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

**Why Business and EA?**

**Because**

**Architects**

**Deeply**

**Understand**

**Biz. Capability**

**And**

**Technology**

**Biz. Models**

**Value Discipline**

**Orientation**

**Capabilities**

**People, Process + Technology**

**Mission** → **Vision**

**Strategies** → **Goals**

**Tactics** → **Objectives**

**Drivers**

**Leadership**

**Operational Excellence**

**Customer Intimacy**

**Minimum Threshold to Compete**
What is The *Point* of Enterprise Architecture? (/2)
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;
### Zachman Framework

<table>
<thead>
<tr>
<th>Abstractions</th>
<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></td>
<td>Scope</td>
<td>List of Things</td>
<td>List of Processes</td>
<td>List of Locations</td>
<td>List of Organizations</td>
<td>List of Events</td>
<td>List of Business Goals</td>
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<td></td>
<td>Planner</td>
<td>Important to the Business</td>
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<tr>
<td></td>
<td></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/Mean = Major Business Goal/Critical Success Factor</td>
</tr>
<tr>
<td></td>
<td></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>
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<td></td>
<td>Contextual</td>
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<tr>
<td></td>
<td>Owner</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></td>
<td></td>
<td>Entity = Business 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>
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<td>Designer</td>
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<td>Technological</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></td>
<td>Model</td>
<td>Entity = Table/Segments/etc.</td>
<td>Process = Computer Function</td>
<td>Node = Hardware/System Software</td>
<td>People = User Work</td>
<td>Time = Execute Cycle</td>
<td>End = Condition Means = Action</td>
</tr>
<tr>
<td></td>
<td>Builder</td>
<td>Rel. = Data Relationship</td>
<td>I/O = Data Elements/sets</td>
<td>Link = Line Specifications</td>
<td>Work = Screen/Device Format</td>
<td>Cycle = Component Cycle</td>
<td>Means = Action</td>
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<td>Physical</td>
<td></td>
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<td></td>
<td>Detailed</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>E.g., Rule Specification</td>
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<td>Representations</td>
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<td>Subcontractor</td>
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<td>Out-of-context</td>
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**Lecture 1: Enterprise Architecture: Fundamentals**
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.
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
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 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

Conceptual framework of IEEE 1471 (partial view)
TOGAF’s EA 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)

- 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:
    - 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
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
  o Teri helps sponsoring org here (as MedAMore has never done one before)
  o Includes business reasons for EA request + budget, personnel, constraints & scope
  o Establish high-level definitions for baseline & target architectures (Phases B-D)
  o 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
  o 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 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
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):
  
  o 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

  o Major Outputs: Baseline & Target Info and Applications Arch, Gap Analysis.

- Phase D finishes Tech Architecture: mainly with Irma's technical team
  
  o 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.
    - TOGAF tells Teri to "focus on projects delivering short-term payoffs and so create an impetus for proceeding with longer-term projects."
    - So Teri should look for projects with maximum saving for minimum staff inputs.
    - Look firstly to org pain-points guiding Cath (CEO) towards an EA originally.
    - 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
    o Extract value from projects
    o Organizing them to help firm go from as-is to to-be state in structured manner
  – Found that these can run at same time:
    o Reorganize mgmt & departments
    o Align a product Parts catalogue
  – But the latter was dependent on
    o Moth-balling site-specific applications
    o 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??