **Architecture Development Method (ADM)**

TOGAF complements Zachman:

- Zachman says how to categorise artefacts; TOGAF is a process to create them

---

**Basic TOGAF Concepts**

- **System**
- **Stakeholder**
- **Concern**
- **Viewpoint**
- **Architecture Description**
- **View**

**Conceptual framework of IEEE 1471 (partial view)**
TOGAF's worldview is shown below:

- **Enterprise Continuum**: TOGAF sees EA continuum from generic to very specific
- **Foundation Archs**: Generic principles, applicable to any organisation
- **Common Systems Archs**: More specific principles (e.g. for security, mgmt) - all incomplete in overall system functionality, but complete in particular problem domain
- **Industry Archs**: Principles for domain (e.g. data model with business functions & BPs)
- **Org Architectures**: Principles, specific to a specific enterprise (e.g. MedAMore)

**ADM** shows how to go from the generic to the specific

- Each cycle, EA considers what Arch resources are available from the EC (e.g. business models for the org’s industry sector) to build enterprise-specific archs & solution(s)

The Enterprise Continuum (/2)

- **Classification**: Arch/solution artefacts going from **Generic** to **Org-Specific** Archs.
- **Architecture Repository (AR)**
  - Supports EC by storing different classes of arch output at different levels of abstraction, created by ADM
  - Stores artefacts from prior EA runs (internals), industry ref models/ arch patterns (externals)
  - So TOGAF facilitates understanding/ co-operation between SHs and practitioners
The Enterprise Continuum (/3)

- **Enterprise Continuum**
  - A Model for Structuring a Virtual Repository + Methods for Classifying Arch, Solution Artefacts in the:
    - Architecture Continuum (logical repn)
    - Solutions Continuum (physical repn)
      - generic tools, products, services, solution components i.e. fundamental providers of capabilities.
      - Impln of CSA with a set of products & services (may be certified/branded).
      - Impln of an IA providing re-usable packages of common industry-specific components & services
      - Impln of OSA providing required business functions; contain as much uniqueness to suit actors & BPs in orgs

Establishing and Maintaining an Enterprise Architecture Capability

- Developing an EA Capability Requires of an Organization:
  - Org Structures
  - Roles & Responsibilities
  - Skills
  - Processes
  - & RE-ITERATION!
Establishing and Maintaining an EA Capability (2)

- What does ‘RE-ITERATION!’ mean here? Cycles of TOGAF ADM

TOGAF’s Architecture Development Method (ADM)

- TOGAF’s ADM is Shown:
  - Generic method used to realize an EA from business requirements.
  - First some Preliminary Investigation
  - Then cycle thro the 8 phases A-H ...
  - At ALL stages conform to requirements
  - But MedAMore needs TOGAF expertise before starting on ADM:
    - MedAMore can train itself or
    - Can buy in TOGAF expertise (specialist TOGAF consultants)
    - E.g. Teri
ADM Preliminary Phase

- For this phase of MAM-EA ADM Teri needs to:
  - Make sure everyone is onside with the TOGAF/ADM process
    - Sounds easy but isn’t a given! Sometimes getting buy-in on EA’s need is hard
    - Especially if IT side is driving, &/or bad blood between IT & business, as here
    - Teri is lucky as Cath is behind EA but still Teri must work with:
      - Brett to understand MedAMore’s business philosophy, models & strategic drivers
      - Irma to set out arch principles driving tech architectures & put in TOGAF format
      - Could look at Zachman Row 1 to suggest candidate items here for key issues
  - Modify TOGAF as necessary to fit in with MedAMore culture
    - Any MedAMore-specific considerations? E.g. use only open-source software?
  - Set up the governance system to oversee future architectural work
    - Teri may not work on TOGAF at MedAMore after the first pass
    - Key people in the company must be able to take it forward from there

ADM Phase A: Architecture Vision

- For Phase A: Teri issues a Request for Architecture Work
  - Teri helps sponsoring org here (as MedAMore has never done one before)
  - Includes business reasons for EA request + budget, personnel, constraints & scope
  - Establish high-level definitions for baseline & target architectures (Phases B-D)
  - These include the four EA sub-architectures:
    - Business Architecture: the BPs the org uses to meet its goals
    - Application Architecture: design of specific apps & how they interact
    - Data Architecture: organization of & access to enterprise datastores
    - Technical Architecture: h/w, m/w, s/w infrastructure supporting the interacting apps
  - Produces Statement of Architecture Work to be blessed by SHs before next phase

- Phase A Output: create Arch Vision for ADM 1st Pass
  - Statement of Architecture Work outlines how to develop / deploy the architecture described in the Architecture Vision
ADM Phase B: Business Architecture

Input to Phase B is Phase A’s Output (Architecture Vision)

- For Phase B, Teri works primarily with Brett (&/or team):
  - Phase B describes & inputs the artefacts into Zachman Row 2:
    - detailed business analysis & modelling,
    - tech requirements documentation (drivers for Phase C,D): sets out the implications for work in the remaining architecture domains (e.g. by a dependency/ priority matrix).
  - For good Phase B, input from many SHs needed (e.g. who must do what, why, by when and how is it done?)

- Major Outputs:
  - Detailed baseline & target business architecture
  - Full gap analysis on differences between them

ADM Phase C,D: IS, Technical Architectures

Phase C is to IS Architecture what B is to Business Architecture:

- Develop Target Architectures for Data and Application Systems domains

- For Phase C, Teri works primarily with Irma (&/or team):
  - Essentially, describing & inputting the artefacts into Zachman Row 3:
    - Develop baseline data-arch description (e.g. need data to support the org?)
    - Review and validate principles, reference models, viewpoints, and tools
    - Create arch models, mapping business functions to CRUD data operations
    - Conduct checkpoint reviews of the arch model & building blocks with SHs
    - Review qualitative criteria (e.g., performance, reliability, security, integrity)
    - Complete data architecture, Conduct impact analysis & gap analysis
  - Major Outputs: Baseline & Target Info and Applications Arch, Gap Analysis.

- Phase D finishes Tech Architecture: mainly with Irma’s technical team
  - Sets out infrastructure needed to support proposed new architecture.
ADM Phase E, F: Opportunities & Solutions and Migration Planning

Phase E identifies ways to deliver Target Arch identified in previous phases:

- Looks at various impln possibilities, identifies the major impln projects possible, assessing business opportunities associated with each.
  
  o TOGAF tells Teri to “focus on projects delivering short-term payoffs and so create an impetus for proceeding with longer-term projects.”
  
  o So Teri should look for projects with maximum saving for minimum staff inputs.
  
  o Look firstly to org pain-points guiding Cath (CEO) towards an EA originally.
  
  o These included difficulties in completing regional/warehouse specialization and unreliability in data sharing.

Phase F takes this to the next stage:

- Teri (with MedAMore’s governance body) prioritises the projects from Phase E
  
  - Include not only the cost & benefits (from Phase E), but also the risk factors.

ADM Phase G, H: Implementation Governance & Arch Change Management

Phase G: Implementation Governance: arch oversight of implementation

- Teri ensures accord with Target Arch by setting arch specs for priority projects
  
  - These specifications will include acceptance criteria and lists of risks and issues.
  
  - Outputs: Populated AR, Architecture Vision, updated post-implementation

Phase H: Arch Change Mgmt: methods to manage change to new arch

- Teri alters the arch change-mgmt with new artefacts & new info from last cycle
  
  - She ensures arch lifecycle is maintained & Governance Framework is executed

- Teri is then ready to start the cycle again.
  
  - First cycle goal is info transfer so Teri’s services needed less with more cycles
  
  - Results depend as much on Teri’s relationship with MedAMore as TOGAF itself
  
  - TOGAF is meant to be very adaptable & sparse on details for various artefacts
**SECTION 1.4: TOGAF AT WORK IN HELIPARTS**

**Case Study #2: TOGAF at Heliparts**

- **The Environment/Problem:**
  - Founded in mid-1990’s in small Helicopter Construction, Repair & Maintenance area
  - By late 2000’s Heliparts was a SME in Crisis
    - Economic downturn,
    - Increased competition combined with
    - Rise of drones
  - ‘perfect storm’ for company
  - Result: Heliparts must reduce cost by 10%

- **Solution:**
  - EA (with TOGAF) suggested for Change Mgmt
  - Heliparts hoped to respond to changing market & identify new opportunities
Case Study #2: Application of ADM

- Architecture Change Management
  - Luckily Heliparts had existing Architecture Board
  - Need to decrease costs taken as necessary change
  - Board mandated an ADM cycle to look into arch changes needed to realise this change
  - Thus org responded to changing market & seeking new opportunities: Part of normal cycle of change!

Case Study #2: ADM Preliminary Phase

- Architecture Board Focus:
  - "where, what, why, who, & how we do architecture" in Heliparts
  - See in this ADM cycle what parts of Heliparts are in/ out of scope
  - Define the Stakeholders & get all onside
  - Reassess use of TOGAF, make changes to BPs needed
  - If after first phase of TOGAF, might need to use org’s own EA team
Case Study #2: ADM Phase A

- Architecture Board Focus: *Statement of Architecture Work*
  - Says how to develop/deploy arch set out in *Architecture Vision*
  - Interview stakeholders and agree timings of architectural work
  - Develop *Arch Vision* covering Business, Application & Technology

![Diagram of Organization Viewpoint (Gap view)](image2)

Case Study #2: ADM Phases BCD

- Board Focus: Develop Baseline and Target Business, Application, Technology Architectures
Case Study #2: ADM Phases BCD (2)

- Board Focus: Develop Baseline and Target Business, Application, Technology Architectures
  - Gap Analysis points to what needs to be done to get to business goals
  - For instance, can see that:
    1. Developing standard Project Parts dB
    2. Aligning departments to a new management structure
    3. Decommissioning certain site-specific applications
      would help realise our goal
  - Note each one of these comes from one of ADM phases BCD

Case Study #2: Phase E Opportunities & Solutions

- Arch Board Focus:
  - Gap analysis output of B-D consolidated into work packages & projects
  - Now look at products & services available to us from suppliers & partners
  - Key here
    - Extract value from projects
    - Organizing them to help firm go from as-is to to-be state in structured manner
  - Found that these can run at same time:
    - Reorganize mgmt & departments
    - Align a product Parts catalogue
  - But the latter was dependent on
    - Moth-balling site-specific applications
    - Moving to a single supplier
Case Study #2: Phase F Migration Planning

- Arch Board Focus: Project Prioritisation
  - If plan is acceptable as realistic & achievable start to develop project charters, stating:
    - scope,
    - objectives, and
    - participants in a project
  - Included, in particular, are:
    - Time
    - Cost
    - Dependencies
    - Resource Requirements
  - Take stakeholders’ views into consideration

Case Study #2: Phases G, H

- Phase G: Implementation Governance
  - Arch Board Focus: Oversee priority projects to accord with Target Arch
  - Set arch specs for projects (eg acceptance criteria & lists of risks, issues)
  - Board also supports them by overseeing:
    - Their initiation
    - Project compliance with guideline specs

- Phase H: Arch Change Management
  - This stage allows the architecture to be developed in a stable environment
  - Provides a mechanism to deal with changes in a controlled manner
  - Saw that changes as firm transitioned into a stable state had enabled us to save >10%
Questions??