Enterprise Architectures are?

An Introduction to Enterprise Architectures
2014 Update
Prof. Duane Truex
Cognitive Map of 8090

IS Architectures as Strategy
Weill, Ross & Robertson, “Enterprise Architecture as Strategy”

Work Systems Models
S. Alter, “Work System Method”

IS architectural components and development
Mid-Range Modeling

ERP as instantiation of Architectures

Architectural Modeling options
The term enterprise architecture refers to many things.

Like architecture in general, it can refer to a description, a process or a profession.

- To some, "enterprise architecture" refers either to the structure of a business, or the documents and diagrams that describe that structure.
- To others, "enterprise architecture" refers to the business methods that seek to understand and document that structure.
- A third use of "enterprise architecture" is a reference to a business team that uses EA methods to produce architectural descriptions of the structure of an enterprise.

A formal definition (from the MIT Center for Information Systems Research)

- "Enterprise Architecture is the organizing logic for business processes and IT infrastructure reflecting the integration and standardization requirements of the firm’s operating model."
Architectural Definitions…

- “Mental forms”
  - A plastic concept
  - A complex metaphorical idea that shapes the categories, discourse and language used. (Densai 2001 in Coneliussen 2008)

- Four metaphors (Smolander, 2002 in Coneliussen 2008)
  - As literature
    - The documentation of an existing artifact
  - As language
    - A vehicle for communication and creating common understanding about some artefact
  - As decision
    - Basis of a rational decision-making process
  - As blueprint
    - The structure of an extant system
Ross says… (MISQ Executive, 2003)

- “The term IT architecture lacks a universally accepted definition. ...the terms architecture and infra-structure are sometimes used interchangeably, with architecture seen as the plan for the next infrastructure. More often, IT architecture refers to a firm’s list of technology standards. But viewing IT architecture only as technology standards does not connect it to business requirements. The enterprise IT architecture concept, though, does place technology standards in the context of business requirements.” (p. 32)

- At the enterprise level, an IT architecture is:
  - the organizing logic for applications, data, and infrastructure technologies, as captured in a set of policies and technical choices, intended to enable the firm’s business strategy. Accordingly, the enterprise architecture implies certain IT capabilities.
  - These capabilities are the objectives of the IT architecture, specifying what the architecture enables the business to do.
  - Enterprise architecture is not just the sum of the technology architecture, applications architecture, and data architecture.
Two distinct streams:
The Business (or Enterprise Architecture) vs the Software architecture
Different descriptions

- Different semantics
  - ‘architecturing’ (Corneliussen, 2008)
    - The process of architecturing
  - Represents different ‘states’
    - Of the system
    - Of a business
    - Of a social order
## Generality, scope, audience

<table>
<thead>
<tr>
<th>Level</th>
<th>Scope</th>
<th>Detail</th>
<th>Impact</th>
<th>Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enterprise Architecture</strong></td>
<td>Agency/Organization</td>
<td>Low</td>
<td>Strategic Outcomes</td>
<td>All Stakeholders</td>
</tr>
<tr>
<td><strong>Segment Architecture</strong></td>
<td>Line of Business</td>
<td>Medium</td>
<td>Business Outcomes</td>
<td>Business Owners</td>
</tr>
<tr>
<td><strong>Solution Architecture</strong></td>
<td>Function/Process</td>
<td>High</td>
<td>Operational Outcomes</td>
<td>Users and Developers</td>
</tr>
</tbody>
</table>

from the 2006 FEA Practice Guidance of US OMB; retrieved from Wikipedia Commons image library, 5/28/09
## Software vs. Business Architecture

<table>
<thead>
<tr>
<th></th>
<th><strong>Software architecture</strong></th>
<th><strong>Business architecture</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus</strong></td>
<td>(Inter)relations among software components</td>
<td>(Inter)relations among business components</td>
</tr>
<tr>
<td><strong>Main Purpose</strong></td>
<td>Documentation</td>
<td>Strategic planning</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td>Software products</td>
<td>Enterprise</td>
</tr>
<tr>
<td><strong>Approach</strong></td>
<td>Top-Down</td>
<td>Top-Down</td>
</tr>
<tr>
<td><strong>Used by</strong></td>
<td>Engineers, Software developers, Software architects</td>
<td>Managers, Enterprise architects</td>
</tr>
<tr>
<td><strong>Leading metaphors</strong></td>
<td>Architecture as literature, Architecture as blueprint</td>
<td>Architecture as decision, Architecture as language</td>
</tr>
</tbody>
</table>

*Table 1: Two architectural streams: Software architecture and Business architecture*

(Corneliussen, 2008)
### Zachman Framework

<table>
<thead>
<tr>
<th>Scope (Contextual)</th>
<th>Data</th>
<th>Function</th>
<th>Network</th>
<th>People</th>
<th>Time</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entity = Class of Business Thing</td>
<td>List of Things Important to the Business</td>
<td>List of Processes of the Business</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/Strat</td>
</tr>
<tr>
<td>Planner</td>
<td>Function = Class of Business Process</td>
<td>People = Major Organizations</td>
<td>Time = Major Business Event</td>
<td>Ends/Means = Major Bus. Goal/Strategic Business Factor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enterprise Model (Conceptual)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>e.g. Semantic Model</td>
<td>e.g. Business Process Model</td>
<td>e.g. Business Logistic System</td>
<td>e.g. Work Flow Model</td>
<td>e.g. Business Plan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System Model (Logical)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Designer</td>
<td>e.g. Local 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. Business Rule Model</td>
</tr>
<tr>
<td>Ent = Data Entity</td>
<td>Proc = Application Function</td>
<td>Node = LS Function</td>
<td>People = Role</td>
<td>Time = System Event Cycle</td>
<td>Ends = Strategic Accountability</td>
</tr>
<tr>
<td>Reln = Data Relationship</td>
<td>I/O = User Views</td>
<td>I/O = Processor System and Line Interface Characteristics</td>
<td>Work = Deliverable</td>
<td>Cycle = Processing Cycle</td>
<td>Means = Action</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technology Model (Physical)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>e.g. Physical Data Model</td>
<td>e.g. System Design</td>
<td>e.g. Technology Architecture</td>
<td>e.g. Presentation Architecture</td>
<td>e.g. Rule Specification</td>
</tr>
<tr>
<td>Ent = Segment/Tabuletto</td>
<td>Proc = Computer Function</td>
<td>Node = Hardware/Software</td>
<td>People = User</td>
<td>Time = Execute Cycle</td>
<td>Ends = Sub-condition</td>
</tr>
<tr>
<td>Reln = Primary/Secondary</td>
<td>I/O = Data Element/Subsystem</td>
<td>Link = Link Specifications</td>
<td>Work = Screen Format</td>
<td>Cycle = Component Cycle</td>
<td>Means = Step</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Detailed Representations (Out-of-Context)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Contractor</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>
</tr>
<tr>
<td>Ent = Field</td>
<td>Proc = Language Syntax</td>
<td>Node = Addresses</td>
<td>People = Identity</td>
<td>Time = Interrupt Cycle</td>
<td>Ends = Sub-condition</td>
</tr>
<tr>
<td>Reln = Address</td>
<td>I/O = Control Steps</td>
<td>Link = Protocols</td>
<td>Work = Job</td>
<td>Cycle = Machine Cycle</td>
<td>Means = Step</td>
</tr>
</tbody>
</table>

### Figure 1: The Zachman ISA Framework from (Sowa and Zachman 1992) (Corneliussen, 2008)
Architecture is…

- Simplistic
  - A description of a systems gross structure
  - With sufficient detail to
    - appraise the completeness and accuracy
    - Conduct high-level analysis
  - Kruchen- “A Rational View”, 1996
Architectures have multiple views

- Logical view
  - Objects, classes categories

- Process view
  - Processes and threads

- Implementation view

- Modules and subsystems

- Deployment view
  - Processors, interconnections and threads

- Use case view
  - Complete overview system description from viewpoint of external actors
Architectural roles

- Understanding
- Reuse
- Construction
- Evolution
- Analysis
- Management
ADLs

- Domain specific
- Need appropriate “R-forms”
  - R-form is the depiction, representation
- Standards for sharing
  - A language like XML
Challenges to address

- Build-vs-buy
- Network-centric computing
  - Publish-and-subscribe
- Standards
- Pervasive computing
Architecture Business Cycle

- Relationship of
  - Architecture to Organization?

- Business Triangle

- The Cycle
  - Building the business case
  - Understanding the requirements
  - Create or select the architecture
  - Document and communicate the architecture
  - Analyze and evaluate the architecture
  - Implement the system base on the architecture
  - Ensure (audit) that the system conforms to the architecture
The corners are interlocking. Change one and all must adjust.

Business Strategy

Manager in the coordinating role

Information Strategy

IS Strategy is affected by the other strategies a firm uses. Changes in IS strategy must be accompanied by changes in the other two.

Organizational Strategy

Includes the whole concept of organizational design

IS strategy has (sometimes unintentional) consequences on the business and organizational strategies.
A ‘Good ‘ Architecture

- Created by whom?
- Functional requirements (whose?)
- Documentation
- Stakeholders ?\Measures?
- Implementation means?
- Reducible?
A ‘Poor’ Architecture

- Obtuse
- Nonspecific or too detailed
- Elements unclear
- Connections uncertain
- Loaded with acronyms and undefined terms
Extended definition

- “…is the structure or structures of the system, which comprise software elements, the externally visible properties of those elements, and the relationships among them.” Bass, Clements, Kazman text pg 21
Caveats

- First
  - Defines software elements
  - An abstraction
  - Contains Public details; not private details

- Second
  - Highlights more than one structure
  - There may be several architectures

- There exist multiple views and elements

- All elements can be seen from the viewpoint of different views
Design Complexity and Architectures

- Do we design for complexity?
The Result of Traditional System Implementation Approaches

Corporate Data

Data
Applications
Technology Platforms

Corporate Networks & Infrastructure Services
Companies gradually mature enterprise architecture and build out their platforms.

<table>
<thead>
<tr>
<th>Business Silos</th>
<th>Standardized Technology</th>
<th>Optimized Core</th>
<th>Business Modularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td></td>
<td></td>
<td>% of Firms</td>
</tr>
</tbody>
</table>

- Locally Optimal Business Solutions
- Enterprise-Wide Technology Standards
- Standardized Enterprise Processes/Data
- Standard Interfaces and Business Componentization

Business Agility


Percentage of firms in each stage is updated based on a 2007 survey of 1508 IT executives.
Architecture maturity increases global agility.

IT spending changes as architecture matures.

<table>
<thead>
<tr>
<th>Strategic Implications of IT</th>
<th>Local/Functional Optimization</th>
<th>IT Efficiency</th>
<th>Operational Efficiency</th>
<th>Strategic Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>11%</td>
<td>14%</td>
<td>17%</td>
<td>18%</td>
</tr>
<tr>
<td>100%</td>
<td>36%</td>
<td>25%</td>
<td>16%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Architecture Maturity

IT budgets are based on a 2007 survey of 1508 IT executives. Business silos budget is the baseline. Budgets for other stages are represented as a percentage of the baseline budget.
Why do we need architecture?
The systems landscape we'd like to have

- Data Warehouse
- Middleware
- Core Processes
- Data
- Applications
- Technology Platforms
- Corporate Networks & Infrastructure Services
How UPS delivers business agility

- Proprietary Delivery Apps
- Package Data
- Package Tracking App
- DIAD/Handheld Device
- Middleware
- Internet Apps
- Links to Partners
- Global Networks & Centralized Infrastructure Services
## All Outsourcing Arrangements Are Not Equal

### Three Mutually Exclusive Models

<table>
<thead>
<tr>
<th></th>
<th>Transaction Arrangement</th>
<th>Co-sourcing Alliance</th>
<th>Strategic Partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What is Outsourced</strong></td>
<td>Narrowly defined, repeatable process</td>
<td>Project management and implementation</td>
<td>Broad responsibility for operational activities</td>
</tr>
<tr>
<td><strong>Key Metrics</strong></td>
<td>Quality and/or cost per transaction</td>
<td>Project success</td>
<td>Bottom-line impact</td>
</tr>
<tr>
<td><strong>Client-Vendor</strong></td>
<td>Arms length</td>
<td>Joint project management</td>
<td>Negotiated accountability</td>
</tr>
<tr>
<td><strong>Client Success ¹</strong></td>
<td>90%</td>
<td>63%</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Vendor Success</strong></td>
<td>90%</td>
<td>75%</td>
<td></td>
</tr>
</tbody>
</table>

### Increasing Risk

¹ Client views based on 80 surveys of outsourcing success. Questions asked: “Within the firm we view this outsourcing agreement as a success” and “The vendor is profiting from the outsourcing arrangement.” Percentage is based on number of respondents who rated the statement as a 4 or 5 on a scale of 1 to 5.

Finding the Sweet Spot for Clients and Vendors

Client Expectations

- Best Practice
- Variable Capacity
- Management Focus on Core Competencies

Sweet Spot

- Low Maintenance Relationship
- Reasonable Margins
- Innovation to Ensure Process Improvements

Vendor Offerings

- Standard Best Practice Process Components
- Economies of Scale
- Distinctive Assets

Transaction Arrangement

Co-Sourcing Alliance

- Cost Savings
- Access to Expertise on Demand
- Variable Project Staffing
- Leverage Offshore
- Disciplined Project Mgmt

- Labor Arbitrage
- Project Management Expertise
- Expertise on Specialized Technologies

Strategic Partnership

- Cost Savings
- Variable Capacity
- Management Focus on Core Competencies
- Capability to Deliver Broad Range of Specialized Services
- Integration Expertise
- Disciplined Practices
- Economies of Scale

1 Based on surveys of 80 IT managers.
2 Based on eight case studies.

## Outsourcing Can Support Architecture Maturity

<table>
<thead>
<tr>
<th>What to Outsource</th>
<th>Business Silo</th>
<th>Standardized Technology</th>
<th>Optimized Core</th>
<th>Business Modularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easily isolated processes</td>
<td>IT infrastructure management</td>
<td>Project management of major systems implementations</td>
<td>Process design and operation with supporting technology</td>
<td></td>
</tr>
<tr>
<td>Ideal Model</td>
<td>Narrowly focused transaction arrangement</td>
<td>Strategic Partnership</td>
<td>Co-Sourcing Alliance</td>
<td>Transaction Arrangement</td>
</tr>
<tr>
<td>Achievable Outsourcing Objectives</td>
<td>Cost savings</td>
<td>IT management discipline; Cost savings; Risk reduction; Management focus</td>
<td>Technology/expertise transfer; Process discipline and reengineering; Management focus; Cost effectiveness; Variable capacity; Risk sharing</td>
<td>Strategic agility; Leverage IT and process expertise for world class business processes; Variable capacity; Management focus; Cost effectiveness; Risk sharing</td>
</tr>
</tbody>
</table>

Firms with more services in place report higher IT savings but lower payback on their SOA investment…

reuse is not the answer

*IT cost savings are highest in firms reporting the highest number of services in production and services reused, but these savings come at a high price.*

1 Payback is the difference between SOA budget and savings from reuse.
SOA is not a silver bullet…
More mature firms have greater reuse of their services and a higher percentage of new software is reused, but they have fewer services.

Delta’s Unification Operating Model

Operational Pipeline

Allocate Resources  Prepare for Flight Departure  Load Aircraft  Flight Departure and Closeout  Monitor Flight  Flight Arrival and Closeout  Unload Aircraft  Clean/Service Aircraft

Electronic Events

Location  Flight  Schedule  Maint.

Nine Core Databases

Equip.  Employee  Aircraft  Customer  Ticket

Delta Nervous System

Pagers  Voice  Video

Gate Readers

Hand Helds

Kiosks

Business Reflexes

Employee Relationship Management

Cell Phones  Desktops

Laptops

Scanners

Reservation Systems

PDAs

Customer Experience

Skylinks  Skymiles  Reservations  Travel Agent  Skycap  Ticket Counter  Crown Room  Boarding  Inflight  Baggage

Personalization  Digital Relationships  Loyalty Programs

Source: Adapted from Delta Air Lines documents. Used with permission.
P&G's Diversification Operating Model

• Strong marketing and customer focus
• Ownership of unique business processes
• Product and service innovation and delivery

• Catalogue of services—some mandatory, some optional
• Marketing approach to build “brand” awareness and loyalty to GBS services
• Ownership of shared solution business processes
• Unit price management with guaranteed reductions over time
• Scorecard of GBS performance with variable compensation
• Architecture interconnecting the different solutions to be building blocks for innovation
• New product development group to add new solutions
• Management of outsourcing partners

Source: MIT CISR Briefing by Peter Weill, Christina Soh, and Siew Kien.
Carlson’s Diversification Operating Model

Source: Carlson Company. Used with permission.
MetLife’s Coordination Operating Model

Source: Adapted from MetLife documents. Used with permission.
ING DIRECT’s Replication Operating Model

Customer Relationship Services
- CIF
- CRM
- Contact History
- Product Info

Core Banking Services
- Mutual Funds
- Brokerage
- Banking Engine
- Credit Score

Common Business Services
- Transactions
- Customers
- Products
- Services

Channel Services
- IVR/CTI Server
- Imaging Server
- E-mail Server
- Web Server
- Gateway Server

External Services
- Prospect Fulfillment
- Statement Fulfillment
- Payments
- Checks
- Reports Local/HQ/Tax

Customer Contact:
- Call Center, IVR, E-mail, Direct Mail

Self-Service:
- Internet, MinTel, ATM, WAP, (WebTV)