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/ 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
  - Blueprint defining structure & 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?

- Basic Defs
- Case Study
- Zachman
- TOGAF
- Ent. Cont.
- ADM
What is The *Point* of Enterprise Architecture? (/2)

- **Basic Defs**
- Case Study
- Zachman
- TOGAF
- Ent. Cont.
- ADM

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

• 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

Brett (business VP)  Cath (CEO)  Irma (CIO)

• 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
SECTION 1.1: A FIRST ENTERPRISE ARCHITECTURE FRAMEWORK
Approach 1: Zachman’s Enterprise Architecture (EA) ‘Framework’

- Zachman’s ‘Framework’ is a widely used approach for developing or documenting an enterprise-wide architecture.
- Main goal: **logical constructs to manage increasing complexity of IS in orgs.**
- Zachman is a 2D matrix representing:
  - **viewpoints** on Y axis;
  - **views** on the X axis.
- In this framework viewpoints are represented by:
  - different stakeholders; and
  - clearly defined deliverables;
<table>
<thead>
<tr>
<th>Perspectives</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>List of Things - Important to the Business</td>
<td>List of Processes - the Business Performs</td>
<td>List of Locations - in which the Business Operates</td>
<td>List of Organizations - Important to the Business</td>
<td>List of Events - Significant to the Business</td>
<td>List of Business Goals and Strategies</td>
</tr>
<tr>
<td><strong>Planner</strong></td>
<td>Entity = Class of Business Thing</td>
<td>Function = Class of Business Process</td>
<td>Node = Major Business Location</td>
<td>People = Class of People and Major Organizations</td>
<td>Time = Major Business Event</td>
<td>Ends/Mes = Major Business Goal/Critical Success Factor</td>
</tr>
<tr>
<td><strong>contextual</strong></td>
<td><strong>ENTERPRISE MODEL</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Owner</strong></td>
<td>E.g., Semantic Model</td>
<td>E.g., Business Process Model</td>
<td>E.g., Logistics Network</td>
<td>E.g., Work Flow Model</td>
<td>E.g., Master Schedule</td>
<td>E.g., Business Plan</td>
</tr>
<tr>
<td><strong>conceptual</strong></td>
<td>E.g., Logical Data Model</td>
<td>E.g., Application Architecture</td>
<td>E.g., Distributed System Architecture</td>
<td>E.g., Human Interface Architecture</td>
<td>E.g., Processing Structure</td>
<td>E.g., Business Rule Model</td>
</tr>
<tr>
<td><strong>SYSTEM MODEL</strong></td>
<td><strong>TECHNOLOGY CONSTRAINED MODEL</strong></td>
<td><strong>DERAILLED REPRESENTATIONS</strong></td>
<td><strong>FUNCTIONING</strong></td>
<td><strong>DATA</strong> Implementation</td>
<td><strong>FUNCTION</strong> Implementation</td>
<td><strong>NETWORK</strong> Implementation</td>
</tr>
<tr>
<td><strong>Designer</strong></td>
<td>E.g., Physical Data Model</td>
<td>E.g., System Design</td>
<td>E.g., Technical Architecture</td>
<td>E.g., Presentation Architecture</td>
<td>E.g., Control Structure</td>
<td>E.g., Rule Design</td>
</tr>
<tr>
<td><strong>logical</strong></td>
<td>Entity = Data Entity</td>
<td>Process = Application Function</td>
<td>Node = IS Function</td>
<td>People = Role</td>
<td>Time = System Event Cycle</td>
<td>End = Structural Assertion</td>
</tr>
<tr>
<td><strong>Builder</strong></td>
<td>E.g., Physical Data Model</td>
<td>E.g., System Design</td>
<td>E.g., Technical Architecture</td>
<td>E.g., Presentation Architecture</td>
<td>E.g., Control Structure</td>
<td>E.g., Rule Design</td>
</tr>
<tr>
<td><strong>physical</strong></td>
<td>Process = Computer Function</td>
<td>I/O = Data Elements/sets</td>
<td>Node = Hardware/System Software</td>
<td>Link = Line Specifications</td>
<td>People = User Work = Screen/Device Format</td>
<td>Time = Execute Cycle = Component Cycle</td>
</tr>
<tr>
<td><strong>SUBCONTRACTOR</strong></td>
<td>E.g., Data Definition</td>
<td>E.g., Program</td>
<td>E.g., Network Architecture</td>
<td>E.g., Security Architecture</td>
<td>E.g., Timing Definition</td>
<td>End = Sub-condition</td>
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</table>

*Lecture 1: Enterprise Architecture: Fundamentals*
• Zachman & Enterprise Architecture (EA)

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 take part in talks;

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.

Lecture 1: Enterprise Architecture: Fundamentals  CA4101 Lecture Notes (Martin Crane 2018)
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 imple
  - 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
Approach 2: The Open Group
Architecture Framework (TOGAF)

• Other Frameworks list deliverables but do not say ‘how’
• TOGAF complements (e.g.) Zachman:
  – Zachman says how to categorise artefacts;
  – TOGAF is a process to create them
• TOGAF
  – answers the ‘how’ (with its ADM ‘Recipe’)
  – useable with other frameworks for their deliverables
  – is a framework by itself, but can be used by itself for its own deliverables!
Approach 2: The Open Group Architecture Framework (TOGAF)

- The Open Group Architecture Framework’s EA view

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 behind interacting apps

**Key part**: *Architecture Development Method (ADM)*
Basic TOGAF Concepts

Conceptual framework of IEEE 1471 (partial view)
TOGAF. Its Worldview

• **TOGAF’s**

  – **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)
TOGAF: The Essentials

- Basic Defs
- Case Study
- Zachman
- TOGAF
- Ent. Cont.
- ADM

The organisation structure, roles, responsibilities, skills and process required to practice Enterprise Architecture.

Is a view of the architecture repository that provides methods for classifying architectures and solution artifacts as they evolve.

Stores different classes of architecture outputs at different levels of abstraction.

ADM provides a tested and repeatable process for delivering architectures.

Lecture 1: Enterprise Architecture: Fundamentals

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The Enterprise Continuum (/2)

- Classifies 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:
    o Architecture Continuum (logical repn)
    o 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 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

TOGAF’s Architecture Development Method (ADM)

Basic Defs
Case Study
Zachman
TOGAF
Ent. Cont.
ADM

Architecture Development Method (ADM), Adapted from TOGAF (2011)
ADM Preliminary Phase

For this phase of MAM-EA ADM Teri needs to:

– Make sure everyone is onside with the TOGAF/ADM process
  o Sounds easy but isn’t a given! Sometimes getting buy-in on EA’s need is hard
  o Especially if IT side is driving, &/or bad blood between IT & business, as here
  o 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
  o Any MedAMore-specific considerations? E.g. use only open-source software?

– Set up the governance system to oversee future architectural work
  o Teri may not work on TOGAF at MedAMore after the first pass
  o 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)
- Has biz reasons for EA request + budget, personnel, constraints & scope
  
  ▪ e.g. Regional Specialization, Data Sharing, Cost-cutting etc

- Define baseline & target architectures (Phases B-D), incl:
  
  ▪ *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
  
  o *Statement of Architecture Work* outlines how to develop / deploy the architecture described in the *Architecture Vision*
ADM Phase A: Architecture Vision
TOGAF Class Exercise

• For Phase A: What are the Contents of the Architecture Vision?
  - What is the problem?
  - Who are the main SHs? What are their Concerns/Requirements?
  - What are the Detailed Objectives of the Architecture?
  - What are the main Business Processes involved?
  - What are the main Actors and their Roles and Responsibilities?
  - What will the Target Architecture look like?
  - How will it solve the problem(s)
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
    o Economic downturn,
    o Increased competition combined with
    o 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
Case Study #2: ADM Phases BCD

- Board Focus: Develop Baseline and Target Business, Application, Technology Architectures

Organisation Viewpoint (Gap view)
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:
    o Their initiation
    o 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??