

Enterprise Architecture

Enterprise Architectures for Big Data

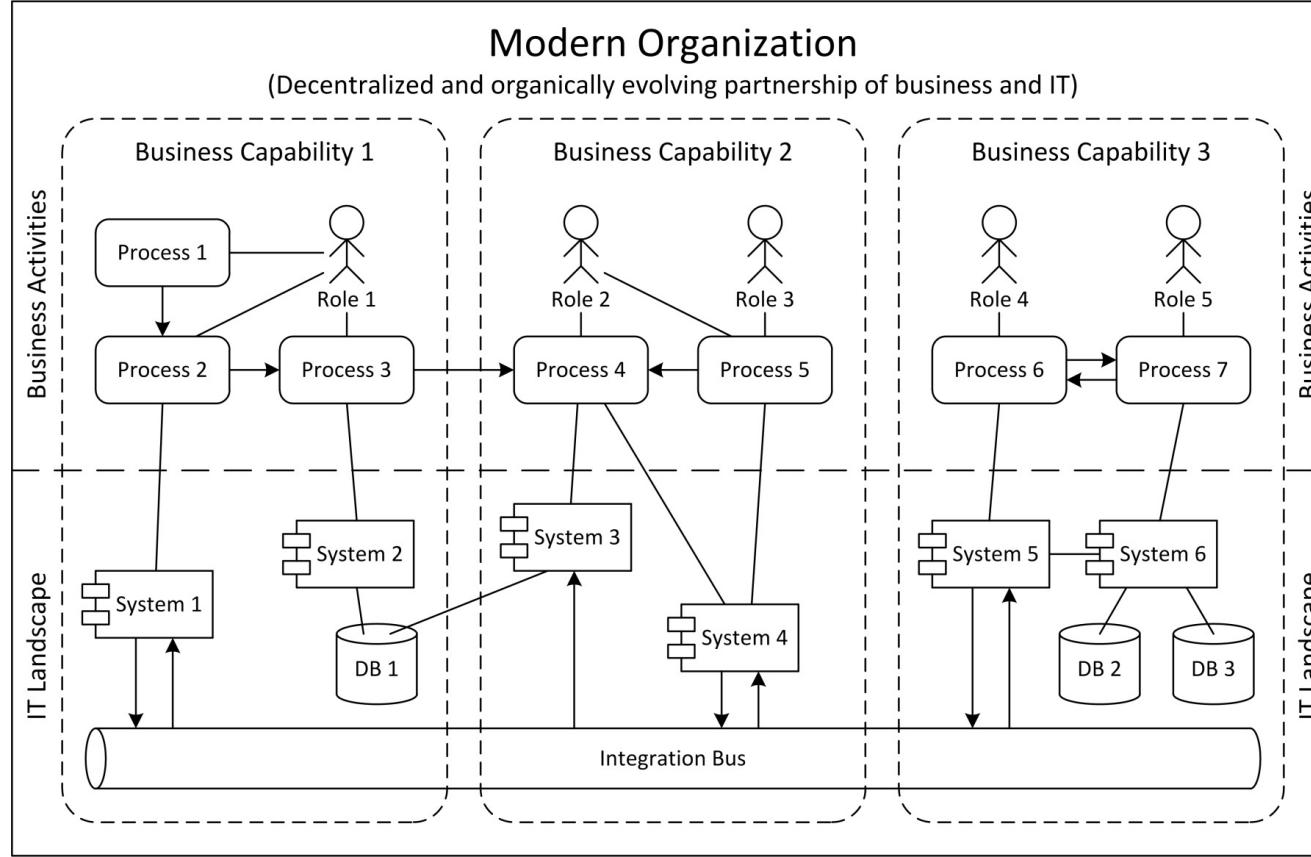


Business and IT Alignment

Organizations as Socio-Technical Systems

- Most organizations today essentially experience the convergence of business and IT
- **Business capabilities** determined largely by the capabilities of its IT systems
- Modern organizations represent complex **socio-technical systems** consisting of diverse but interacting
 - human actors,
 - business processes and
 - IT systems
- Business activities and IT landscapes enabling these activities represent “two sides of the same coin”

The View of a Modern Organization

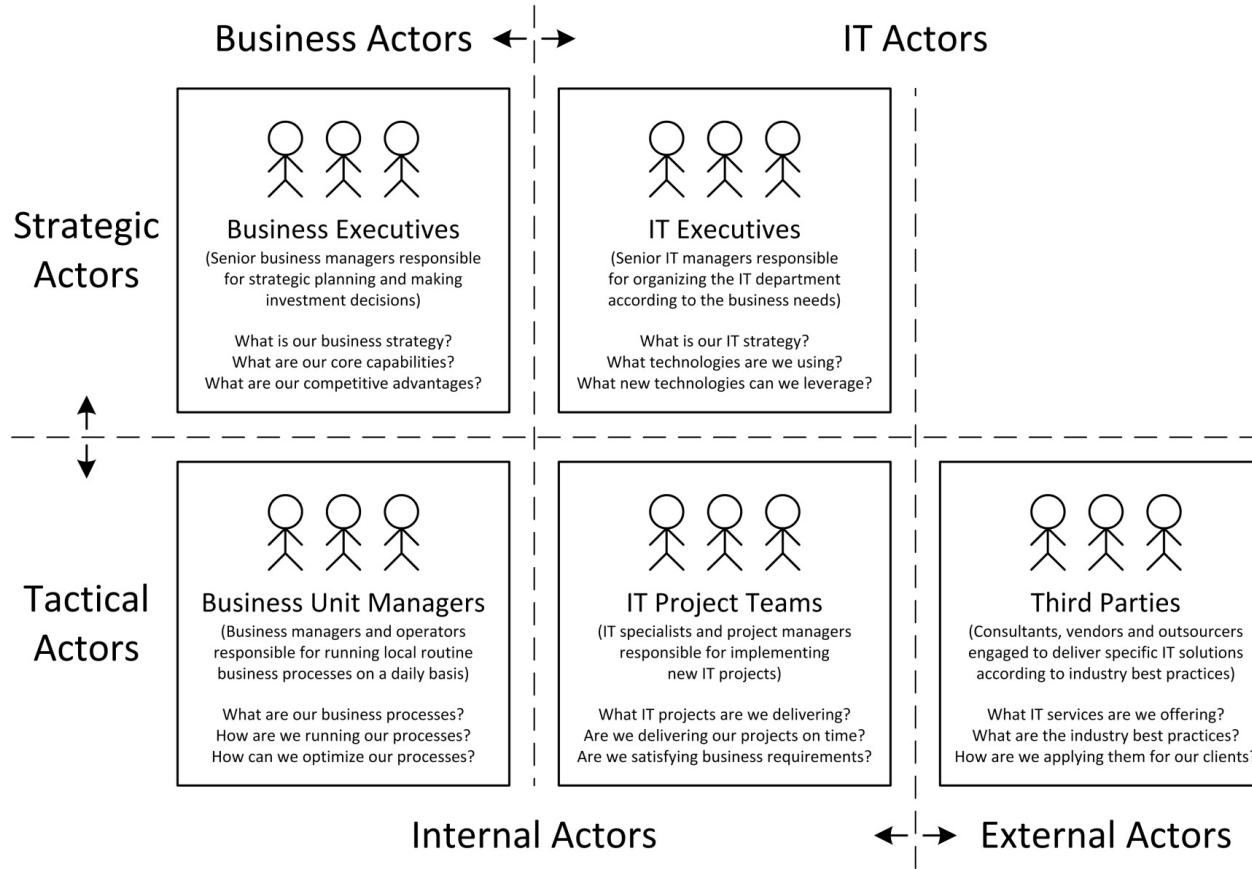


Business and IT Alignment

■ Business and IT alignment

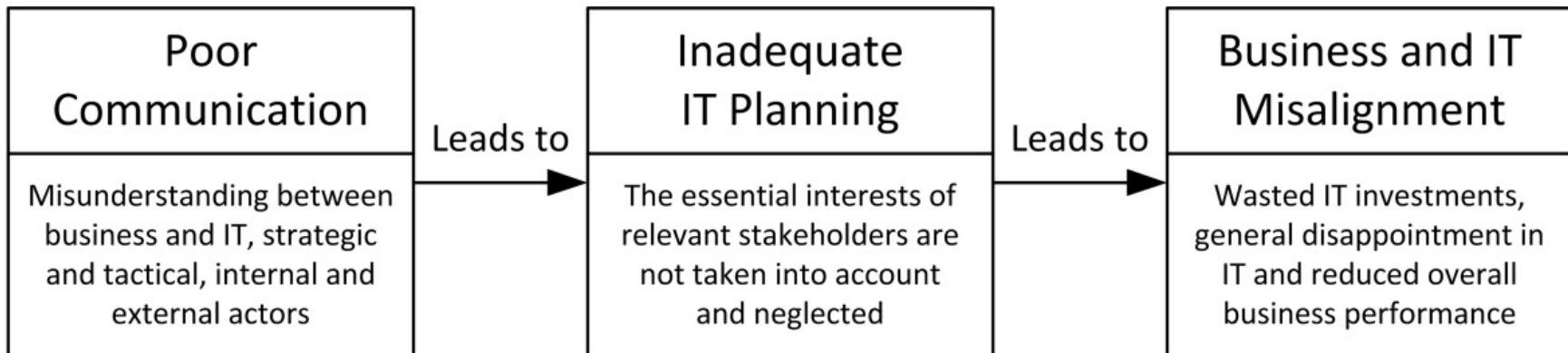
- IT goals, plans and systems in an organization are **consistent** with its business goals, plans and processes
- To achieve alignment
 - an organization should act as a single “big brain” always making best globally and locally optimized business and IT decisions
- However,
 - no actors are **competent enough** to make such optimal planning decisions alone and
 - **powerful enough** to enact the subsequent implementation of these decisions
- For this reason, business and IT alignment requires **collective decision-making** with the involvement of multiple organizational actors

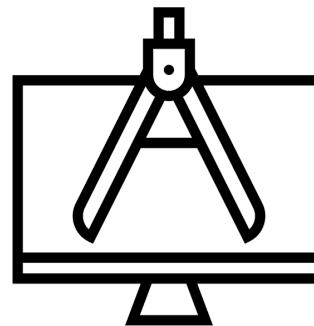
Main Groups of Actors and Boundaries



Miscommunication Causes Misalignment

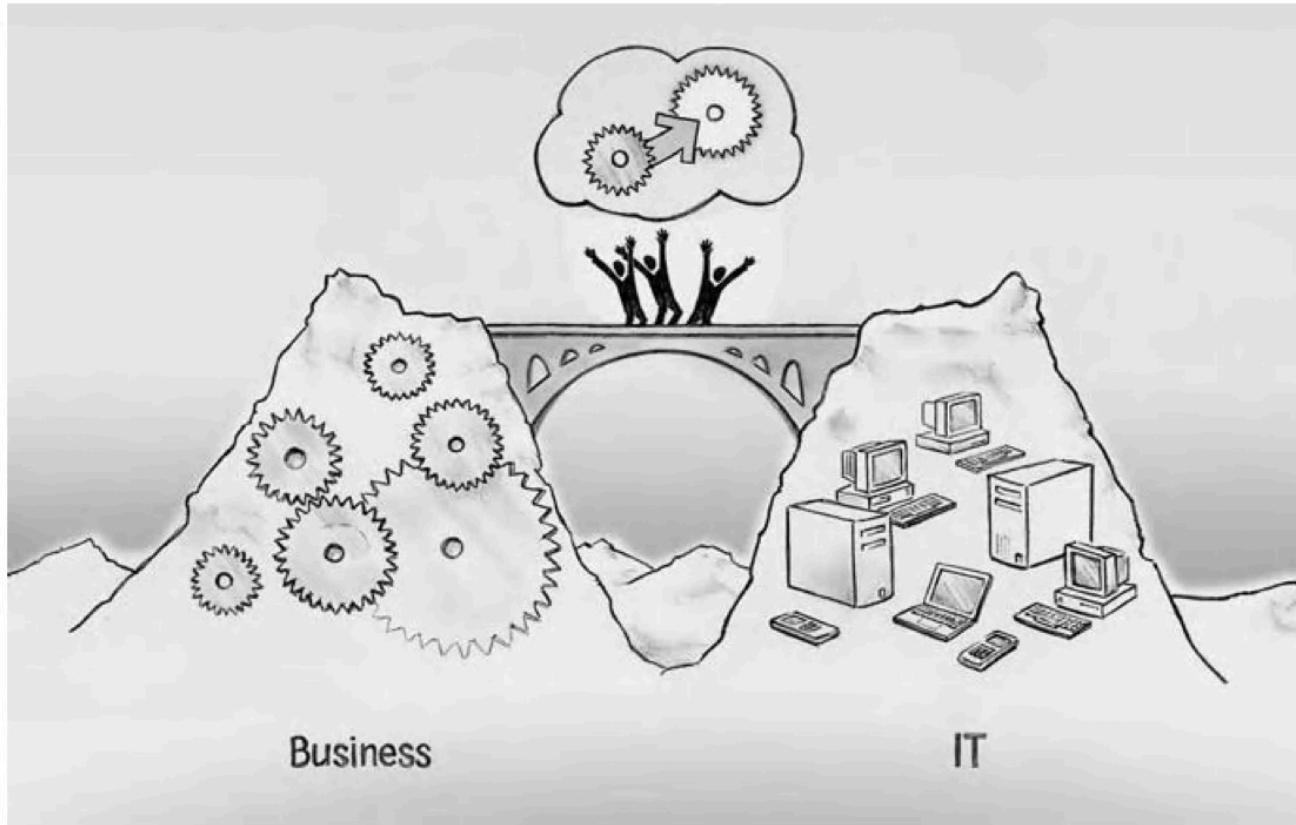
- Misalignment between business and IT
 - caused by miscommunication
 - ends up in wasted IT investments
 - disappointment in IT
 - reduced business performance





Enterprise Architecture

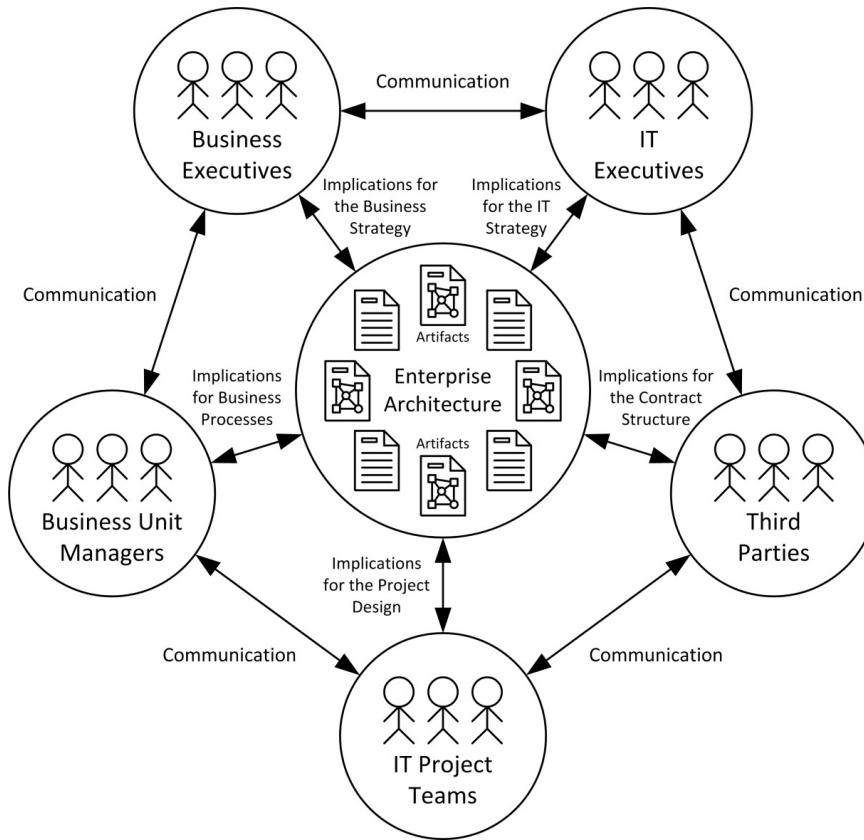
Enterprise Architecture as a Bridge between Business and IT



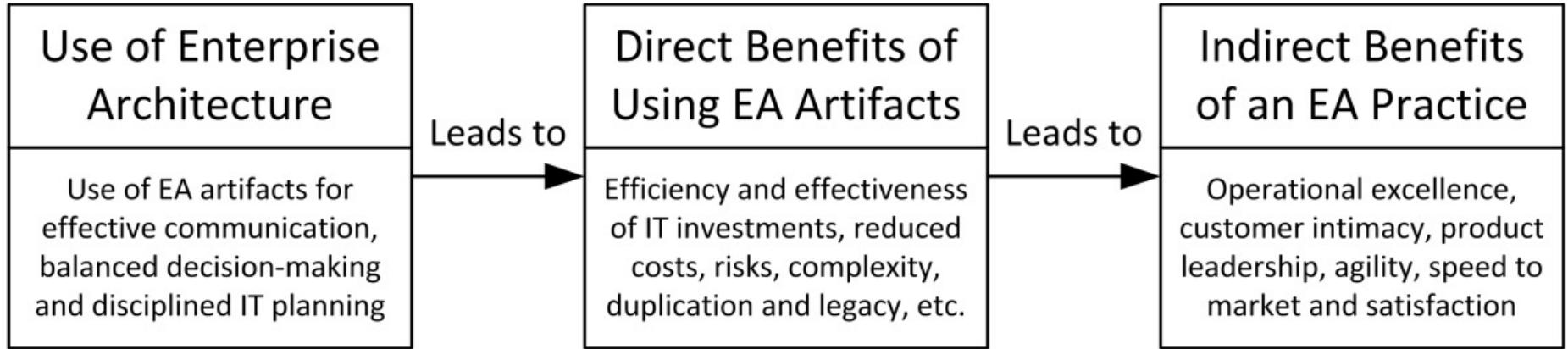
What Is Enterprise Architecture?

- **Enterprise architecture (EA)** can be defined as
 - a collection of special documents (**artifacts**)
 - describing various aspects of an organization
 - from an integrated business and IT perspective
 - intended to **bridge the communication gap** between
 - business and
 - IT stakeholders,
 - facilitate **information systems planning**
 - and thereby improve **business and IT alignment**

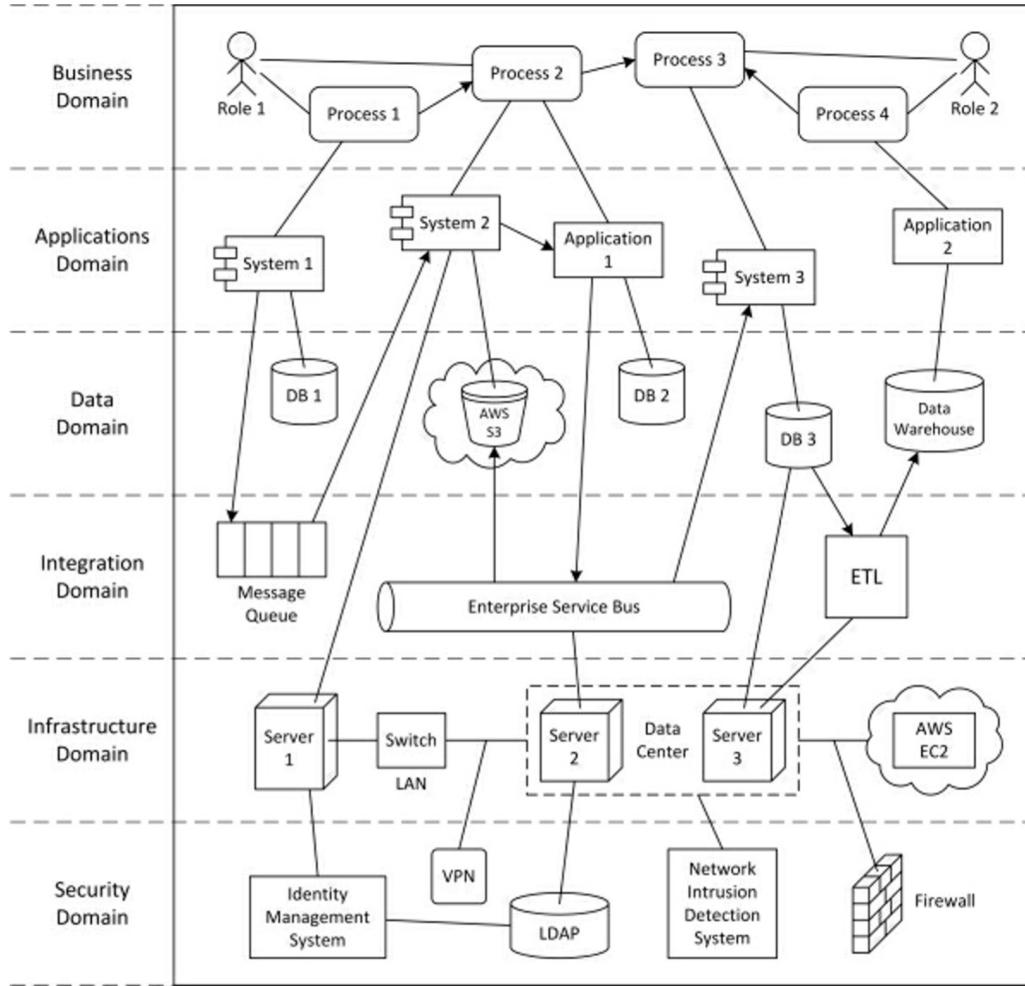
EA as an Instrument for Communication



Link Between Direct and Indirect Benefits



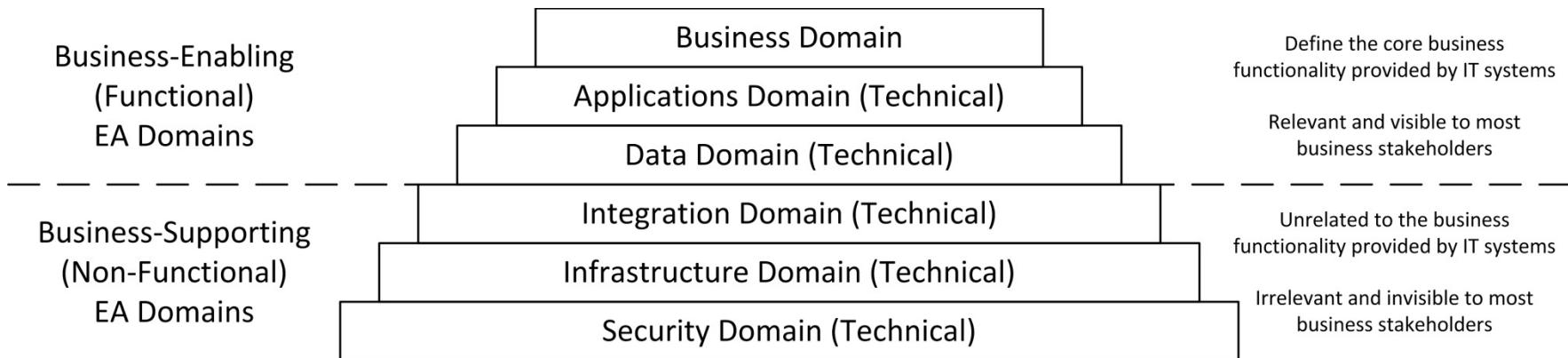
EA Domains as different layers of an organization

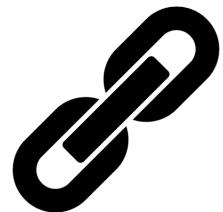


The Stack of EA Domains

■ EA domains

- Multilayered
- Lower layers underpin higher layers

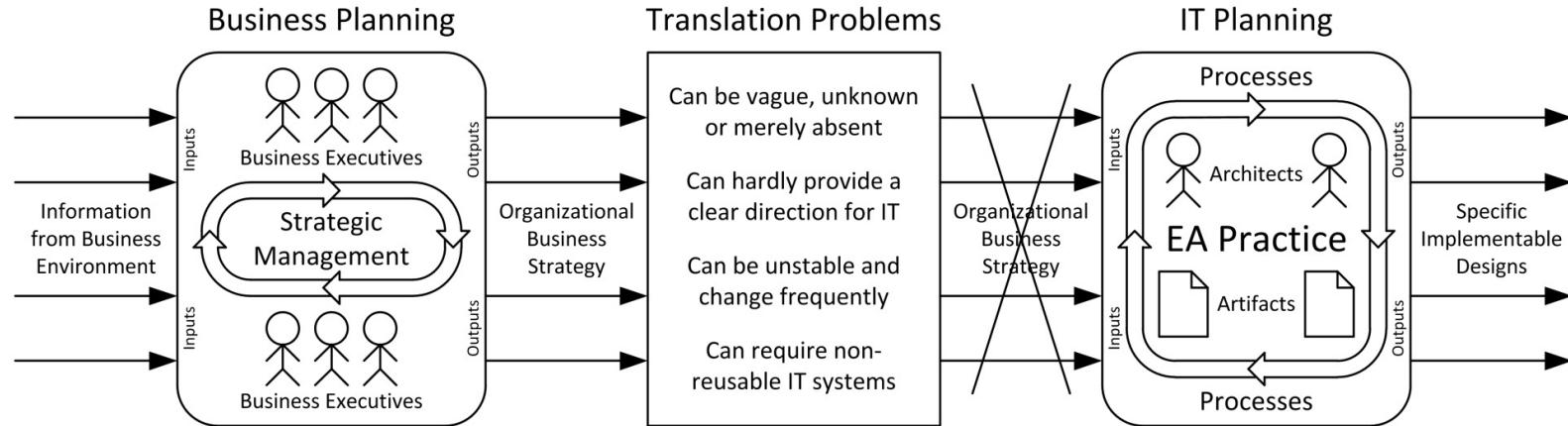




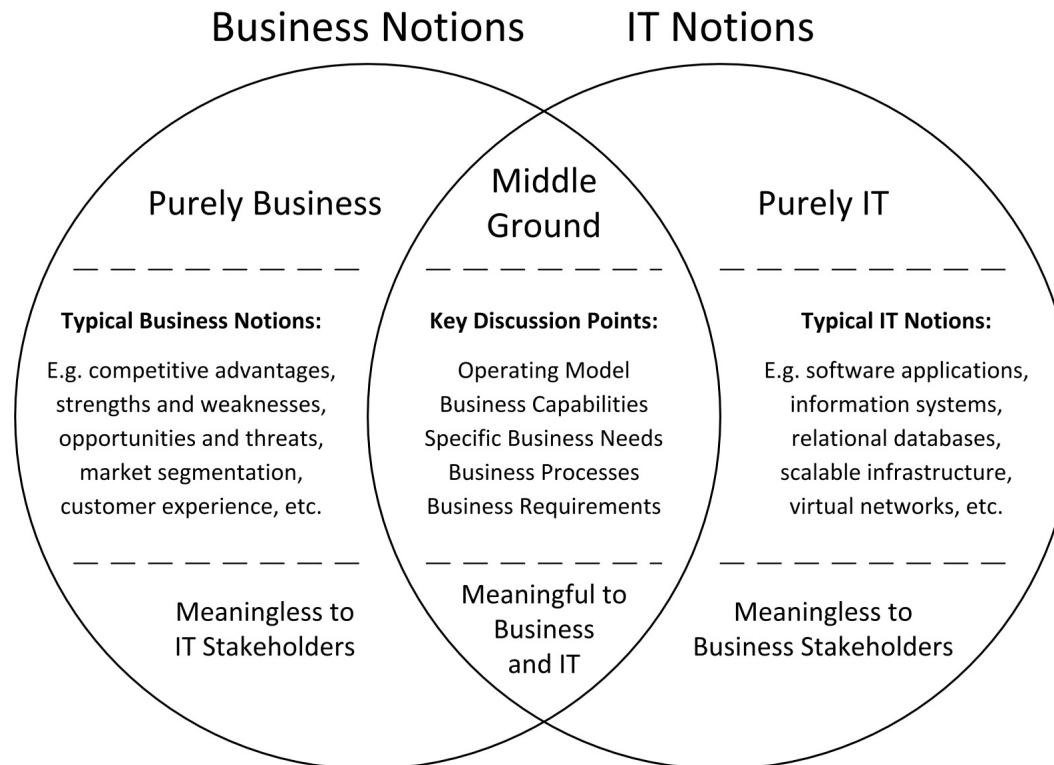
Link between Business Strategy and IT Architecture

The Role of Strategy for an EA Practice

- The business strategy in a narrow sense rarely provides a very useful input for an EA practice
- The strategy specifies neither what IT should do right now, nor what IT should provide after the next 3-5 years
- A business strategy sets only the “soft” context for an EA practice, but does not provide enough “hard” data



Convenient Discussion Points



Operating Model

- **Operating model** is the desired level of
 - organization-wide process standardization and
 - data integration
- **Process standardization**
 - Degree to which business units should perform same business processes in the same way
- **Data integration**
 - Degree to which business units should share business data between each other
- The combination of these two decisions defines four possible operating models:
 - Diversification
 - Coordination
 - Replication
 - Unification

Four Operating Models

		Low	High
		Process Standardization Across Business Units	
Data Integration Across Business Units	High	Coordination Business Units: Diverse but interdependent, run different business processes but share some common data IT Landscape: Local applications owned by business units, global databases, IT services and infrastructure Key Features: Superior customer service, local innovations, transparency, cross-selling and upselling opportunities Strategic Leverages: Deep process expertise of business units, common IT infrastructure for global data sharing	Unification Business Units: Similar and interdependent, run same business processes and share some common data IT Landscape: Global applications, databases, IT services and infrastructure shared by all business units Key Features: Efficient business processes, consistent customer experience, integrated data, minimized costs Strategic Leverages: Significant economies of scale resulting from the global standardization and integration
	Low	Diversification Business Units: Diverse and independent, run different business processes and do not share any common data IT Landscape: Local applications and databases owned by business units, global IT services and infrastructure Key Features: Independence, flexibility and local autonomy of separate business units in serving their customers Strategic Leverages: Synergies between business units, economies of scale from shared IT infrastructure and services	Replication Business Units: Similar but independent, run same business processes but do not share any common data IT Landscape: Globally standardized but locally owned applications and databases, global IT services and infrastructure Key Features: Efficient business processes, consistent customer experience, capacity for global process innovation Strategic Leverages: Standardized business processes and systems for expanding into new markets and offering new services

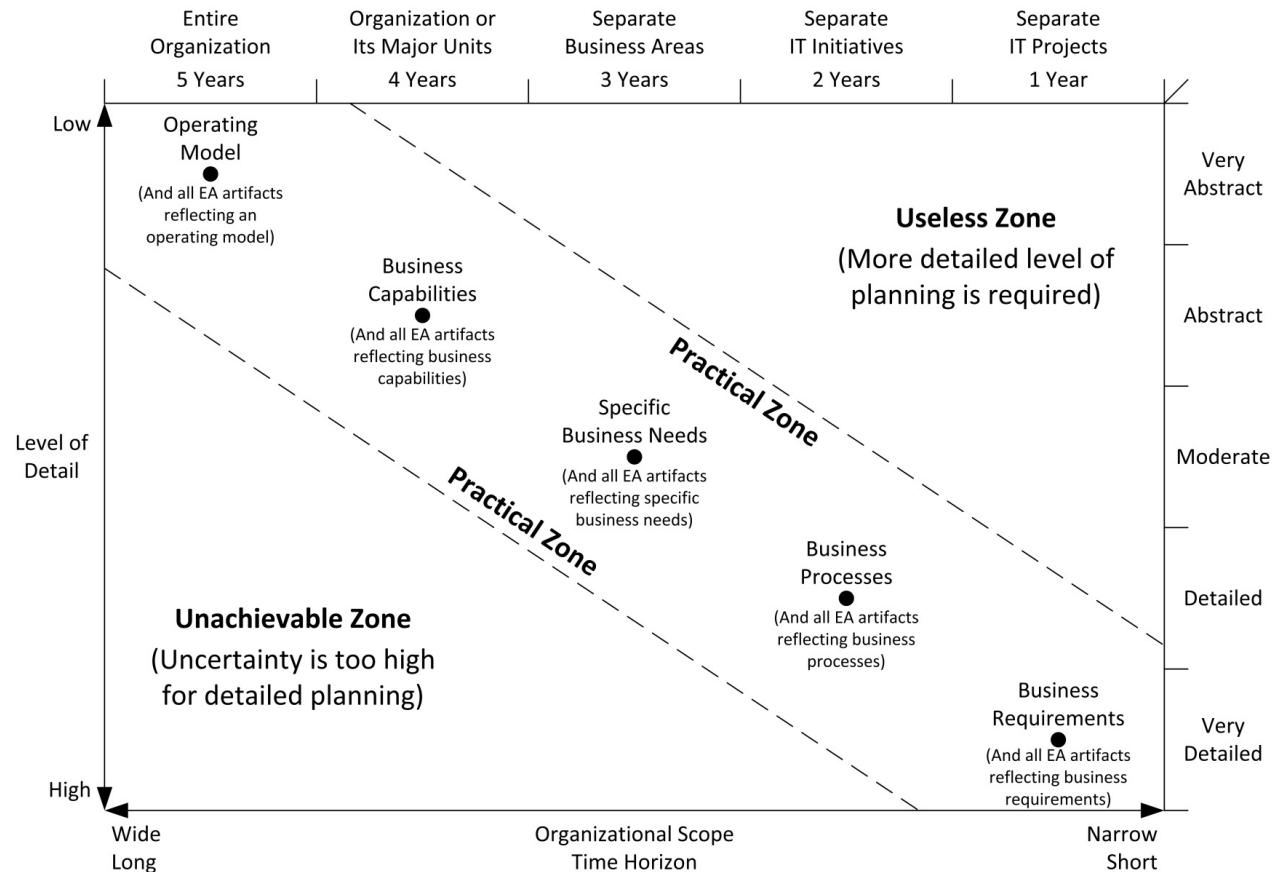
Business Capabilities

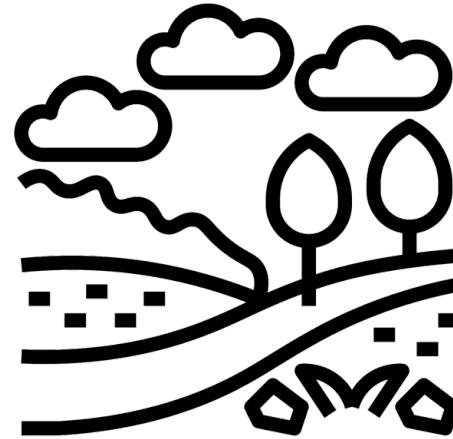
- A **business capability** is a general ability or capacity of an organization to perform a specific business activity
- The full set of all organizational business capabilities represents everything that an organization can do or needs to do to run its business
- Business capabilities are multifaceted notions encompassing all underlying
 - business processes,
 - people,
 - knowledge and
 - other resources, including information systems, required to fulfill these capabilities
- Business capabilities of an organization offer a **stable view** of its business and change pretty rarely, only in case of significant business transformations

Properties of the Key Discussion Points

Discussion point	Abstraction level	Planning scope	Planning horizon	Key business concerns	Key IT concerns
Operating model	Very abstract	Very wide (entire organization)	Very long-term (>3-5 years)	What operating model should be appropriate for the business of an entire organization?	What general structure of the IT landscape is required to enable the adopted operating model?
Business capabilities	Abstract	Wide (entire organization or major business units)	Long-term (3-5 years)	What business capabilities should be improved to execute the business strategy?	What IT capabilities are required to improve the strategic business capabilities?
Specific business needs	Moderate	Moderate (separate business areas)	Mid-term (2-3 years)	What specific business needs should be addressed in the future?	What types of IT solutions are required to address the identified business needs?
Business processes	Detailed	Narrow (separate IT initiatives)	Short-term (1-2 years)	How should specific business processes be changed?	What systems, data and infrastructure are required to change the business processes as requested?
Business requirements	Very detailed	Very narrow (separate IT projects)	Very short-term (<1 year)	What specific business functionality should be provided?	What technical structure of IT systems is required to provide the necessary functionality?

EA Uncertainty Principle



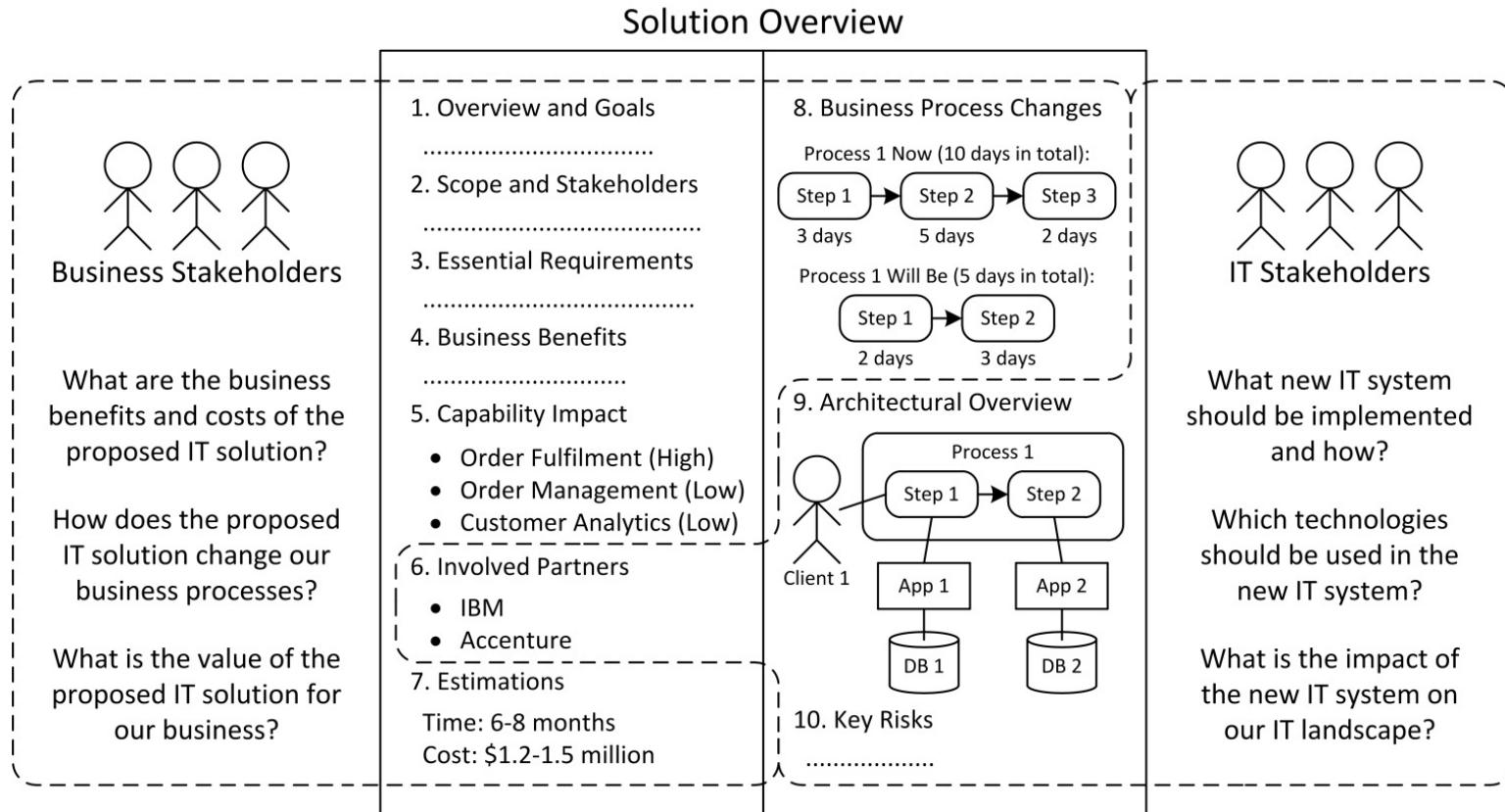


The Nature of EA Artifacts

Duality of EA Artifacts

- **Duality of EA artifacts** implies that the information provided is
 - **relevant** to two different audiences simultaneously,
 - satisfies the **information needs** of both these audiences
 - and presented in a **convenient format** appealing to both audiences
- Duality allows using EA artifacts as a **means of communication** between different groups of actors
- **Explicit duality**
 - relevant to different groups of actors
- **Implicit duality**
 - interpreted differently by different actors

Example of a Dual EA Artifact



Two Meanings of EA Artifacts

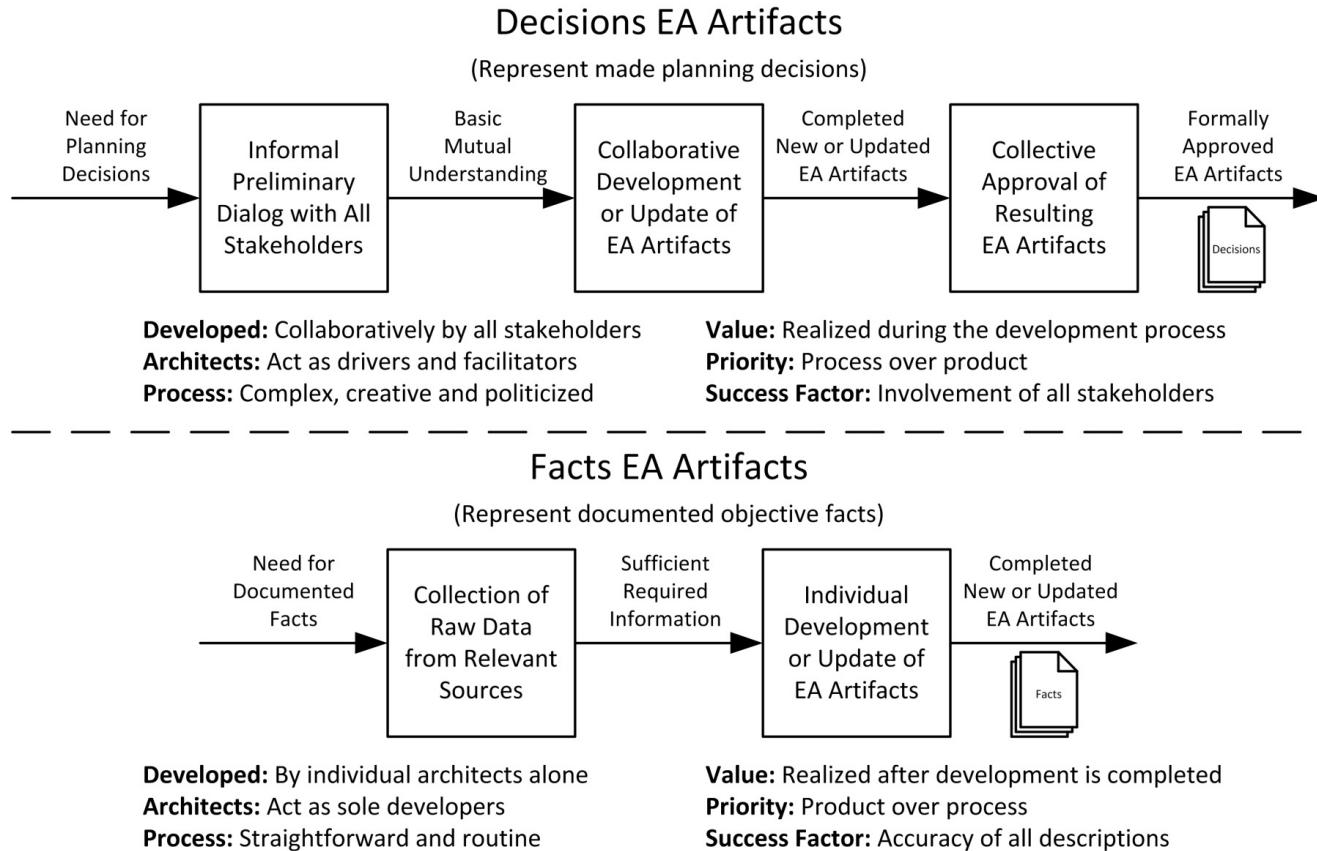
■ Decisions EA artifacts

- represent made **planning decisions**
- achieved and formalized agreements between various stakeholders regarding the desired future course of action
- always developed or updated **collaboratively** by all relevant stakeholders

■ Facts EA artifacts

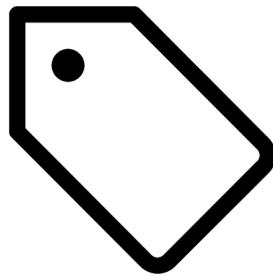
- represent documented **objective facts**
- reflections of the actual current situation in an organization as it is
- may be developed or updated solely by specific actors

Processes for Developing EA Artifacts



Examples of EA Artifacts

EA Artifact	Principles	Landscape Diagram	Solution Design
Example	<p>Principle 1: Standardized Business Processes Statement: Rationale: Implications:</p> <p>Principle 2: Single Customer View Statement: Rationale: Implications:</p> <p>Principle 3: Business Continuity Statement: Rationale: Implications:</p>		<p>1. Brief Overview 2. Goals and Objectives 3. Detailed Requirements 4. Solution Context</p> <p>5. Data Architecture </p> <p>6. Application Architecture </p> <p>7. Infrastructure Architecture </p>
Description	General imperatives defining how the whole organization needs to work, updated on a yearly basis	A snapshot of the current IT landscape in a specific business function, maintained up-to-date	A detailed technical description of a specific IT project which is going to be implemented shortly
Analysis of EA Artifacts			
Format	Textual	Graphical	Textual and graphical
Detail	Very low level of detail	Low level of detail	High level of detail
Scope	Entire organization	Business function	Separate IT project
Domains	Business	Applications, data and integration	Business, applications, data and infrastructure
State	Stateless (no specific time focus)	Current state	Short-term future state
Dual	Yes	No	Yes
Meaning	Decisions	Facts	Decisions
Lifecycle	Permanent	Permanent	Temporary



Taxonomy of EA Artifacts

Taxonomy of EA Artifacts

- Two orthogonal dimensions
- Dimension 1: *what* objects they describe
- Dimension 2: *how* they describe objects

Taxonomy of EA Artifacts

- Dimension 1: *what* objects they describe
 - **Rules** - describe *broad global rules* defining an organization or its divisions
 - **Structures** - describe *high-level structures* of an organization or its parts
 - **Changes** - describe specific *proposed incremental changes* to an organization
- Dimension 2: *how* they describe objects
 - **Business-focused** - tend to be technology-neutral and use business language (money, customers, capabilities, business goals, competitive advantages, etc.)
 - **IT-focused** - tend to be purely technical and use IT-specific language (systems, applications, databases, platforms, networks, etc.)

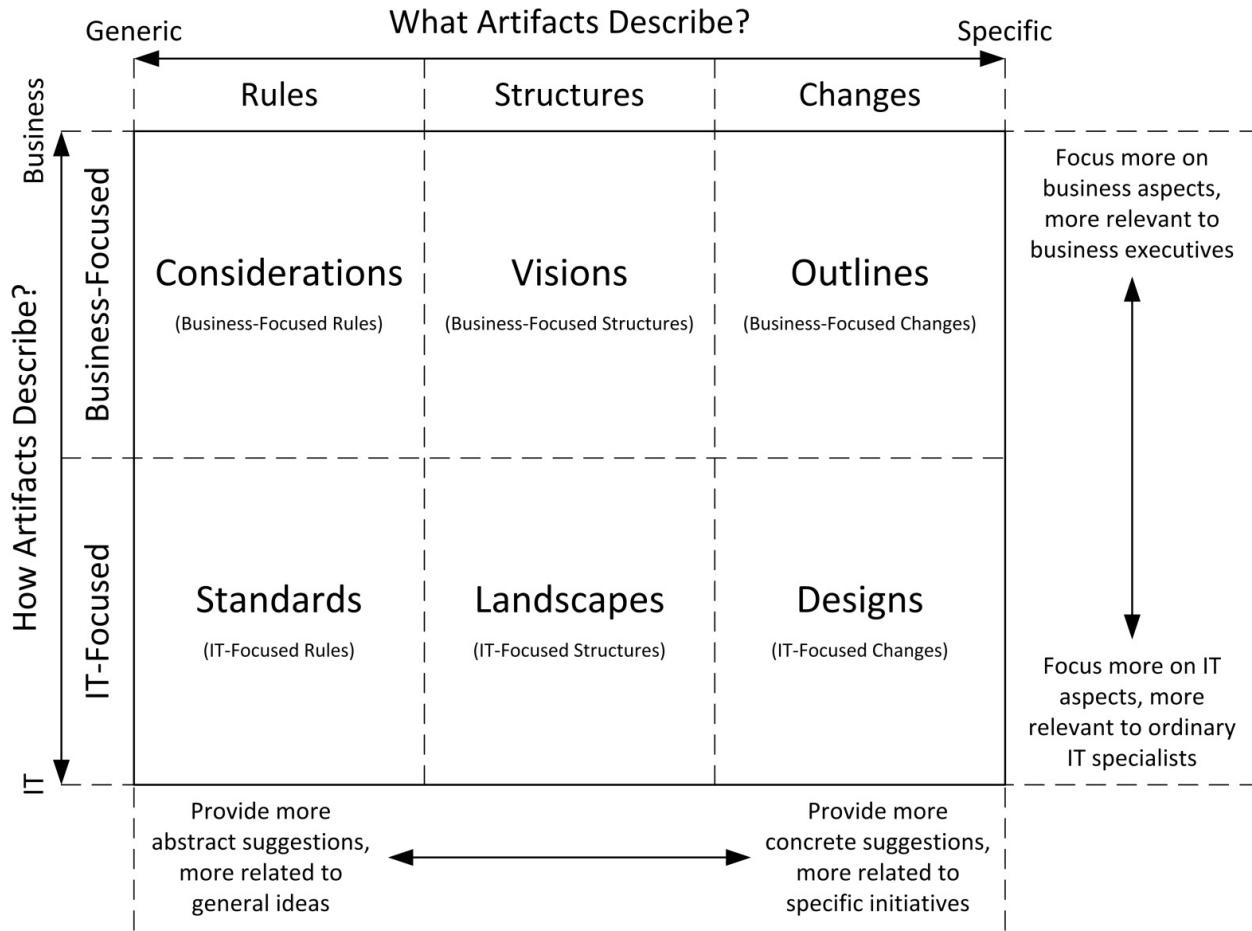
Dimension 1: *what objects they describe*

Rules, Structures and Changes

Artifacts	Rules	Structures	Changes
Describe	Broad global rules defining an organization or its divisions	High-level structures of an organization or its parts	Specific proposed incremental changes to an organization
Scope	Very wide, often cover an entire organization	Wide, often cover large parts of an organization	Narrow, limited to separate IT initiatives or projects
Format	Often textual	Usually graphical	Mix of textual and graphical
Question	How do we work or want to work?	What approximately do we have or want to have?	What exactly are we going to change right now?
Lifecycle	Permanent, created once and then periodically updated	Permanent, created once and then continuously updated	Temporary, created for specific purposes and then discarded
Role	Basis for all other planning decisions	High-level “maps” facilitating decision-making	Tactical plans of an organization
Purpose	Help achieve consistency and homogeneity of all planning decisions	Help understand what changes are desirable and how to implement them	Help plan separate changes in detail

Dimension 2: *how they describe objects* Business- and IT-Focused EA Artifacts

Artifacts	Business-focused	IT-focused
Language	Technology-neutral business language	Technical IT-specific language
Domains	Business domain and often other relevant domains at a high level	Applications, data, integration, infrastructure, security domains and sometimes business domain
Format	Brief, intuitive, largely informal and include only the most essential information	Can be voluminous, formal, use strict notations and include comprehensive details
Stakeholders	Business leaders and architects	Architects and other IT specialists
Role	Communication interfaces between business and IT	Internal IT tools invisible to business
Purpose	Help business leaders manage IT	Help architects organize IT

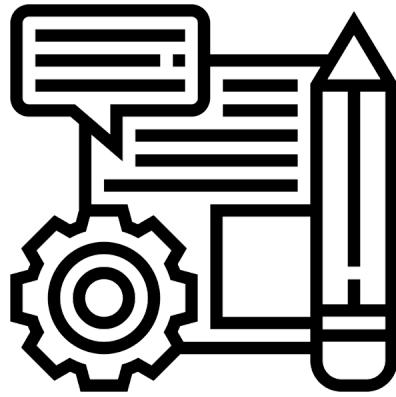


What Artifacts Describe?

How Artifacts Describe?

	Rules	Structures	Changes	
Business-Focused	Considerations (Business-Focused Rules)	Visions (Business-Focused Structures)	Outlines (Business-Focused Changes)	Language: Technology-neutral business language Domains: Business domain and often other relevant domains at a high level Format: Brief, intuitive, largely informal and include only the most essential information Stakeholders: Business leaders and architects Role: Communication interfaces between business and IT Purpose: Help business leaders manage IT
IT-Focused	Standards (IT-Focused Rules)	Landscapes (IT-Focused Structures)	Designs (IT-Focused Changes)	Language: Technical IT-specific language Domains: Various technical domains and sometimes also business domain Format: Can be voluminous, formal, use strict notations and include comprehensive details Stakeholders: Architects and other IT specialists Role: Internal IT tools invisible to business Purpose: Help architects organize IT
	Describe: Broad global rules defining an organization or its divisions Scope: Very wide, often cover an entire organization Format: Often textual Question: How do we work or want to work? Lifecycle: Created once and then periodically updated Role: Basis for all other planning decisions Purpose: Help achieve consistency and homogeneity	Describe: High-level structures of an organization or its parts Scope: Wide, often cover large parts of an organization Format: Usually graphical Question: What approximately do we have or want to have? Lifecycle: Created once and then continuously updated Role: High-level “maps” facilitating decision-making Purpose: Help understand what changes are desirable and how to implement them	Describe: Specific proposed changes to an organization Scope: Narrow, limited to separate IT initiatives or projects Format: Mix of textual and graphical Question: What exactly are we going to change right now? Lifecycle: Created for specific purposes and then discarded Role: Tactical plans of an organization Purpose: Help plan separate changes in detail	

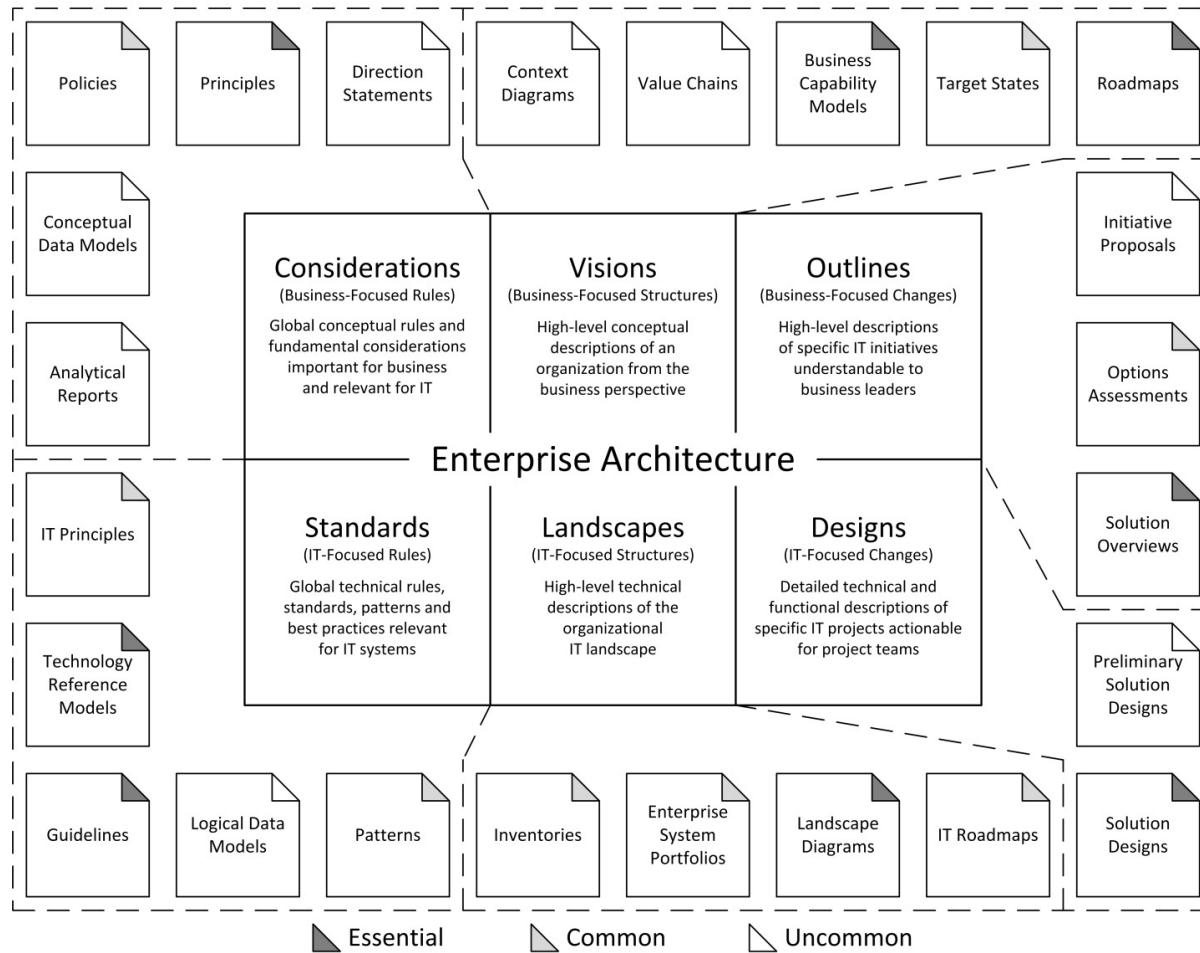
<h2>Considerations</h2> <p>(Business-Focused Rules)</p> <p>Content: Global conceptual rules and fundamental considerations important for business and relevant for IT</p> <p>Meaning: Decisions on how an organization needs to work from the IT perspective</p> <p>Usage: Developed collaboratively by senior business leaders and architects and then used to influence all architectural decisions</p> <p>Purpose: Help achieve the agreement on basic principles, values, directions and aims</p> <p>Benefits: Improved overall consistency between business and IT</p>	<h2>Visions</h2> <p>(Business-Focused Structures)</p> <p>Content: High-level conceptual descriptions of an organization from the business perspective</p> <p>Meaning: Decisions on what IT should deliver to an organization in the long run</p> <p>Usage: Developed collaboratively by senior business leaders and architects and then used to guide IT investments, identify, prioritize and launch new IT initiatives</p> <p>Purpose: Help achieve the alignment between IT investments and long-term business outcomes</p> <p>Benefits: Improved strategic effectiveness of IT investments</p>	<h2>Outlines</h2> <p>(Business-Focused Changes)</p> <p>Content: High-level descriptions of specific IT initiatives understandable to business leaders</p> <p>Meaning: Decisions on how approximately specific IT initiatives should be implemented</p> <p>Usage: Developed collaboratively by architects and business leaders and then used to evaluate, approve and fund specific IT initiatives</p> <p>Purpose: Help estimate the overall business impact and value of proposed IT initiatives</p> <p>Benefits: Improved efficiency and ROI of IT investments</p>
<h2>Standards</h2> <p>(IT-Focused Rules)</p> <p>Content: Global technical rules, standards, patterns and best practices relevant for IT systems</p> <p>Meaning: Decisions on how all IT systems should be implemented and some facts on the current approaches and technologies</p> <p>Usage: Developed collaboratively by architects and technical subject-matter experts and used to shape architectures of all IT initiatives</p> <p>Purpose: Help achieve technical consistency, technological homogeneity and regulatory compliance</p> <p>Benefits: Faster initiative delivery, reduced costs, risks and complexity</p>	<h2>Landscapes</h2> <p>(IT-Focused Structures)</p> <p>Content: High-level technical descriptions of the organizational IT landscape</p> <p>Meaning: Facts on the current IT landscape and some decisions on its future evolution</p> <p>Usage: Developed and maintained by architects and used to rationalize the IT landscape, manage the lifecycle of IT assets and plan new IT initiatives</p> <p>Purpose: Help understand, analyze and modify the structure of the IT landscape</p> <p>Benefits: Increased reuse and agility, reduced duplication and legacy</p>	<h2>Designs</h2> <p>(IT-Focused Changes)</p> <p>Content: Detailed technical and functional descriptions of specific IT projects actionable for project teams</p> <p>Meaning: Decisions on how exactly specific IT projects should be implemented</p> <p>Usage: Developed collaboratively by architects, project teams and business representatives and then used by project teams to implement IT projects</p> <p>Purpose: Help implement approved IT projects according to business and architectural requirements</p> <p>Benefits: Improved quality of the project delivery</p>

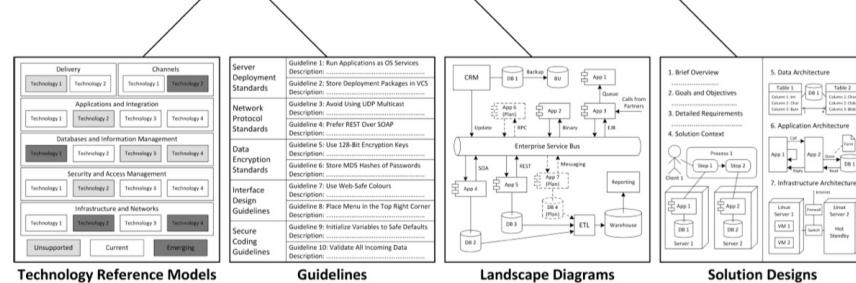
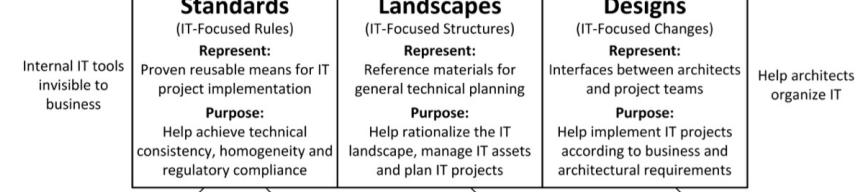
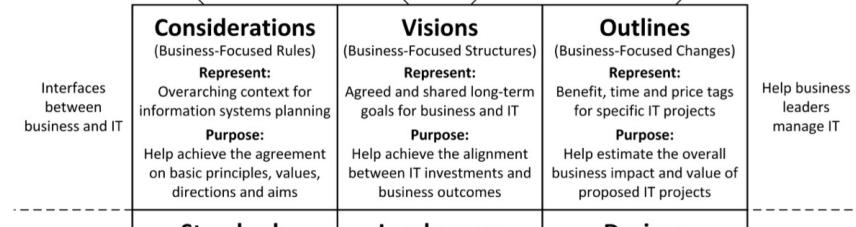
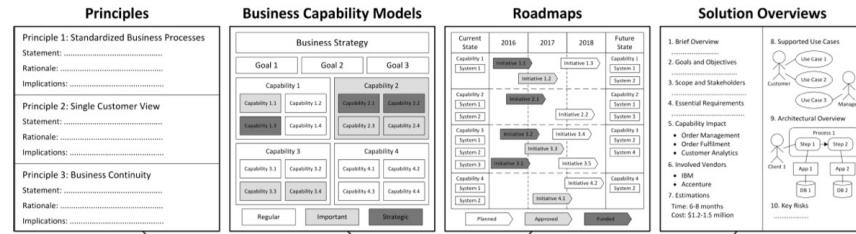


Eight Essential EA Artifacts

EA Artifacts

Considerations (Business-Focused Rules)	Visions (Business-Focused Structures)	Outlines (Business-Focused Changes)
Principles (essential) Policies (common) Conceptual Data Models (uncommon) Analytical Reports (uncommon) Direction Statements (uncommon)	Business Capability Models (essential) Roadmaps (essential) Target States (common) Value Chains (uncommon) Context Diagrams (uncommon)	Solution Overviews (essential) Options Assessments (common) Initiative Proposals (uncommon)
Standards (IT-Focused Rules)	Landscapes (IT-Focused Structures)	Designs (IT-Focused Changes)
Technology Reference Models (essential) Guidelines (essential) Patterns (common) IT Principles (common) Logical Data Models (uncommon)	Landscape Diagrams (essential) Inventories (common) Enterprise System Portfolios (common) IT Roadmaps (common)	Solution Designs (essential) Preliminary Solution Designs (uncommon)





Principles Considerations (Business-Focused Rules)

- **Principles** are specific Considerations defining global high-level guidelines influencing all decision-making and planning in an organization
- Sometimes they can be **also called** *maxims* or *drivers*
- Formulated as **brief written statements** defining what is important for an organization
- The definition of a single Principle often includes its statement, rationale and implications
- Once established, Principles act as underpinning drivers of all IT-related decision-making processes
- Alignment to Principles is required for all plans and decisions reflected in other EA artifacts

Principles Considerations (Business-Focused Rules)

Principle 1: Standardized Business Processes

Statement:

Rationale:

Implications:

Principle 2: Single Customer View

Statement:

Rationale:

Implications:

Principle 3: Business Continuity

Statement:

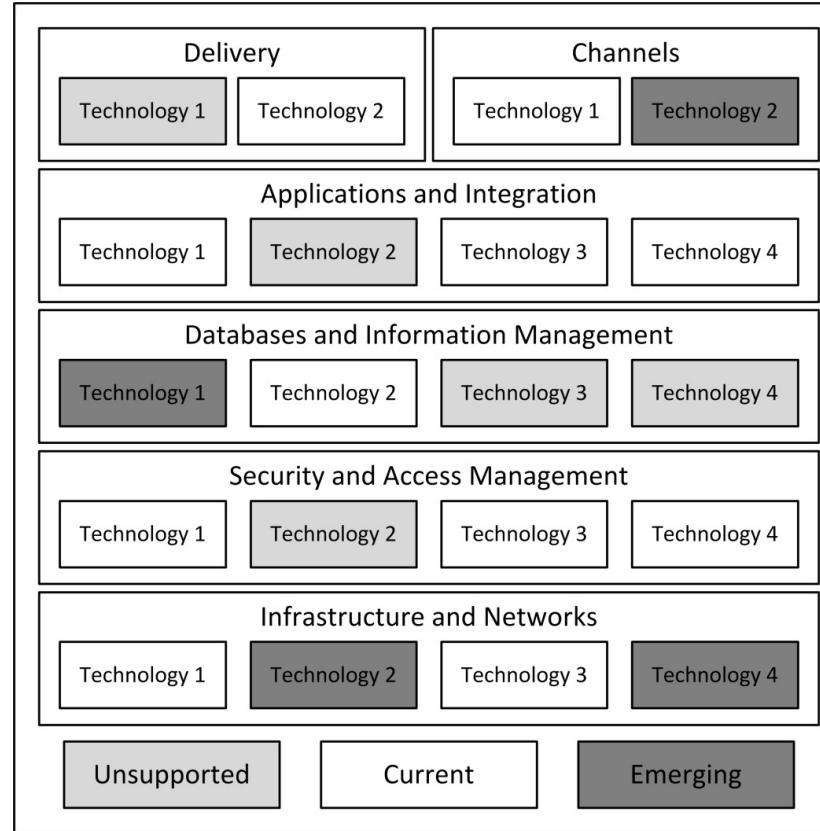
Rationale:

Implications:

Technology Reference Models Standards (IT-Focused Rules)

- **Technology Reference Models** are specific Standards providing structured graphical representations of all technologies used in an organization
- They can be **also called** technology standards, technical reference models, or technology reference architectures
- Organize the **technology stack** into layers, e.g. networks, servers, databases, etc.
- **Color-coded** to indicate the status of different technologies
- Help architects select the most appropriate technologies for new IT solutions

Technology Reference Models Standards (IT-Focused Rules)



Guidelines

Standards (IT-Focused Rules)

- **Guidelines** are specific Standards providing IT-specific implementation-level prescriptions applicable in narrow technology-specific areas or domains
- Guidelines can be **also called** standards
- Formulated as **brief written statements** providing actionable recommendations regarding the usage of particular technologies in IT solutions
- Typically introduced over time as architects and project teams learn new best practices reflecting the effective use of technologies in IT solutions
- Help architects and IT project teams follow proven best practices during the planning and implementation of new IT solutions

Guidelines Standards (IT-Focused Rules)

Server Deployment Standards	Guideline 1: Run Applications as OS Services Description:
	Guideline 2: Store Deployment Packages in VCS Description:
Network Protocol Standards	Guideline 3: Avoid Using UDP Multicast Description:
	Guideline 4: Prefer REST Over SOAP Description:
Data Encryption Standards	Guideline 5: Use 256-Bit Encryption Keys Description:
	Guideline 6: Store MD5 Hashes of Passwords Description:
Interface Design Guidelines	Guideline 7: Use Web-Safe Colours Description:
	Guideline 8: Place Menu in the Top Right Corner Description:
Secure Coding Guidelines	Guideline 9: Initialize Variables to Safe Defaults Description:
	Guideline 10: Validate All Incoming Data Description:

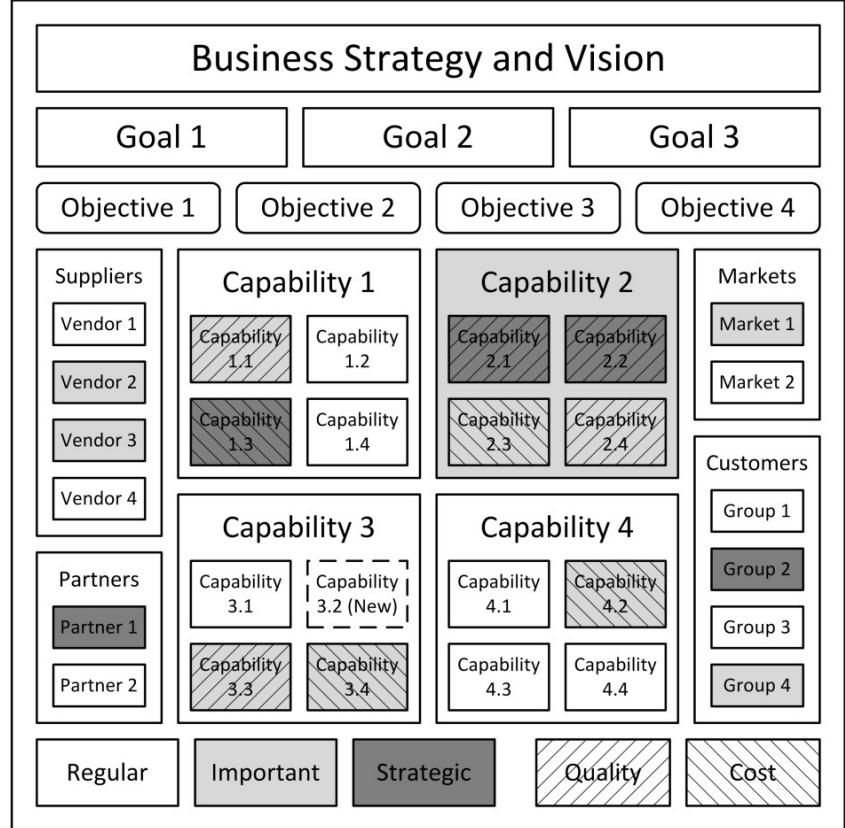
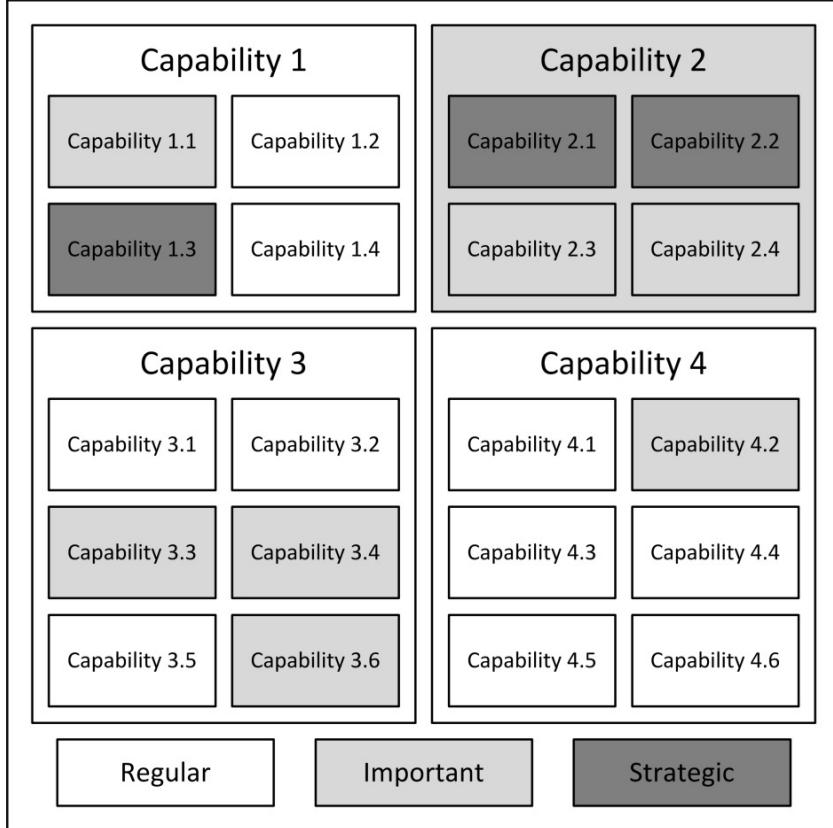
Business Capability Models

Visions (Business-Focused Structures)

- **Business Capability Models** are specific Visions providing structured graphical representations of all organizational business capabilities and their hierarchy
- Sometimes they can be **also called** business capability maps or capability reference models
- Very **stable** and independent of reporting structures, politics and projects
- Business and IT leaders identify the capabilities that require to be uplifted and then do “heatmapping”
- Often considered as an “entry point” to IT for business executives
- Many strategic conversations between business and IT revolve around business capabilities and start from identifying the capabilities to be enhanced with IT

Business Capability Models

Visions (Business-Focused Structures)



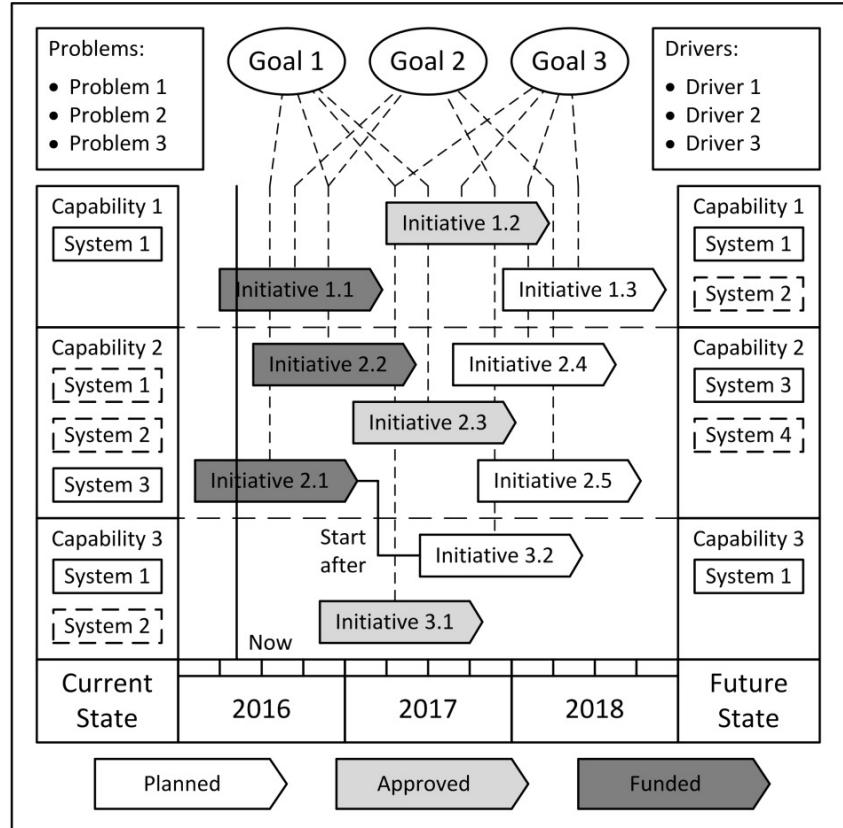
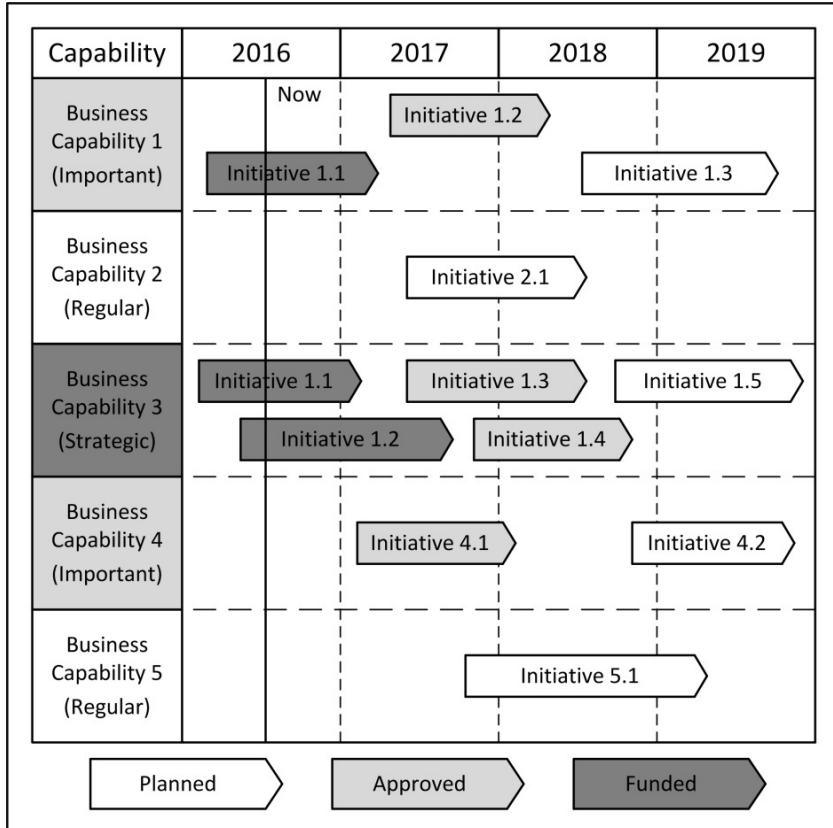
Roadmaps

Visions (Business-Focused Structures)

- **Roadmaps** are specific **Visions** providing structured graphical views of all planned IT initiatives in specific business areas having direct business value
- They can be **also called** investment roadmaps, capability roadmaps, application roadmaps, etc.
- Describe **IT delivery schedules** for different business areas agreed by business and IT leaders
- Usually planned up to three years ahead, more rarely for longer planning horizons up to five years
- Roadmaps help prioritize planned IT initiatives, ensure the alignment between specific IT investments and required business capabilities and connect future IT initiatives with respective business and financial plans

Roadmaps

Visions (Business-Focused Structures)



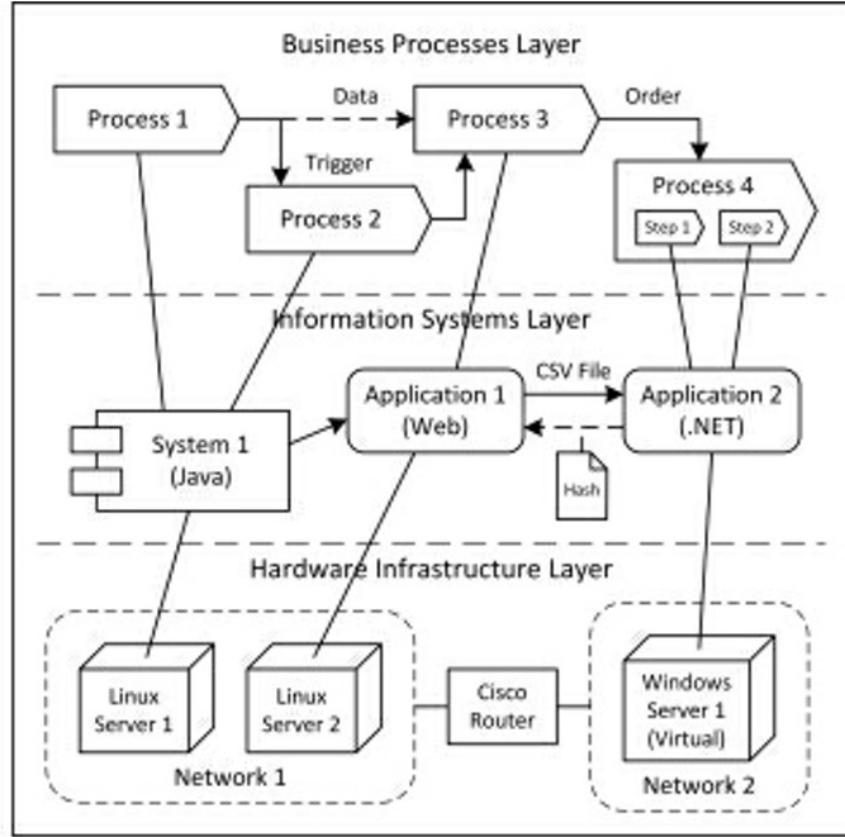
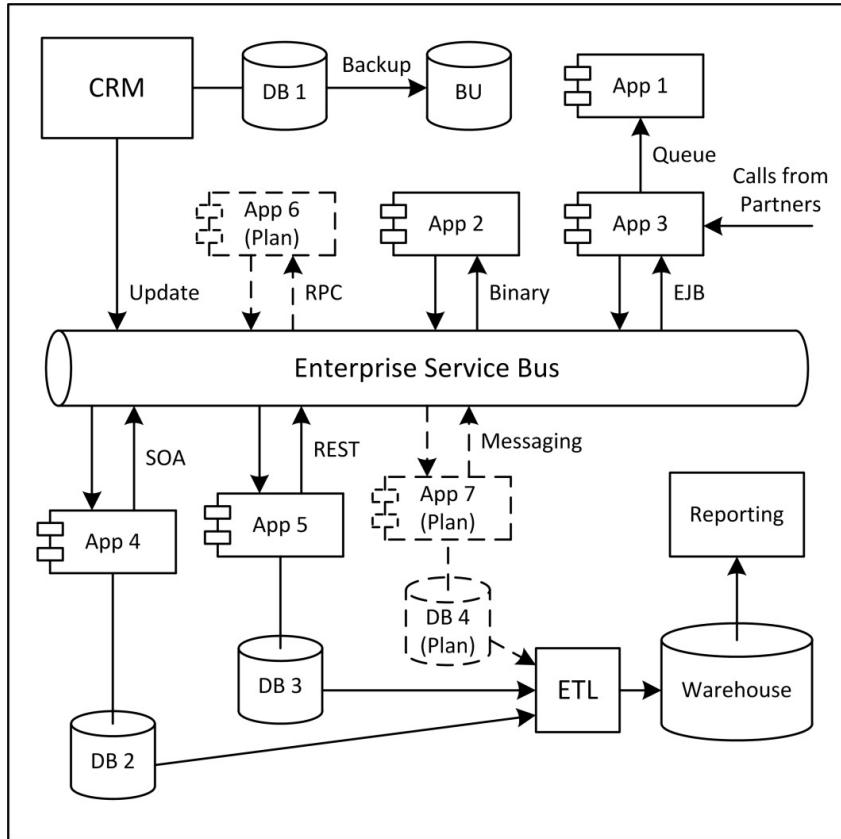
Landscape Diagrams

Landscapes (IT-Focused Structures)

- **Landscape Diagrams** are specific Landscapes showing technical “boxes and arrows” schemes of different scopes and granularities describing the IT landscape
- They can be **also called** simply an architectural repository or used under very diverse titles, e.g. relational diagrams
- Landscape Diagrams most often describe only the current structure of the IT landscape
- Owned by architects
- Developed with the intention to document a particular area of the IT landscape when necessary and then maintained up-to-date to reflect its ongoing evolution

Landscape Diagrams

Landscapes (IT-Focused Structures)



Solution Overviews

Outlines (Business-Focused Changes)

- **Solution Overviews** are specific Outlines providing high-level descriptions of specific proposed IT solutions understandable to business leaders
- They can be **also called** solution outlines, conceptual architectures, conceptual designs, solution briefs, etc.
- Represent finalized descriptions of proposed IT solutions agreed with business sponsors
- Include conceptual architectures, process models and relevant supporting information, e.g. goals, benefits, stakeholders, requirements
- Completed during the later stages of initiation steps of all IT initiatives to represent the finalized versions of proposed IT solutions agreed with their business sponsors

Solution Overviews

Outlines (Business-Focused Changes)

1. Overview and Goals

.....
2. Scope and Stakeholders

3. Essential Requirements

4. Business Benefits

5. Capability Impact

- Order Fulfilment (High)
- Order Management (Low)
- Customer Analytics (Low)

6. Involved Partners

- IBM
- Accenture

7. Estimations

Time: 6-8 months

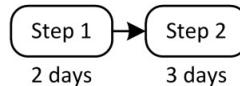
Cost: \$1.2-1.5 million

8. Business Process Changes

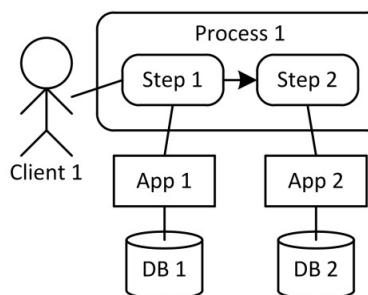
Process 1 Now (10 days in total):



Process 1 Will Be (5 days in total):



9. Architectural Overview



10. Key Risks

.....

1. Business Intent

2. Business Sponsors

3. Basic Requirements

4. Solution Scope and Value

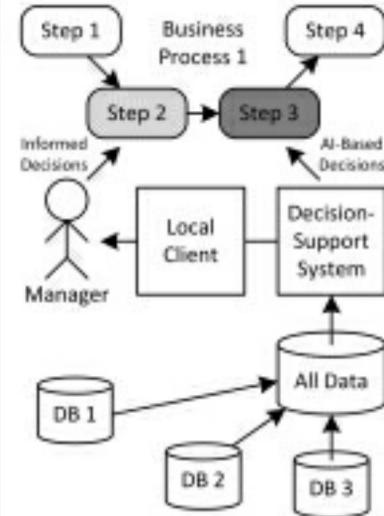
5. Principles Alignment

Principle 1
Principle 2
Principle 3

6. Strategy Alignment



7. Conceptual Architecture



8. Current Estimates

Time: 9-12 months

Cost: \$1.6-2.0 million

Risks:

Solution Designs

Designs (IT-Focused Changes)

- **Solution Designs** are specific Designs providing detailed technical and functional specifications of approved IT solutions actionable for project teams
- They can be **also called** detailed designs, technical designs, physical designs, project-start architectures, solution architectures, solution definitions, etc.
- Solution Designs can vary in their size depending on the size and complexity of an IT project
- They are used directly by IT project teams as an actionable guidance for the project implementation
- Can be around ~25-50 pages long. Typically represented as MS Word documents with complex technical diagrams

Solution Designs

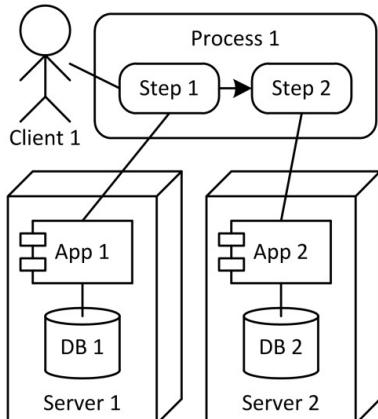
Designs (IT-Focused Changes)

1. Brief Overview

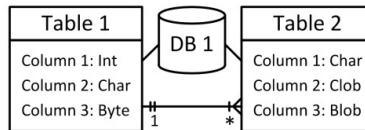
2. Goals and Objectives

3. Detailed Requirements

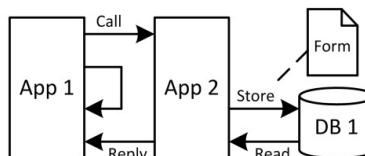
4. Solution Context



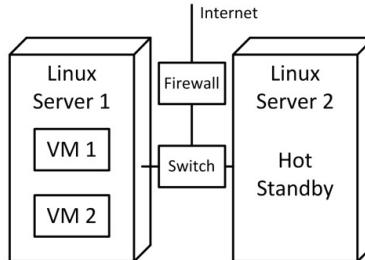
5. Data Architecture



6. Application Architecture



7. Infrastructure Architecture

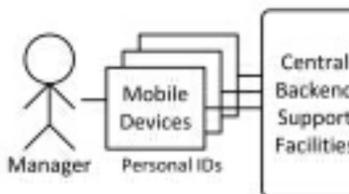


1. Introduction

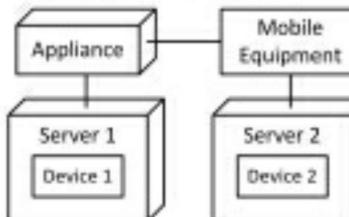
2. Business Problem

3. Solution Specification

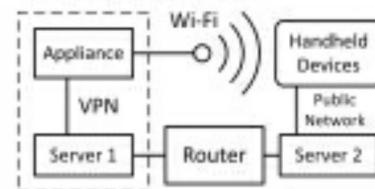
4. Contextual View



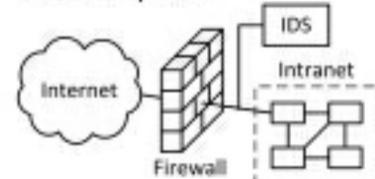
5. Deployment View



6. Connectivity View

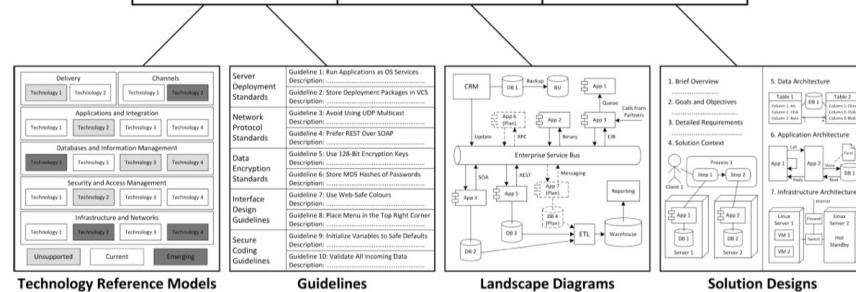
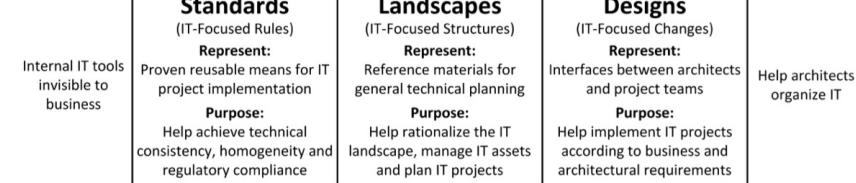
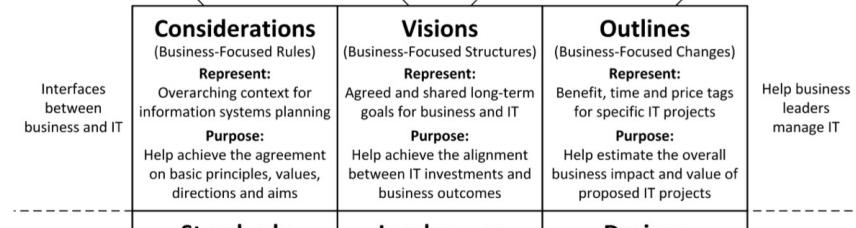
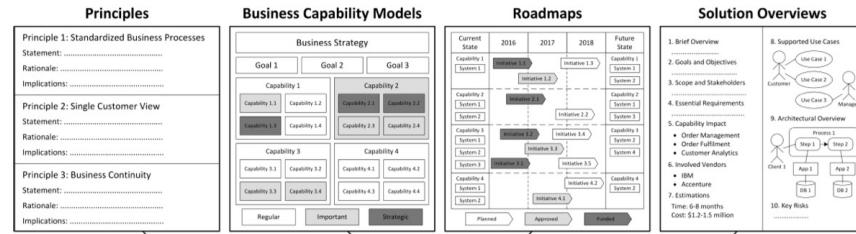


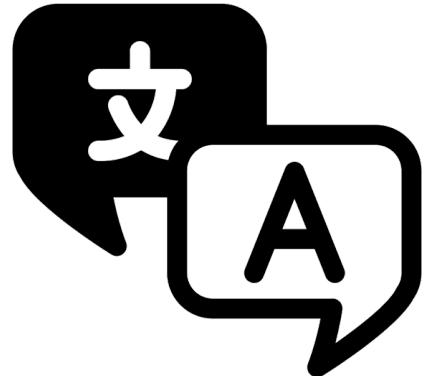
7. Security View



8. Utilized Technologies

Equipment	Qty	Description
Hardware A	3
Hardware B	2
Appliance C	5





Role of Modeling Languages

The Role of Modeling Languages

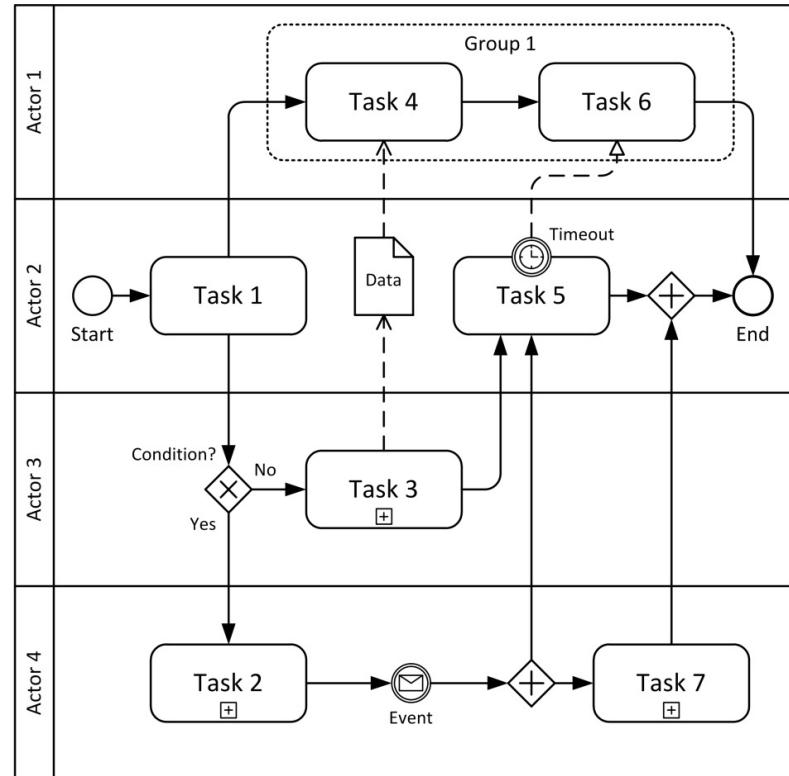
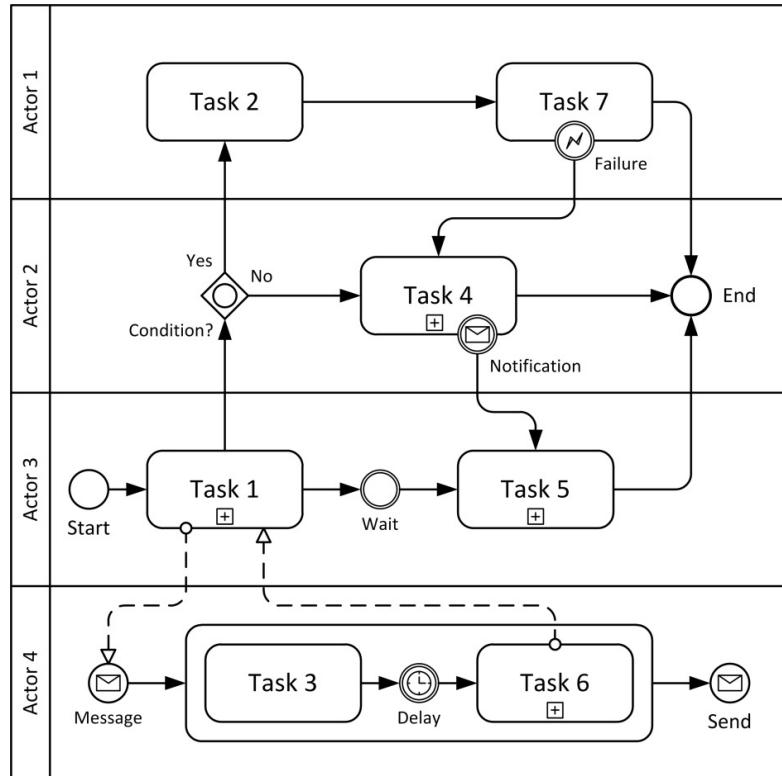
Specific modeling languages **play only a secondary role** in an EA practice, their value should not be exaggerated

1. Perfectly correct modeling is not necessary for an EA practice since the goal is to **support communication**
2. The most critical stakeholders of EA artifacts are business executives, who generally do not understand any formal modeling languages
3. Drawing stakeholder-friendly and especially business-friendly diagrams is more art than engineering
4. Full versions of most modeling languages are rarely used in practice

BPMN

- Business Process Model and Notation (BPMN)
 - popular and powerful notations for specifying business processes
 - does not cover many other EA domains
 - organizes the steps of business processes according to different “swimlanes” representing corresponding actors responsible for these steps
 - provides other elements for defining the process flow, e.g. events, gateways and artifacts
- BPMN gained widespread popularity and is familiar to most practicing architects and business analysts

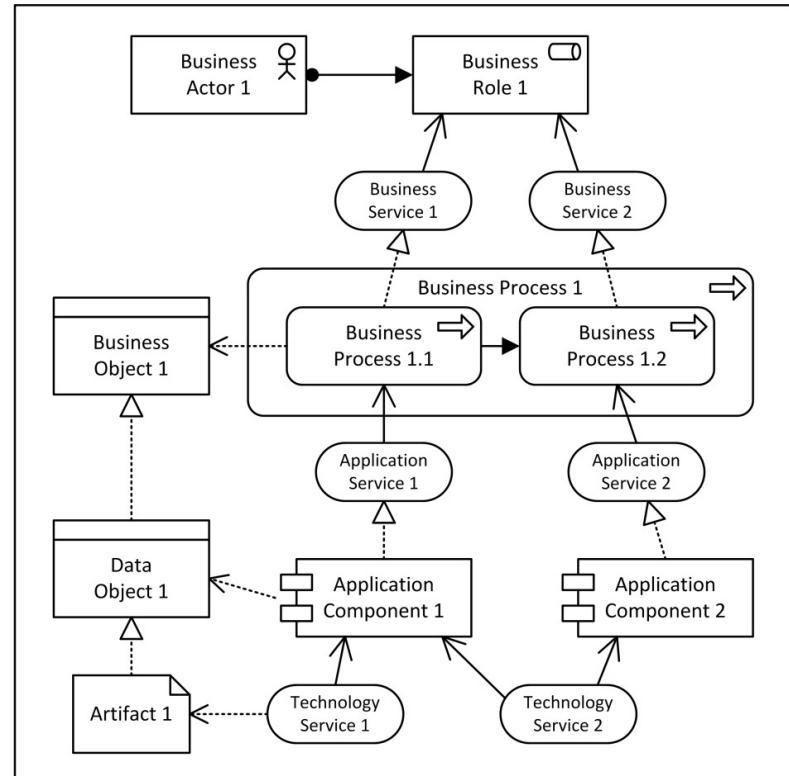
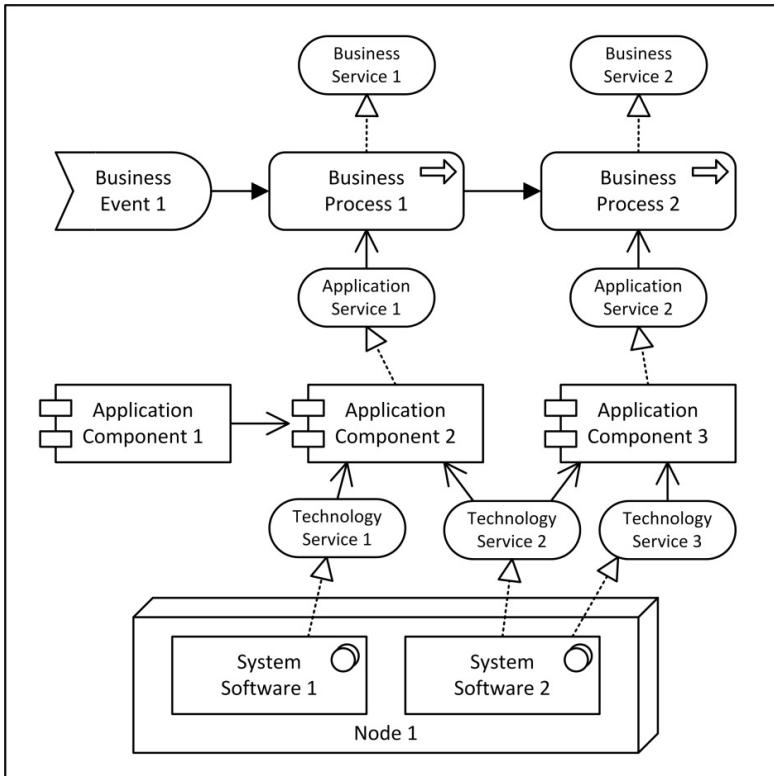
BPMN



ArchiMate

- ArchiMate
 - is a comprehensive EA modeling language
 - provides specialized notations for various objects in the business, application and technology layers as well as their interrelationship
- For each layer ArchiMate offers graphical elements to depict its active structure, behavior and passive structure
- ArchiMate also provides notations for the elements of business strategy, implementation and migration plans, physical elements and motivation behind decisions
- ArchiMate is a relatively new language which is still gaining popularity, but is already rather widely adopted

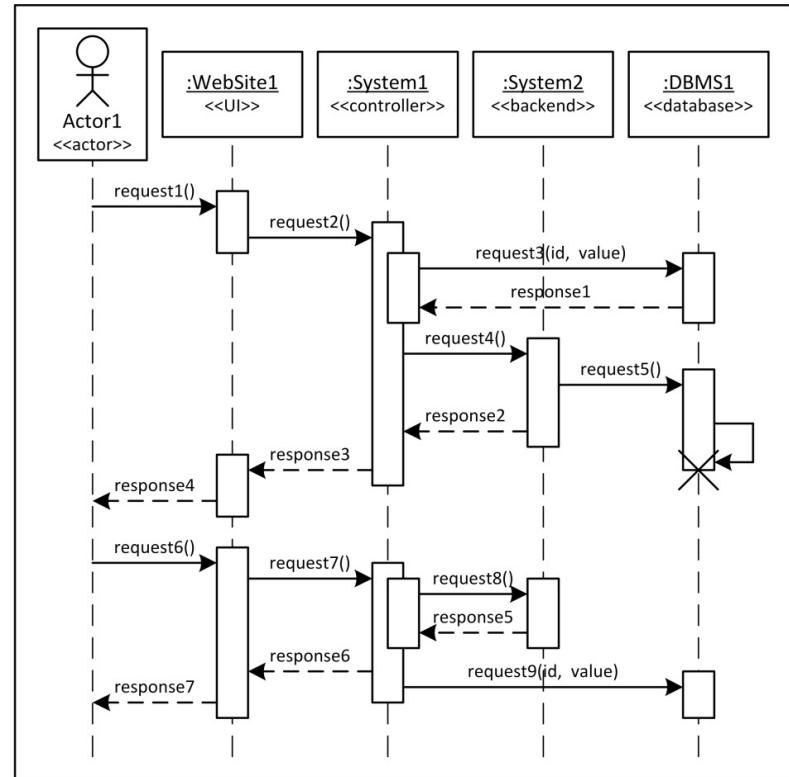
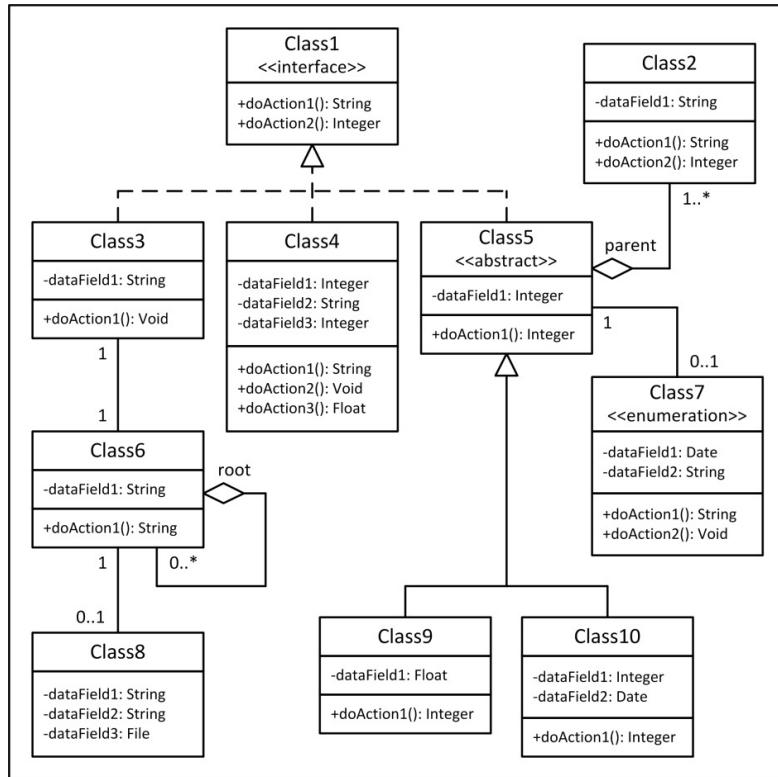
ArchiMate (Examples)



UML

- Unified Modeling Language (UML) is a very well-known general-purpose language for **software engineering**
 - provides many different types of diagrams, which can be separated into structural and behavioral diagrams
 - **Structural diagrams** offer static views of software systems explaining their structure and components, e.g. component, class and object diagrams
 - **Behavioral diagrams** offer dynamic views of software systems explaining their behaviour and interaction, e.g. activity, sequence and timing diagrams
- UML is widely used and familiar to most architects and software engineers

UML (Examples)



Applicability of Modeling Languages

Considerations

Business processes are standardized across all points of presence

All lines of business work with the shared list of customers

All business operations are maintained despite system failures

Visions

Business Strategy

Goal 1 Goal 2 Goal 3

Capability 1 Capability 2

Capability 3 Capability 4

Capability 5 Capability 6

Capability 7 Capability 8

Capability 9 Capability 10

Capability 11 Capability 12

Capability 13 Capability 14

Capability 15 Capability 16

Capability 17 Capability 18

Capability 19 Capability 20

Capability 21 Capability 22

Capability 23 Capability 24

Capability 25 Capability 26

Capability 27 Capability 28

Capability 29 Capability 30

Capability 31 Capability 32

Capability 33 Capability 34

Capability 35 Capability 36

Capability 37 Capability 38

Capability 39 Capability 40

Capability 41 Capability 42

Capability 43 Capability 44

Capability 45 Capability 46

Capability 47 Capability 48

Capability 49 Capability 50

Capability 51 Capability 52

Capability 53 Capability 54

Capability 55 Capability 56

Capability 57 Capability 58

Capability 59 Capability 60

Capability 61 Capability 62

Capability 63 Capability 64

Capability 65 Capability 66

Capability 67 Capability 68

Capability 69 Capability 70

Capability 71 Capability 72

Capability 73 Capability 74

Capability 75 Capability 76

Capability 77 Capability 78

Capability 79 Capability 80

Regular Important Strategic

BPMN

Outlines

1. Overview and Goals

2. Scope and Stakeholders

3. Essential Requirements

4. Business Benefits

5. Capability Impact

- Order Fulfillment
- Order Management
- Customer Analytics

6. Involved Partners

- IBM
- Accenture

7. Estimations

Time: 6-8 months

Cost: \$1.2-1.5 million

8. Process Changes

Now (10 steps in total):

Step 1 → Step 2 → Step 3

3 days 5 days 2 days

Will (5 steps in total):

Step 1 → Step 2

2 days 3 days

9. Architectural Overview

Process 1

Step 1 → Step 2

Client 1 App 1 App 2

DB 1 DB 2

10. Key Risks

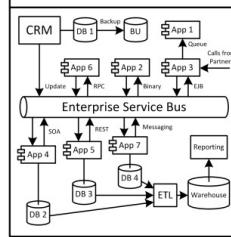
Standards

All applications should be implemented on the Java EE platform

All databases should use the Oracle RDBMS platform

Enterprise Service Bus should be used to integrate all applications

Landscapes



ArchiMate, ARIS

Designs

1. Brief Overview

2. Goals and Objectives

3. Detailed Requirements

4. Solution Context

5. Data Architecture

Table 1 Table 2

Column 1 vs Column 2

Column 1 vs Column 3

Column 2 vs Column 3

6. Application Architecture

Process 1

Step 1 → Step 2

Client 1 App 1 App 2

DB 1 DB 2

7. Infrastructure Architecture

Internet

Linux Server 1

Linux Server 2

Hot Standby

UML



Technical Debt

Technical Debt

- **Technical debt** (or architecture debt) is a temporary deviation from the ideal long-term architectural direction that requires certain corrective measures in the future
- Lead by technological or architectural choices that slows down the development in the long run
- You have to “pay interest” in the long term (a) by slower progress and (b) by higher maintenance effort
- Reasons for Technical dept
 1. Introduced by choosing a suboptimal design solution or technology in order to **ship faster**
 2. A former “optimal” solution can **age** (tech entropy or tech decay)
- “Paying down” technical dept, e.g.
 - Refactoring of cod

REDSTONE
INSIDE THE FAMILY FEUD

WHO TO
BLAME FOR
COLLEGE
COSTS

\$60 OIL?
BELIEVE IT

RETIREMENT GUIDE
REMARRY OR SHACK UP?
DYING WITHOUT A WILL

NOVEMBER 12, 2007 | WWW.FORBES.COM

Forbes

Nokia

ONE BILLION
CUSTOMERS—
CAN ANYONE
CATCH THE
CELL PHONE KING?



ALUMNI
SAURON
BLUETOOTH
HEADSET

PLUS
11 GADGETS WE LOVE



Olli-Pekka Kallasvuo
Chief Executive



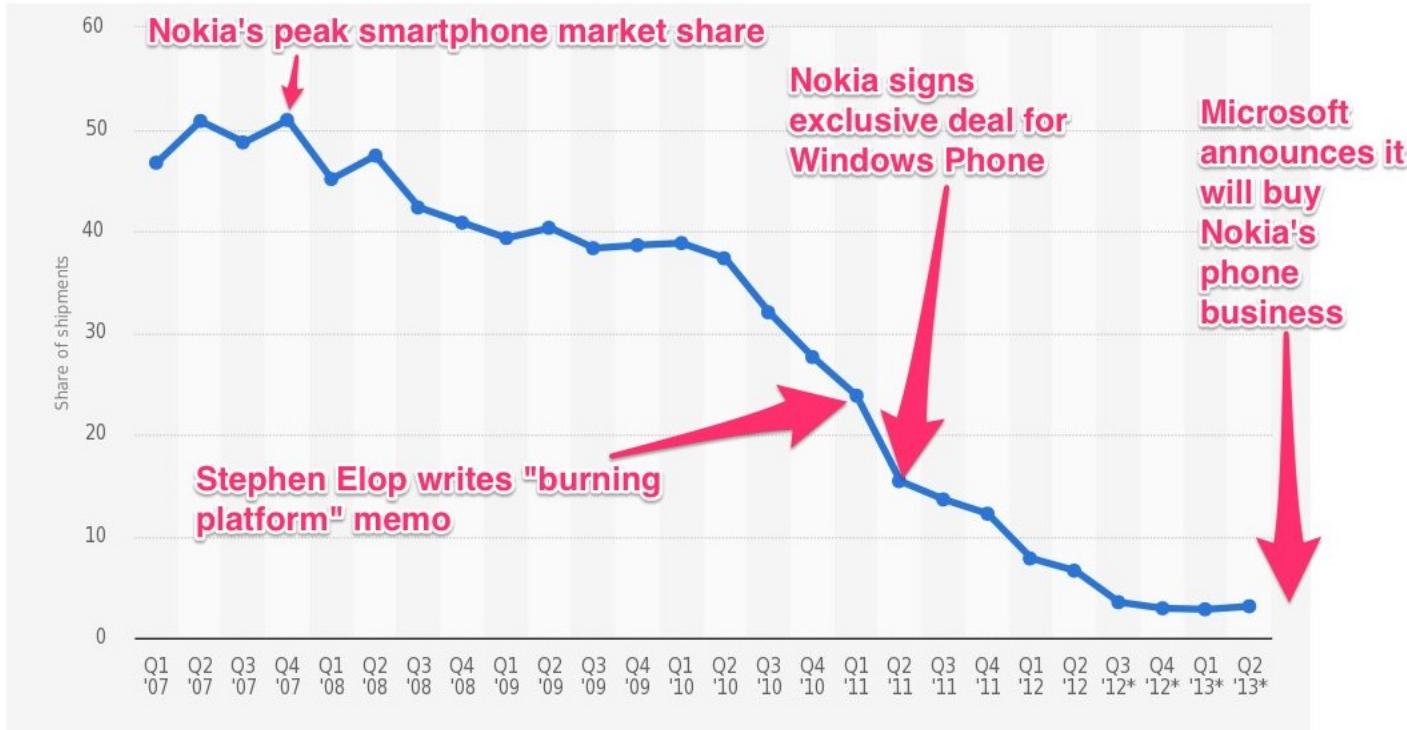
Technical Debt

“In 2010, Risto Siilasmaa was a board director at Nokia. When he learned that generating a Symbian build took *a whole forty-eight hours*, he said that it felt like someone hit him in the head with a sledgehammer,”

Erik says. “He knew that if it took two days for anyone to determine whether a change worked or would have to be redone, there was a fundamental and fatal flaw in their architecture that doomed their near-term profitability and long-term viability. They could have had twenty times more developers, and it wouldn’t have made them go any faster.

Erik pauses. “It’s incredible. Sensei Siilasmaa knew that all the hopes and promises made by the engineering organization was a mirage. Even though there were numerous internal efforts to migrate off of Symbian, it was always shot down by the top executives until it was too late.

Technical Debt



Near Death Experiences because of Technical Debt

- Ebay (1999)
- Microsoft (2002): Bill Gates Memo
- Amazon (2002): Jeff Bezos Memo
- Google (2005): Automated Testing Culture
- Twitter (2008)
- LinkedIn (2009)
- Etsy (2009)

2002 Microsoft Security Standdown

- Feature Freeze for every product
- Reducing Technical Debt

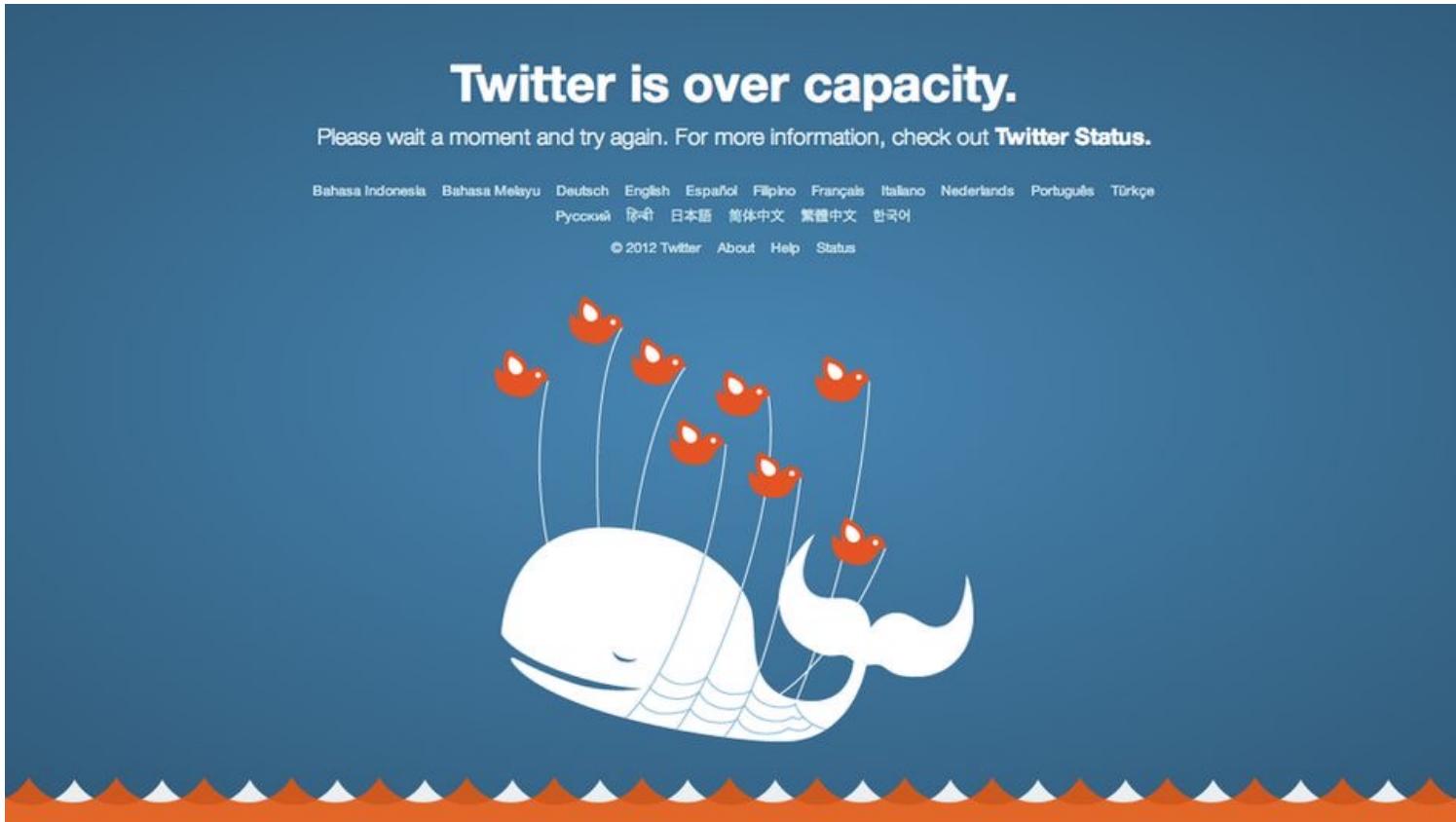
BILL GATES BUSINESS 01.17.02 12:00 PM

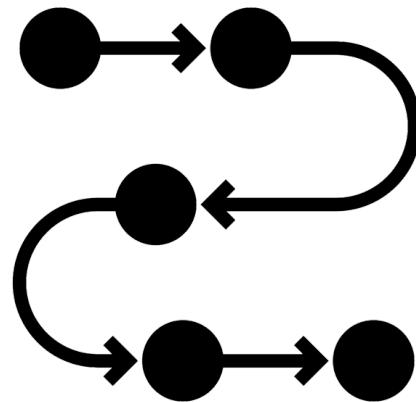
BILL GATES: TRUSTWORTHY COMPUTING

In the past, we've made our software and services more compelling for users by adding new features and functionality, and by making our platform richly extensible. We've done a terrific job at that, but all those great features won't matter unless customers trust our software.

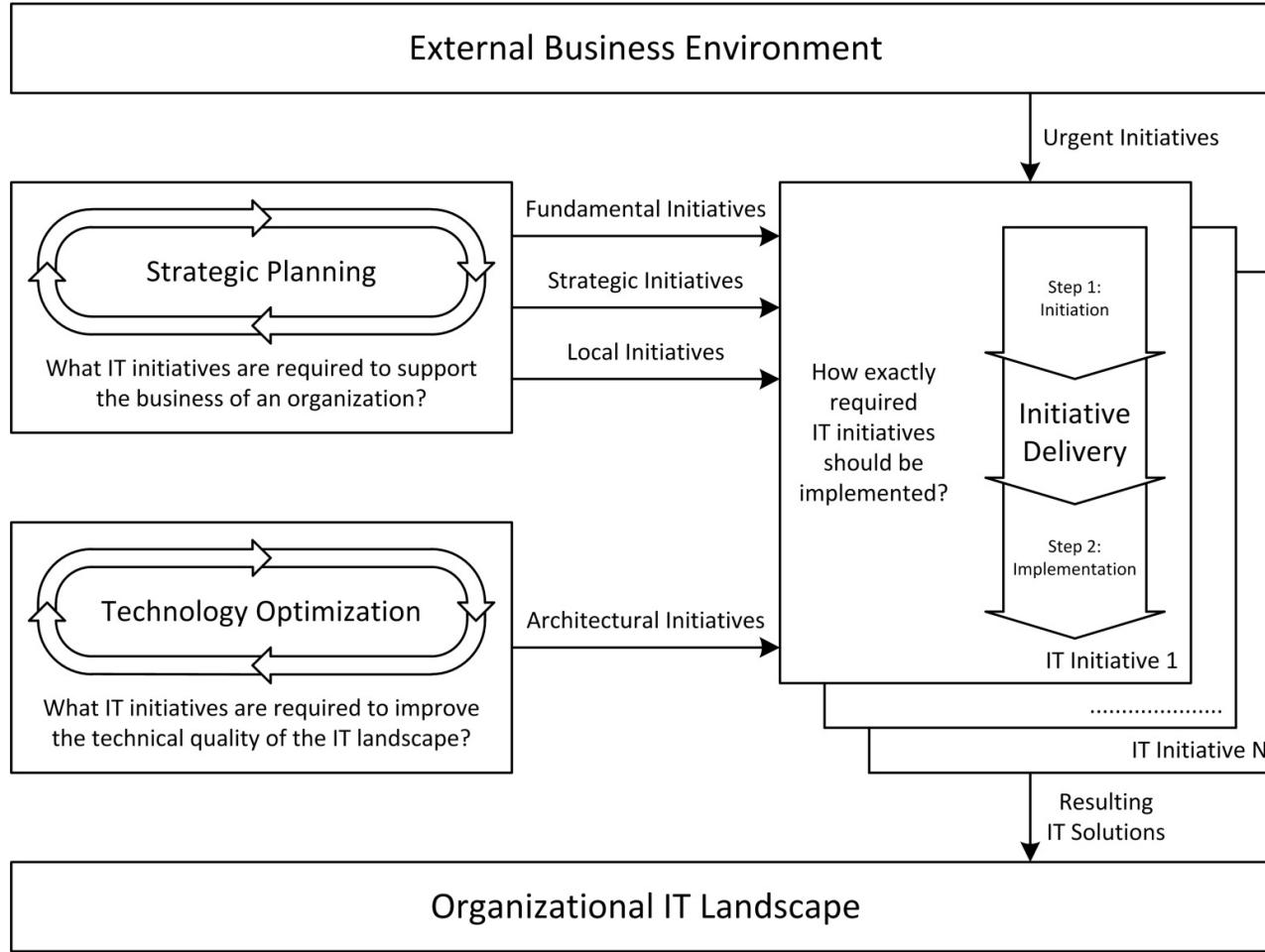
So now, when we face a choice between adding features and resolving security issues, we need to choose security. Our products should emphasize security right out of the box, and we must constantly refine and improve that security as threats evolve. A good example of this is the changes we made in Outlook to avoid e-mail-borne viruses. If we discover a risk that a feature could compromise someone's privacy, that problem gets solved first. If there is any way we can better protect important data and minimize downtime,

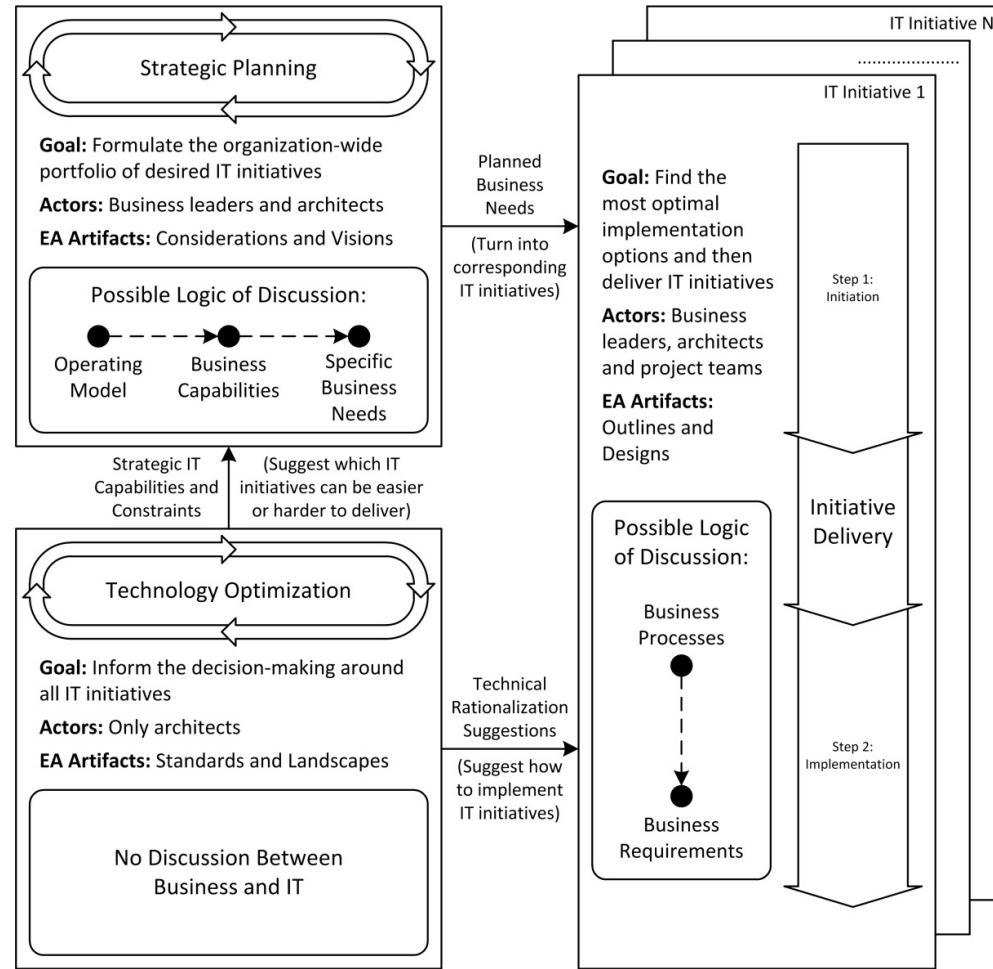
Technical Debt





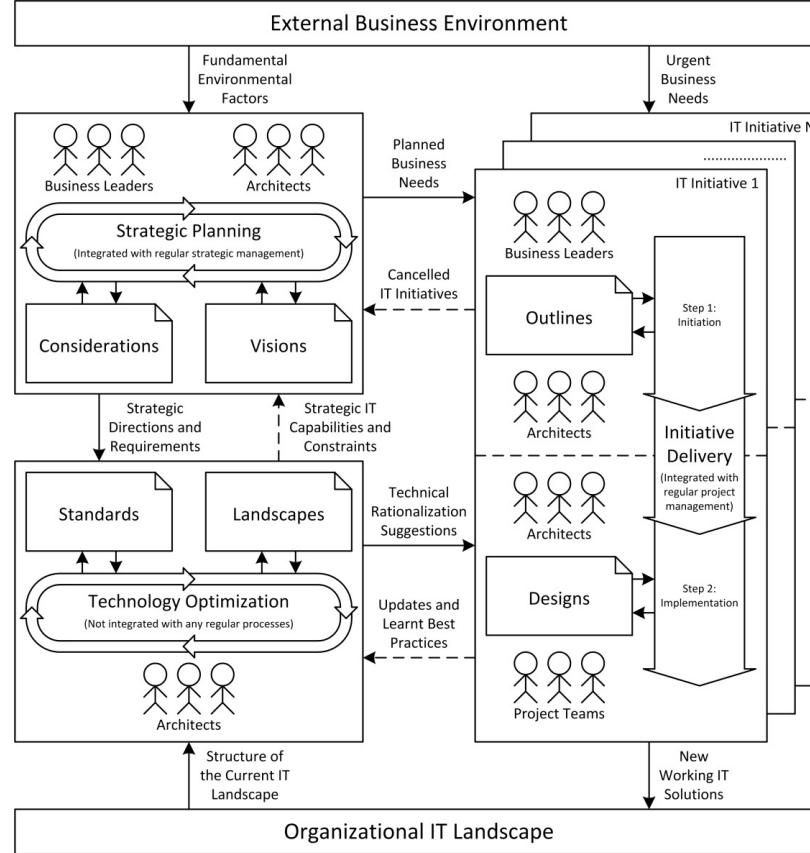
EA Process



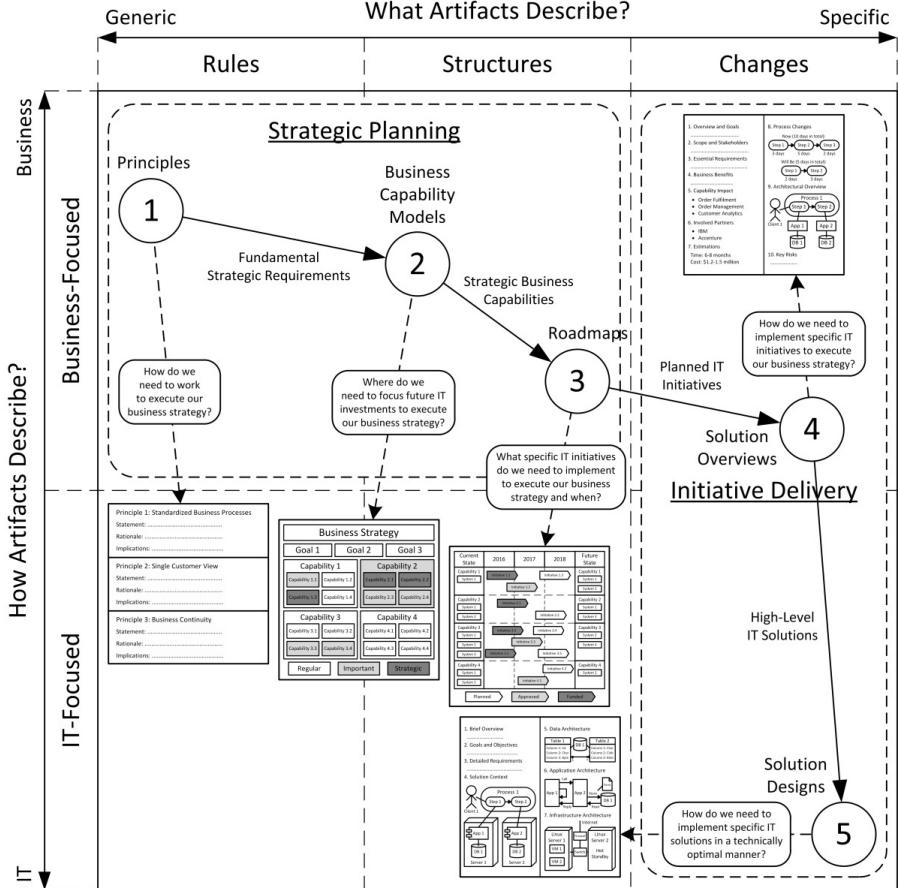


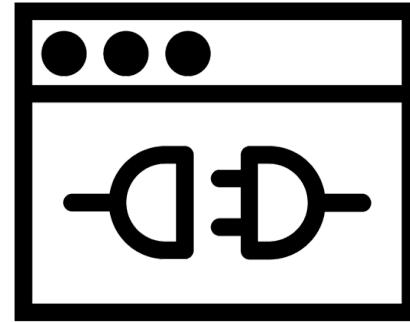
Process	Strategic Planning	Initiative Delivery	Technology Optimization
Instances	Single, or several for highly decentralized organizations	Multiple, i.e. one instance for each IT initiative	Single, or several for highly decentralized organizations
Goal	Articulate the long-term future course of action for IT	Deliver optimal IT solutions for specific needs	Improve the overall quality of the organizational IT landscape
Meaning	Strategy-to-portfolio	Need-to-solution	Structure-to-rationalization
Question	How is the business environment changing and what should we do to react on these changes?	What is the best way to address the requested need and all the associated requirements?	What is wrong with the current IT landscape and what should we do to improve it?
Nature	Continuous and unstructured	Sequential with two main steps: initiation and implementation	Continuous and unstructured
Integration	Integrated with regular strategic management activities	Integrated with regular project management activities	Not integrated with any regular processes or activities
Actors	Business leaders and architects	Initiation step: Business leaders and architects Implementation step: Architects and project teams	Architects alone
EA artifacts	Considerations and Visions	Initiation step: Outlines Implementation step: Designs	Standards and Landscapes
Inputs	Fundamental factors of the external business environment	Specific business, and sometimes technical, needs	Current structure of the organizational IT landscape
Outputs	High-level strategic plans for IT reflected in Considerations and Visions	New working IT solutions	Technical rationalization suggestions reflected in Standards and Landscapes

A Process View of an EA Practice



The EA-Enabled Decision Path





The Amazon API Memo

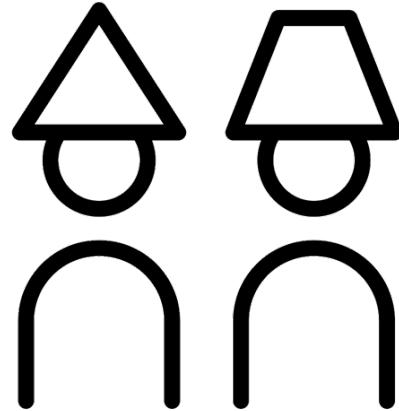
Amazon “Bezos API Mandate” 2002 Email

1. All teams will henceforth expose their data and functionality through service interfaces.
 2. Teams must communicate with each other through these interfaces.
 3. There will be no other form of interprocess communication allowed: no direct linking, no direct reads of another team's data store, no shared-memory model, no back-doors whatsoever. The only communication allowed is via service interface calls over the network.
 4. It doesn't matter what technology is used. HTTP, Corba, Pubsub, custom protocols — doesn't matter.
 5. All service interfaces, without exception, must be designed from the ground up to be externalizable. That is to say, the team must plan and design to be able to expose the interface to developers in the outside world. No exceptions.
 6. Anyone who doesn't do this will be fired.
- Jeff Bezos

Result of the Principle

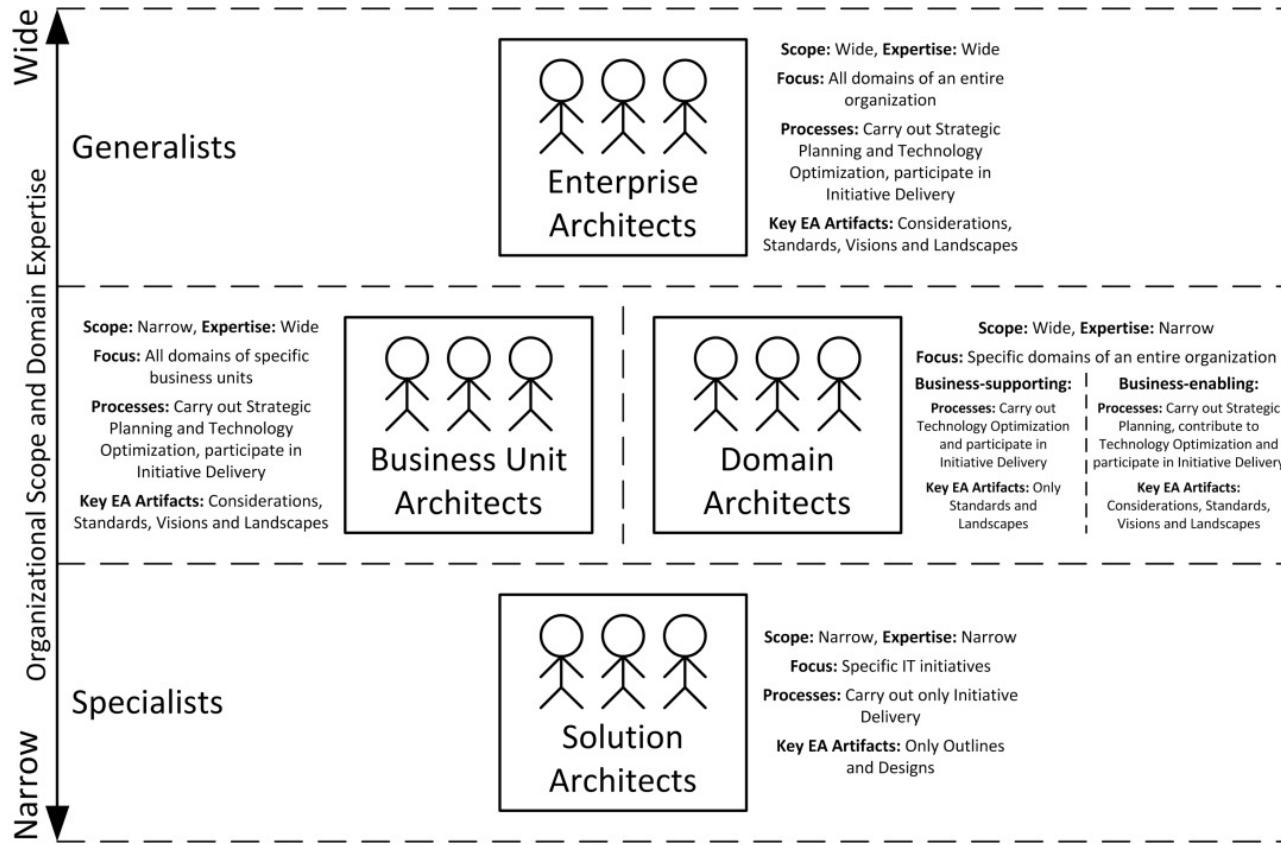
Amazon Web Services, 6-year financials



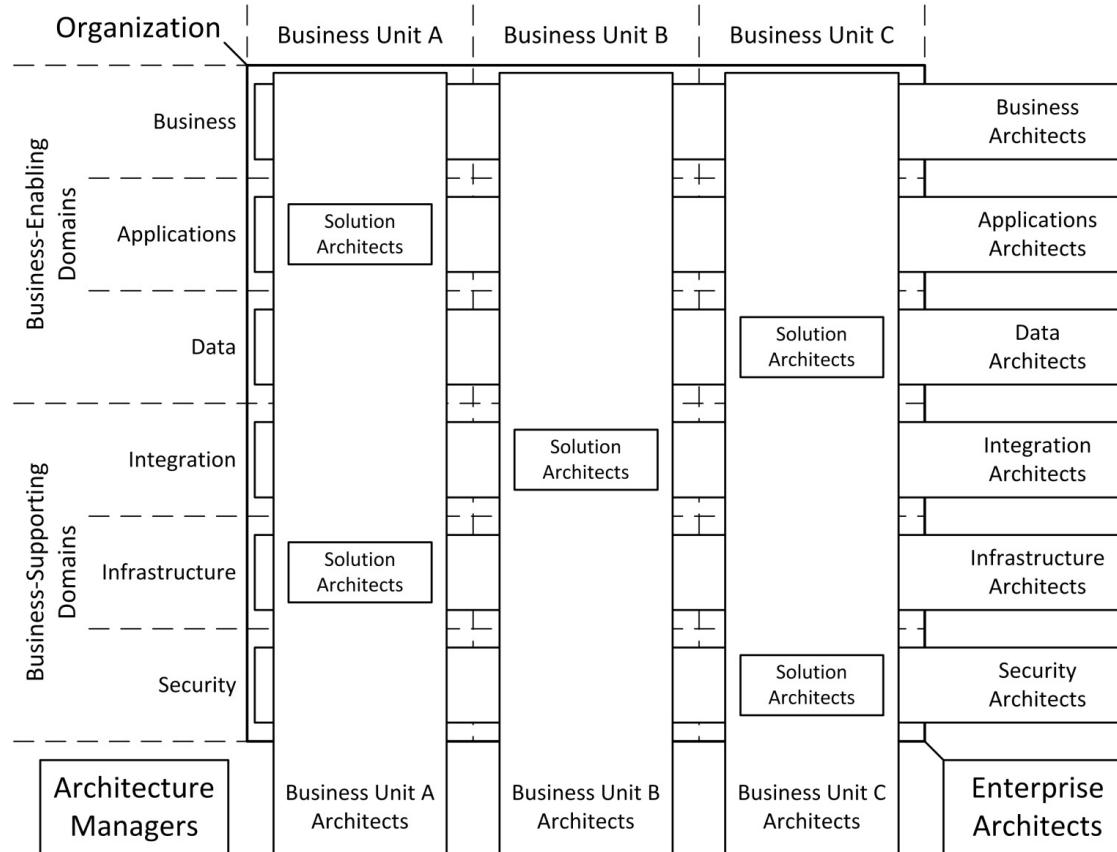


Architectural Roles

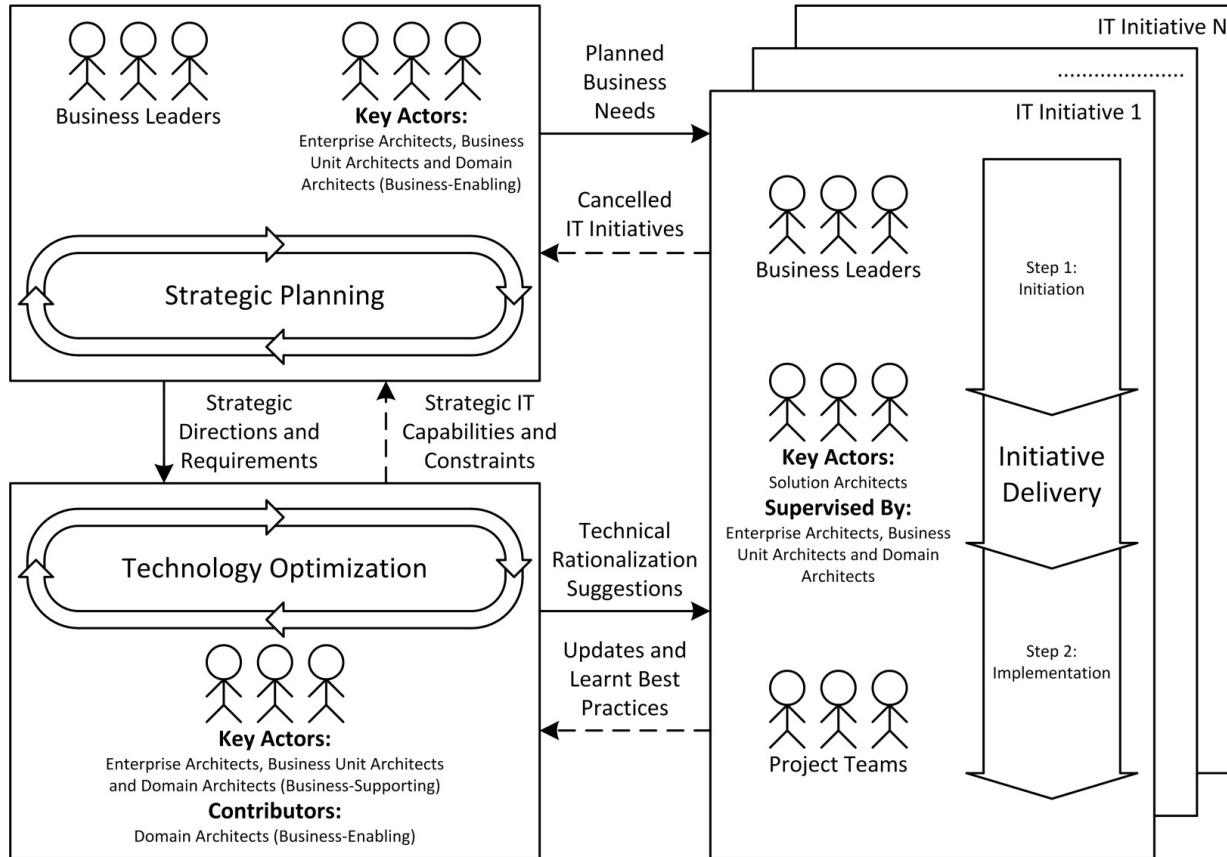
Hierarchy of Architecture Positions



Organizational Mapping of Architects

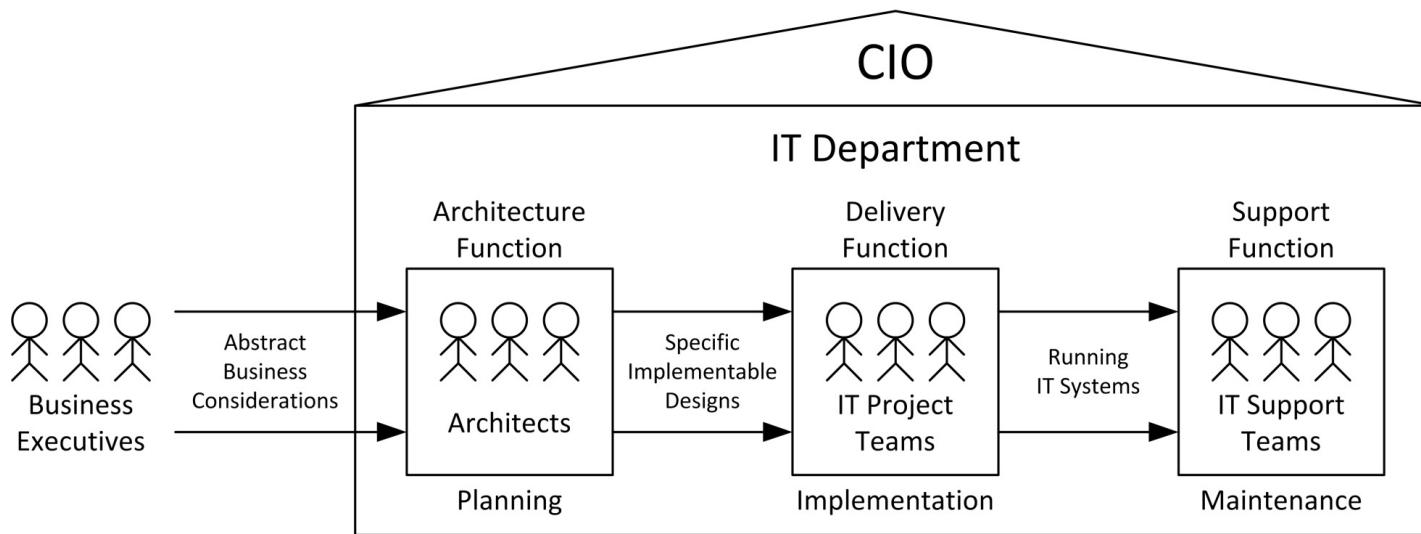


Process Mapping of Architecture Positions



The Role of Architecture Functions

The architecture function translates abstract business considerations into specific designs of new IT solutions, which are implemented by the IT delivery function and then handed over to the IT support function to be maintained





Establishing a EA Practice

The Historical Path to an EA Practice

- The **historical path** reflects typical development patterns of an EA practice in many early-adopter organizations that have been experimenting with enterprise architecture for a long time
- These organizations were at the forefront of EA progress and seemingly developed many of the current EA best practices based on their own harsh practical lessons
- The historical path arguably represents the mainstream path taken by the industry as a whole and corresponds to the historical formation of the entire EA discipline in its current form

The Sequence of the Historical Path

- The historical path developed **from more simple to more complex activities and planning practices**
- The most basic practices relate to separate IT initiatives, i.e. to the usage of Outlines and Designs as part of the Initiative Delivery process (**“solution architecture”**)
- More complex practices relate to the entire IT landscape, i.e. to the usage of Standards and Landscapes as part of the Technology Optimization process (**“IT architecture”**)
- The most sophisticated practices relate to the whole organization, i.e. to the usage of Considerations and Visions as part of the Strategic Planning process (**“true enterprise architecture”**)

The Historical Path to an EA Practice

Strategic Planning ("Enterprise Architecture")

Key Practices: Strategic dialog between business and IT, collective prioritization of IT investments and C-level architecture governance

Considerations
Business processes are standardized across all points of presence
All lines of business work with the shared list of customers
All business operations are maintained despite system failures

The most complex practices
Historically appeared last

Visions
Business Strategy Goal 1 Goal 2 Goal 3 Capability 1 Capability 2 Capability 1.1 Capability 1.2 Capability 2.1 Capability 2.2 Capability 1.3 Capability 1.4 Capability 2.3 Capability 2.4 Capability 3 Capability 4 Capability 3.1 Capability 3.2 Capability 4.1 Capability 4.2 Capability 3.3 Capability 3.4 Capability 4.3 Capability 4.4 Regular Important Strategic

3

Initiative Delivery ("Solution Architecture")

Outlines
1. Overview and Goals 2. Scope and Stakeholders 3. Essential Requirements 4. Business Benefits 5. Components: <ul style="list-style-type: none">Order FulfillmentOrder ManagementCustomer Analytics 6. Involved Partners <ul style="list-style-type: none">IBMAccenture 7. Estimations Time: 6-8 months Cost: \$1.2-1.5 million 8. Process Changes Now (10 days in total): Step 1: 3 days Step 2: 5 days Step 3: 2 days With 10 days in total: Step 1: 3 days Step 2: 3 days Step 3: 3 days 9. Architectural Overview  10. Key Risks

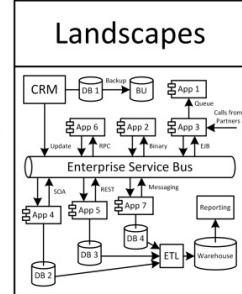
1

The most simple practices
Historically appeared first

Standards

All applications should be implemented on the Java EE platform
All databases should use the Oracle RDBMS platform
Enterprise Service Bus should be used to integrate all applications

Landscapes

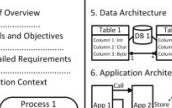
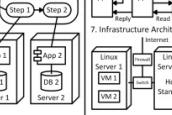


2

Technology Optimization ("IT Architecture")

Key Practices: Centralized selection of technologies, funding of architectural initiatives, architectural reviews and approvals

Designs

Designs
1. Brief Overview 2. Goals and Objectives 3. Detailed Requirements 4. Solution Context  5. Data Architecture Table 1 Table 2 Column 1: ID Column 1: ID Column 2: Name Column 2: Name Column 3: Type Column 3: Type Column 4: Status Column 4: Status Column 5: Date Column 5: Date 6. Application Architecture  7. Infrastructure Architecture Internet Linux Server 1 Linux Server 2 Router VM 1 VM 2 Hot Standby

Key Practices: Business cases for IT initiatives, consistent delivery methodology and control gates for decision-making

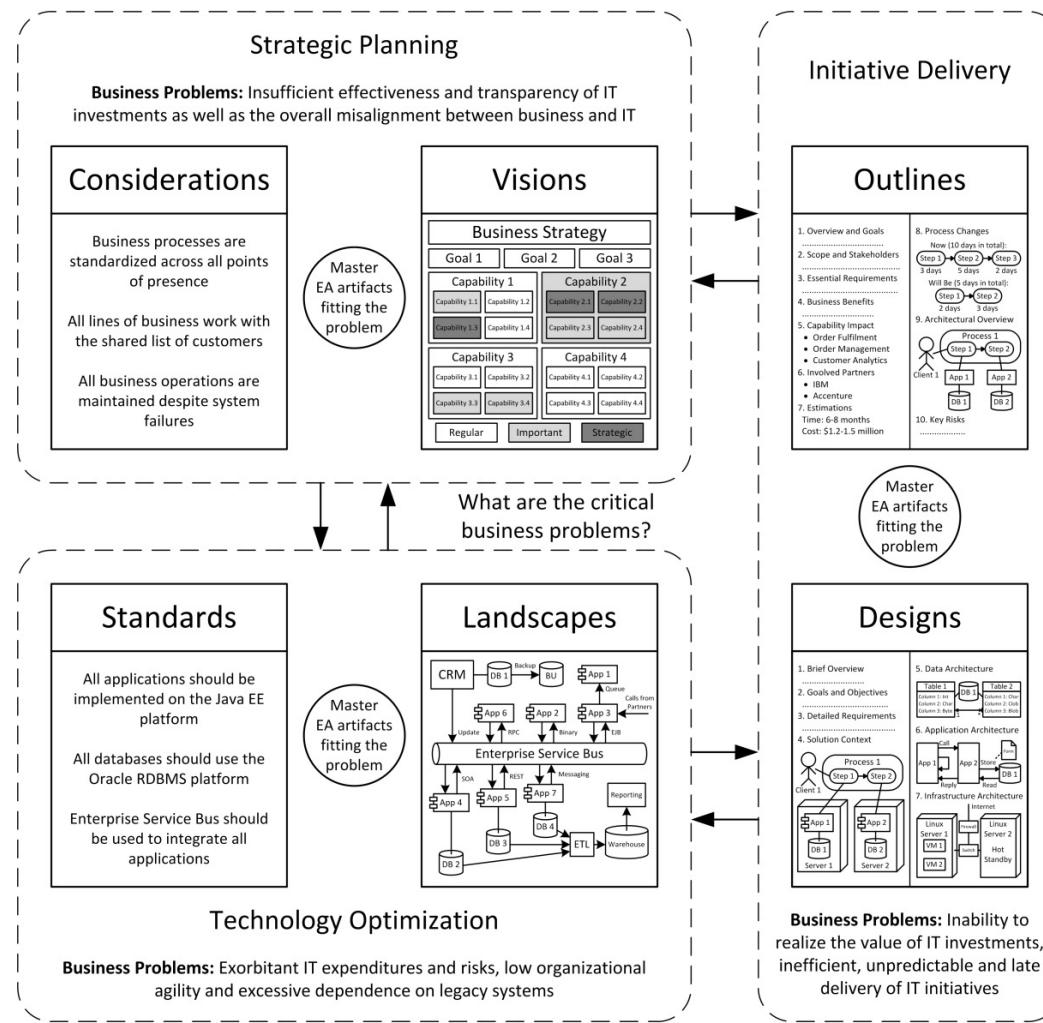
The Deliberate Path to an EA Practice

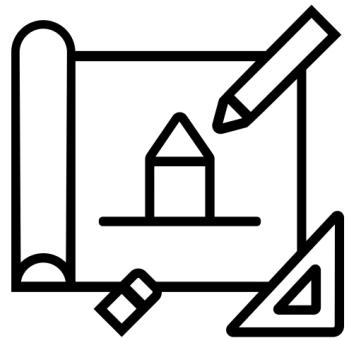
- The newer **deliberate path**
 - Based on the idea of using EA artifacts for **problem solving**
 - Different types of EA artifacts are considered as instruments for solving corresponding business problems
- **Outlines and Designs**
 - help solve the problems related to **poor evaluation and delivery of IT initiatives**
- **Standards and Landscapes**
 - help solve the problems related to **high IT expenditures and low IT agility**
- **Considerations and Visions**
 - help solve the problems related to **poor effectiveness of IT investments and the overall strategic misalignment between business and IT**

The Sequence of the Deliberate Path

- Organizations can start from introducing EA artifacts that address their **most pressing business problems**
- Senior executives should answer the following question:
 - “What is our biggest business problem in relation to IT?”
- If the IT budget is spent mostly on maintenance, IT systems are hard to modify and the IT landscape is full of legacy,
 - then start from Technology Optimization
- If business does not know what IT is doing and how IT dollars are spent,
 - then start from Strategic Planning
- If too many IT initiatives are delivered late or do not bring business value,
 - then start from Initiative Delivery

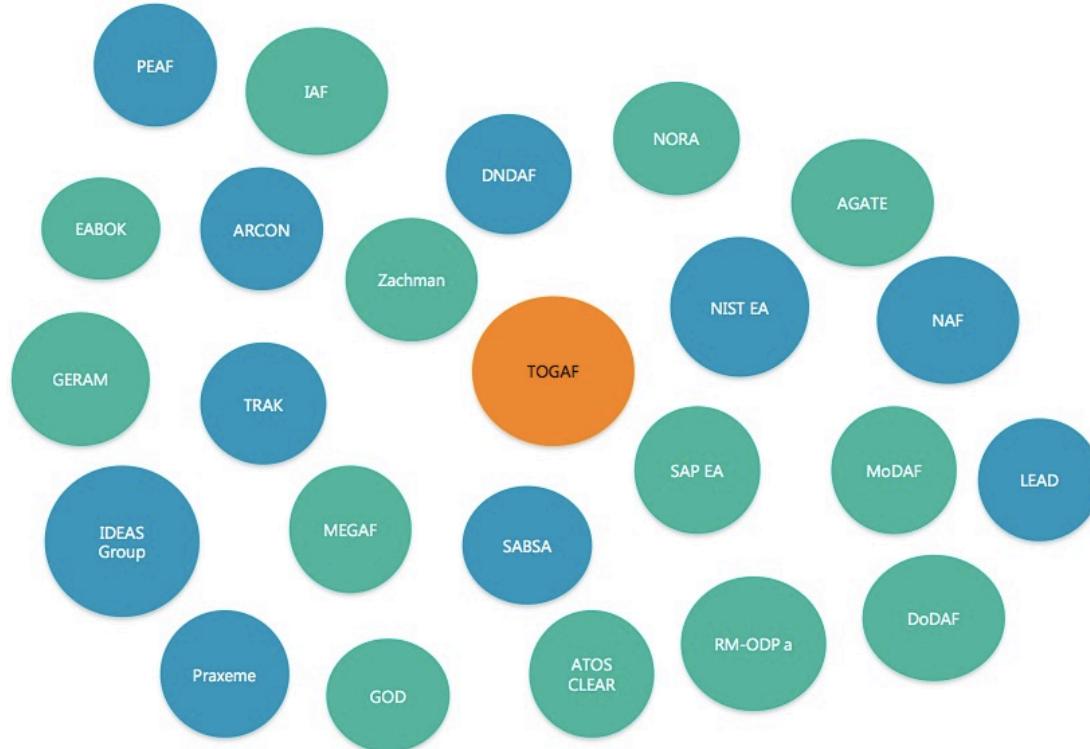
The Deliberate Path to an EA Practice





TOGAF

Many Enterprise Architecture Frameworks



Enterprise Architecture is not just an Implementation of an EA Framework

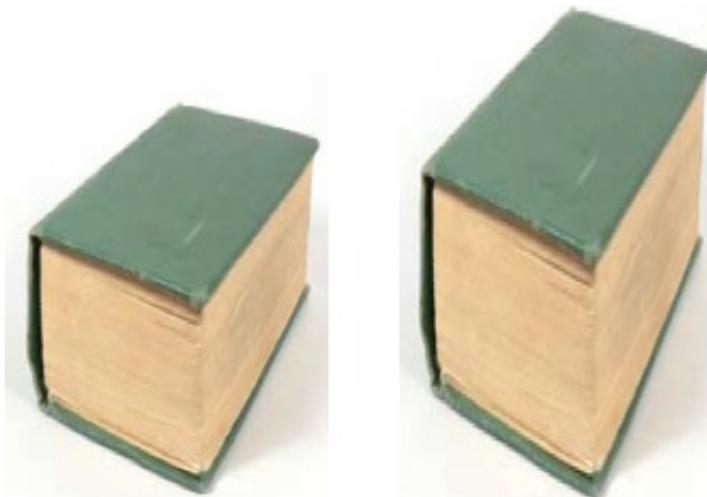
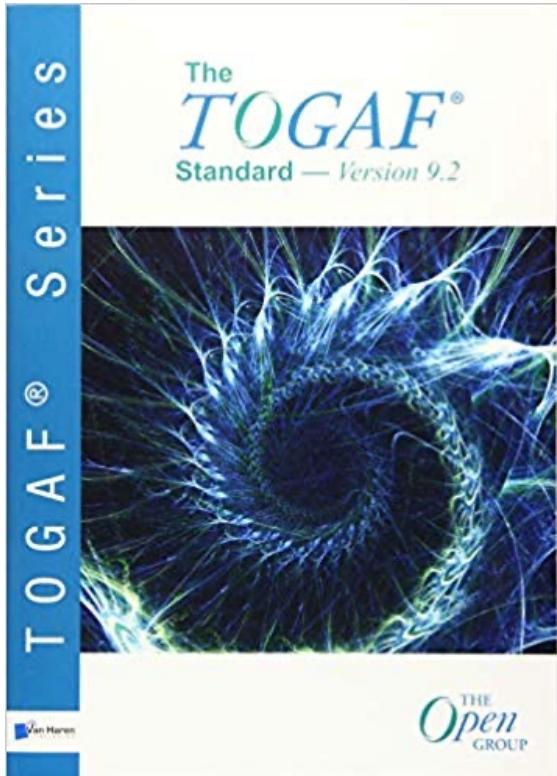
- Since the 1960s consultancies and experts proposed numerous step-by-step architecture-based planning methodologies, and later EA frameworks, to translate business strategies into architectural plans for IT
- However, there are strong evidence that none of these formal architecture planning methodologies actually worked successfully in practice
- An EA practice should not be confused with implementing popular EA frameworks
- EA frameworks are more management fads unrelated to successful EA practices
- All the attempts to follow the actual recommendations of EA frameworks in practice result in failures
- Successful EA practices do not resemble EA frameworks neither in specific details, nor even in general ideas

TOGAF



- The Open Group Architecture Framework
- most used Enterprise Architecture Framework
- Start of the development 1995
- Most TOGAF recommendations are usually found inapplicable
- not followed even in the organizations included in the list of TOGAF-users provided by The Open Group.
- Real examples demonstrating the actual practical usage of TOGAF's recommendations are missing

TOGAF



TOGAF 9
= 778 pages

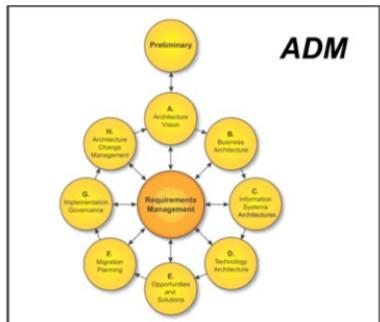
UML 2.4
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TOGAF Parts

How do we manage EA?

How do we map all necessary information?

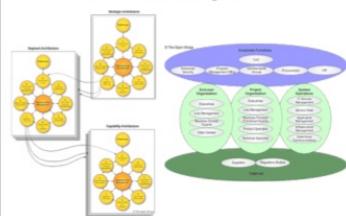
How do we build on industry-practice models?



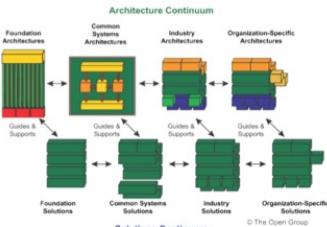
Architecture Content Framework



ADM Guidelines & Techniques



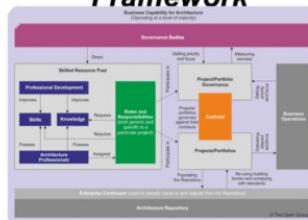
Enterprise Continuum



Reference Models



Architecture Capability Framework

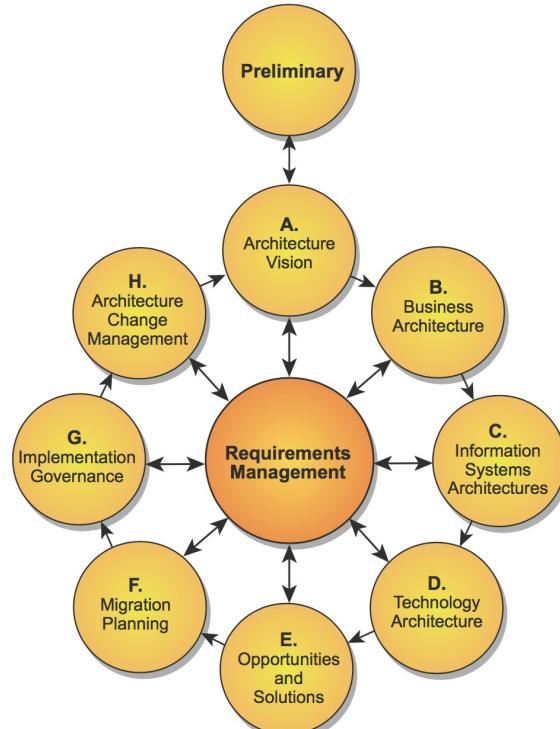


How do we apply the ADM?

How can we maximize recycling of existing architectures?

How do we design our EA?

Architecture Development Method ADM



Summary

Summary

- Organizations represent complex socio-technical systems
- Misalignment between business and IT caused by miscommunication
- Enterprise Architecture as a collection of special artifacts
- Taxonomy of Enterprise Architecture Artifacts
- Eight Essential Enterprise Architecture Artifacts
- The Role of Modeling Languages
- Enterprise Architecture Process
- Architectural Roles
- Use a Deliberate Path to establish an EA Practice
- EA != TOGAF

References

- Kotusev, Svyatoslav (2020). *The Practice of Enterprise Architecture: A Modern Approach to Business and IT Alignment*. SK Publishing. Second Edition