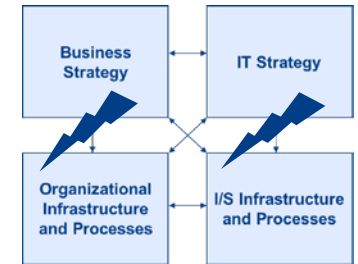# *Enterprise Architecture –*
Dealing with Complexity and Change

Drivers for Change can be internal and external

■ External Drivers

♦ Market Opportunities, new business models

♦ Innovations
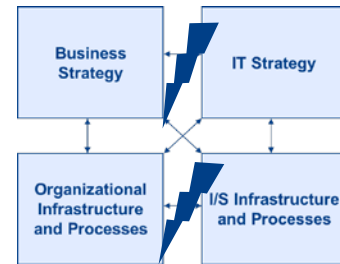
♦ New regulations

♦ Demand for new services and products

> Seize **Opportunities**
> React on **Threats**

■ Internal Drivers

♦ Business Process Optimisation

♦ Increase flexibility

♦ Reorganisation

♦ Migration of Information Systems

♦ Changes in IT infrastructure

> Exploit **Strengths**
> Eliminate **Weaknesses**

Changes and Alignment of Business and IT

- Change can affect the alignment of business and IT on both strategic and operational level

- On strategic level the alignment of business and IT has to deal with problems like the following:
  - ♦ What IT innovations are needed to react on market requirements?
  - ♦ How can we successfully integrate new firms after an acquisition?

- On the operational level questions can be:
  - ♦ Which business units and users will be affected by the migration of an application?
  - ♦ What information does the business process need and how can it be stored?
  - ♦ What applications and infrastructure technologies do we require to run new or redesigned business processes?

- Many organisations lack transparency due to the number and frequency of their organisational changes and have problems to answer these questions.

Architecture: Dealing with Complexity and Change

■ If the object you want to create or change is simple, and it is not likely to change, then you can do it directly.

■ On the other hand, if the object is **complex**, you can't see it in its entirety at one time and it is likely to **change** considerably over time, you need a description or model.

■ This description is what we call an "**Architecture**".
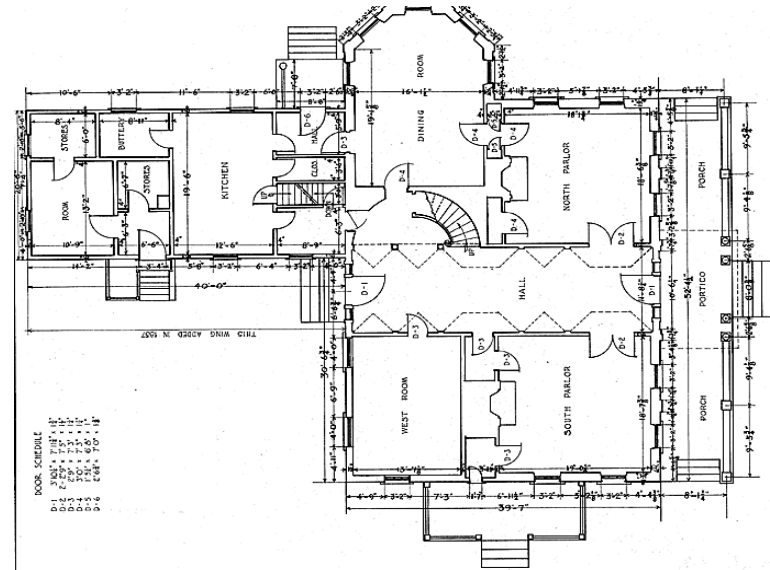
(John Zachmann, 2012)

Architecture – What is it?

■ Is this an Architecture?

Architecture – What is it?

■ Is this an Architecture?

Architecture – What is it?

"*Architecture*" names that which is fundamental about a system; the set of essential properties of a system which determine its form, function, value, cost, and risk. That which is **fundamental** to a system takes several forms:

- ♦ its **elements**: the constituents that make up the system;
- ♦ the **relationships**: both internal and external to the system; and
- ♦ the **principles of its design and evolution**

ISO/IEC/IEEE 42010 - http://www.iso-architecture.org/ieee-1471/cm

Enterprise Architecture: Overall View on the Enterprise

An **Enterprise Architecture** contains all *relevant*

♦ **Business structures** (e.g. organisation structure, business processes)

♦ **IT structures** (e.g. information systems, infrastructure)

♦ and their **relationships**

Architecture and Architecture Description

■ An *architecture* is a **conception of a system** – i.e., it is in the human mind. An architecture may exist without ever being written down.

■ An *architecture description* (AD) is an *artifact* that expresses an Architecture to share with others.

   ♦ An AD is what is written down as a concrete work product. It could be a document, a repository or a collection of artifacts used to define and document an architecture

   ♦ Architects and other system stakeholders use Architecture Descriptions to understand, analyze and compare Architectures, and often as "blueprints" for planning and construction.

http://www.iso-architecture.org/ieee-1471/cm/

Archtecture Description and Architecture Models

- An *Architecture Description* consists of one or several *Architecture Models*

- A Model is a reproduction of a *relevant* part of reality which contains the essential aspects to be investigated.

models (plan)

real object
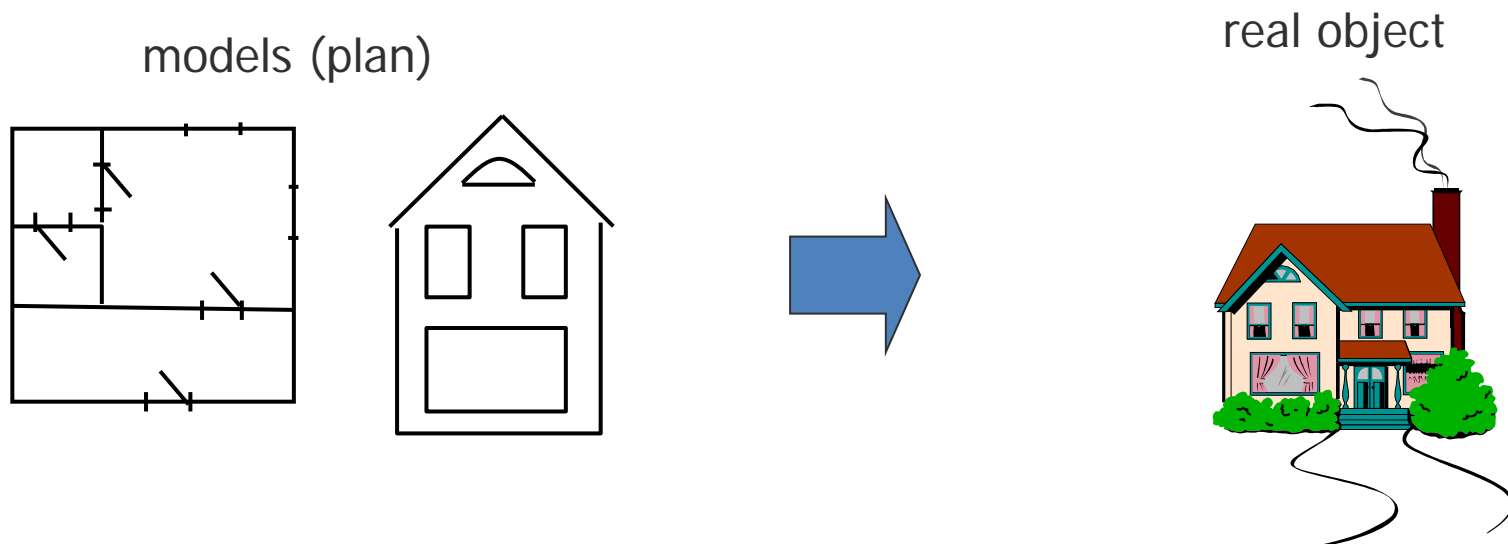
Enterprise Architecture (Description) – What is it?

■ An "Architecture" (for anything) would be the total set of descriptive representations (models) relevant for describing a complex object such that it can be created and that constitute a baseline for changing the object after it has been instantiated.

■ Therefore "**Enterprise Architecture**" would be the total set of models relevant for describing an Enterprise, that is, the descriptive representations required

♦ to create a (coherent, optimal) Enterprise and

♦ to serve as a baseline for changing the Enterprise once it is created.

Adapted from Zachman (2012)

Typical (Change) Projects

Change needed
Agree on objectives
Understand as-is situation
as-is situation
Determine change
Define to-be situation
to-be situation
Implement changes
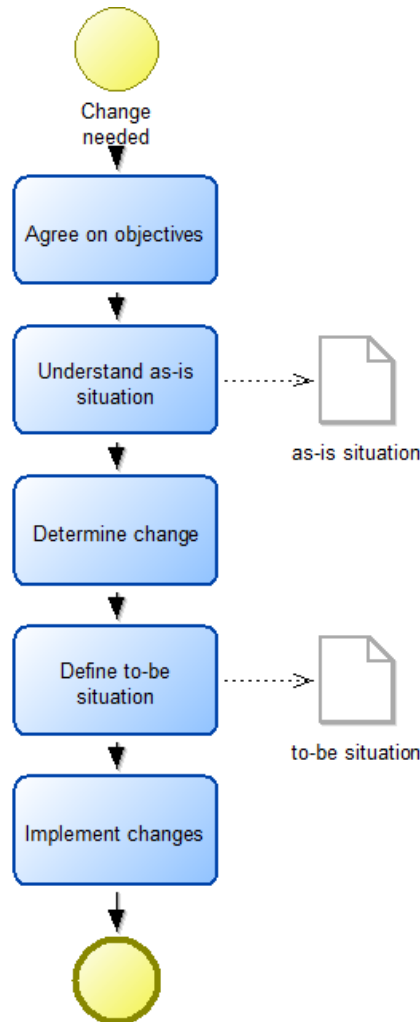
- Typically organisations go through several stages in a change project:
  - recognizing the need to change
  - agreeing on the objectives of the change and a vision that describes a better future
  - understanding what the organisation is changing from (as-is model)
  - determine what needs to change
  - designing the new way of working and its support and management (→ to be model)
  - testing and implementing changes

Architecture Descriptions in an Enterprise
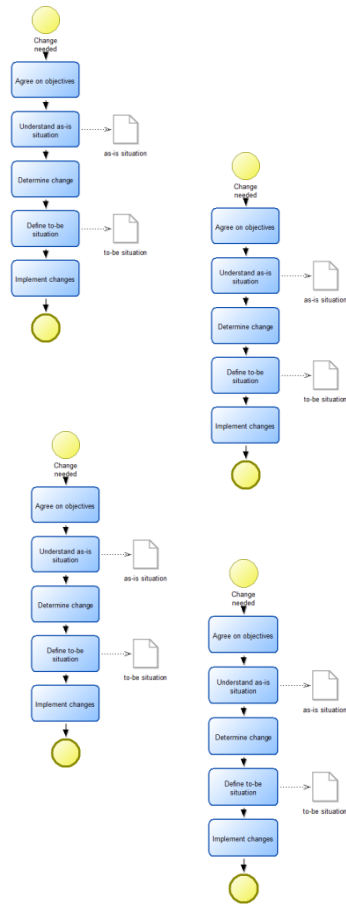
Typically …

… there are a large number of projects

♦ running concurrently or

♦ building on the result of previous projects

… projects have an extensive documentation of their (intended) result

… each project manages its own documentation which is not available for other projects

… there is a lack of coordination between projects

The Need for Architecture Description

■ **Complexity:** If you can't describe it, you can't create it (whatever "it" is).

■ **Change:** If you don't retain the descriptive representations after you create them (or if you never created them in the first place) and you need to change the resultant implementation, you have only three options:

♦ Change the instance and see what happens. (High risk!)

♦ Recreate ("reverse engineer") the architectural representations from the existing ("as is") implementation.
(Typical for many projects - Takes time and costs money!)

♦ Scrap the whole thing and start over again.

■ Better: **Retain description of your enterprise architecture**

(John Zachmann, 2012)

Enterprise Architecture Repository

Enterprise
Architecture
Description

Strategy

Organisation and processes

Information systems

Infrastructure

as-is

to be
(update)
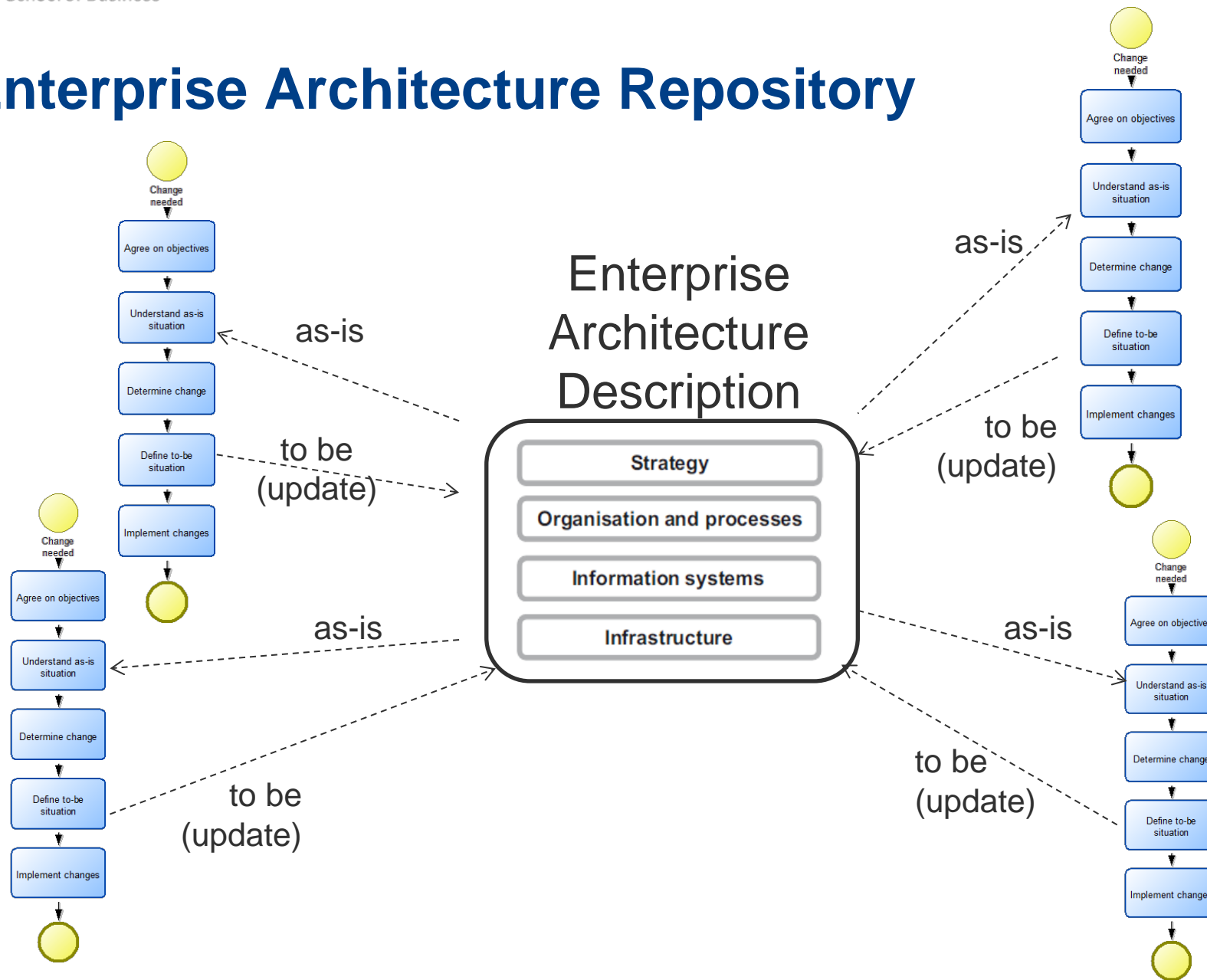
Use of Enterprise Architecture: Managing Change and Decision Making

■ Change the architecture before you change the object!

■ The Enterprise Architecture is managed as a program that facilitates

♦ systematic organization change

♦ continuously aligns technology investments and projects with organisation mission needs.

■ Enterprise Architecture is updated continuously to reflect changes

■ It is a primary tool for baseline control of

♦ complex, interdependent enterprise decisions and

♦ communication of these decisions to organization stakeholders.

(Schekkermann 2008, p. 107)

Enterprise Architecture

Real world

| Strategy |
| Organisation and processes |
| Information systems |
| Infrastructure |

Modeling ↓

Target state

| Strategy |
| Organisation and processes |
| Information systems |
| Infrastructure |

EA development →

Realising ↑

As-is model

| Strategy |
| Organisation and processes |
| Information systems |
| Infrastructure |

To-be model

| Strategy |
| Organisation and processes |
| Information systems |
| Infrastructure |

Enterprise Architecture Model

(Ahlemann et al. 2012, p. 17)

Enterprise Architecture Frameworks

Prof. Dr. Knut Hinkelmann

Architecture Framework

- An *Architecture Framework* establishes a common practice for creating, interpreting, analyzing and using architecture descriptions

- It is a logical structure for classifying and organising the descriptive representations of a system

Timeline of Enterprise Architecture Frameworks
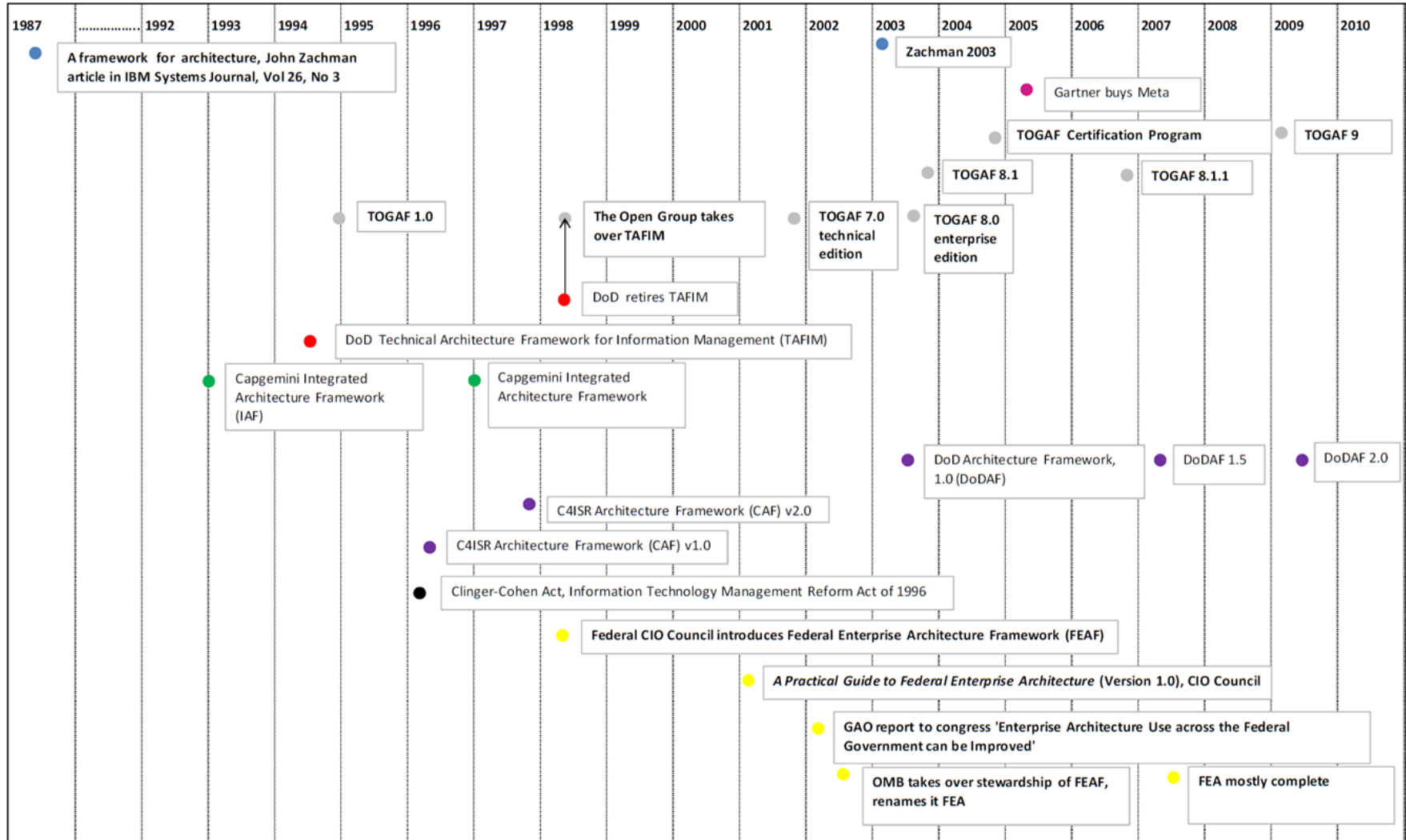
(Bespoke Systems 2012)

Enterprise Architecture Frameworks

■ We can distinguish two main types of structures for Enterprise Architecture Frameworks:

♦ **Three layer architecture** with business, applications and technology, e.g.

● *TOGAF - The Open Group Architecture Framework*

  – A methodology for architecture development

● *ArchiMate* – A modeling language for EA

● *Best Practice Enterprise Architecture*

♦ **Matrix** of aspects and perspectives, e.g.

● *Zachmann Enterprise Architecture Framework*

  – An enterprise ontology
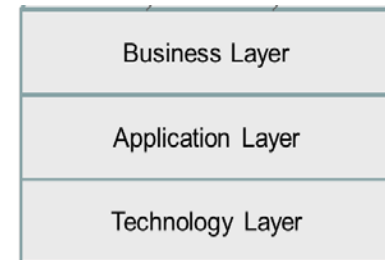
TOGAF – The Open Group Architecture Framework

TOGAF – The Open Group Architecture Framework

■ Developed and continuously evolved since the mid-90's by The Open Group's Architecture Forum

■ At the heart of the framework are the

♦ Architecture Development Method (ADM) and

♦ The Ccontent Framework

■ http://www.opengroup.org/togaf/

Structure of the TOGAF Document

Needs of the business shape non-architectural aspects of business operation

TOGAF Capability Framework

Informs the size, structure, and culture of the capability

Sets targets, KPIs, plans, and budgets for architecture roles
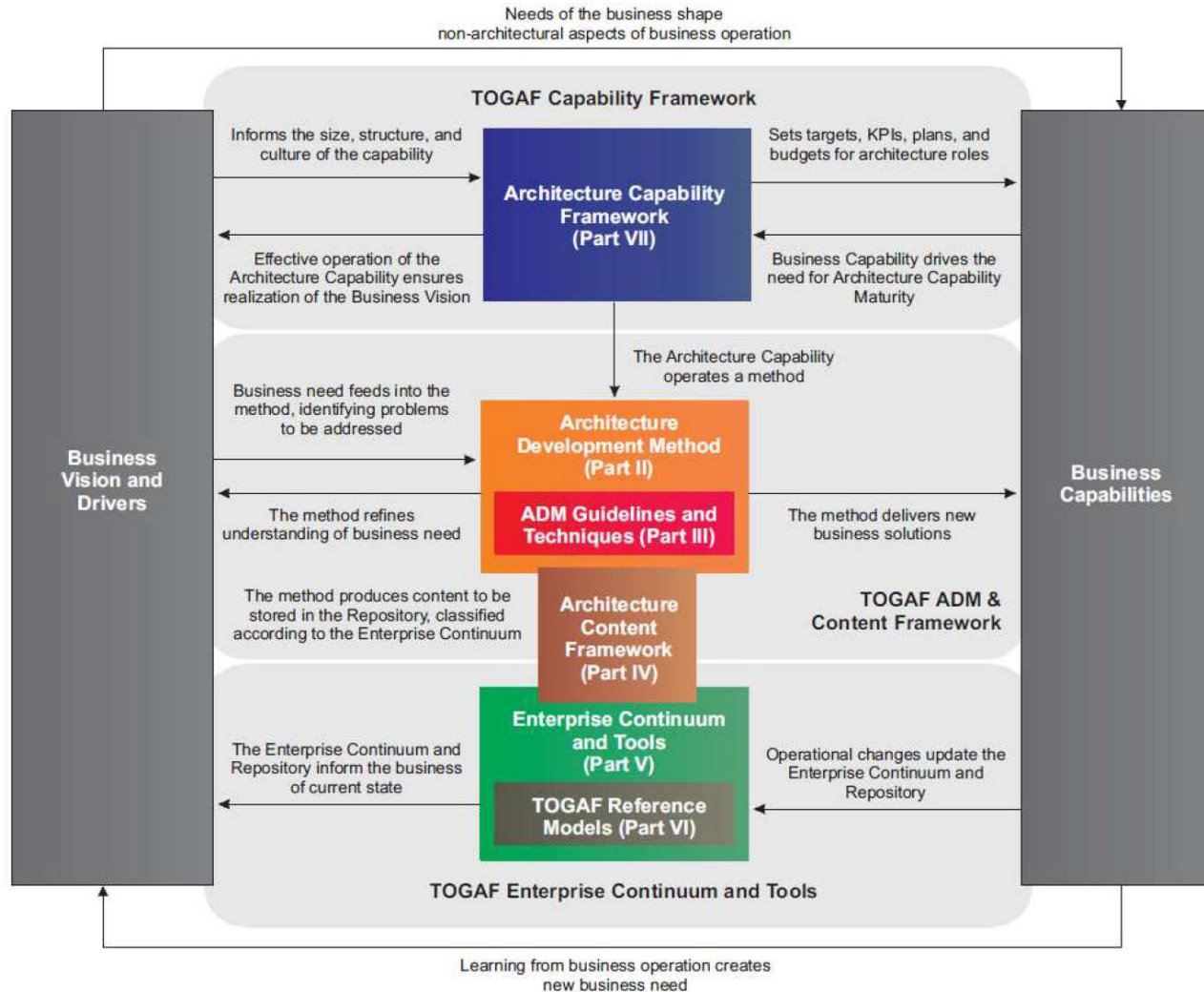
Architecture Capability Framework (Part VII)

Effective operation of the Architecture Capability ensures realization of the Business Vision

Business Capability drives the need for Architecture Capability Maturity

The Architecture Capability operates a method

Business need feeds into the method, identifying problems to be addressed

Architecture Development Method (Part II)

Business Vision and Drivers

The method refines understanding of business need

ADM Guidelines and Techniques (Part III)

The method delivers new business solutions

Business Capabilities

The method produces content to be stored in the Repository, classified according to the Enterprise Continuum

Architecture Content Framework (Part IV)

TOGAF ADM & Content Framework

Enterprise Continuum and Tools (Part V)

The Enterprise Continuum and Repository inform the business of current state

TOGAF Reference Models (Part VI)

Operational changes update the Enterprise Continuum and Repository

TOGAF Enterprise Continuum and Tools

Learning from business operation creates new business need

(The Open Group 2009, p. 4)

TOGAF Architectures

Business Architecture	
Data Architecture	Application Architecture
Technology Architecture	

The TOGAF enterprise architecture model is organised in four partial sub-architectures:

♦ **Business Architecture**

- Strategies, governance, organisation and business processes of the enterprise

♦ **Information Systems Architecture** – consists of

- **Data Architecture**
  - data and their releations as well as principles for the organisation and the management of resources
- **Application Architecture**
  - information systems and their relations to business processes

♦ **Technology Architecture**

- currenct technical realisation and future enterprise-specific standards like operating system, middleware, infrastructure
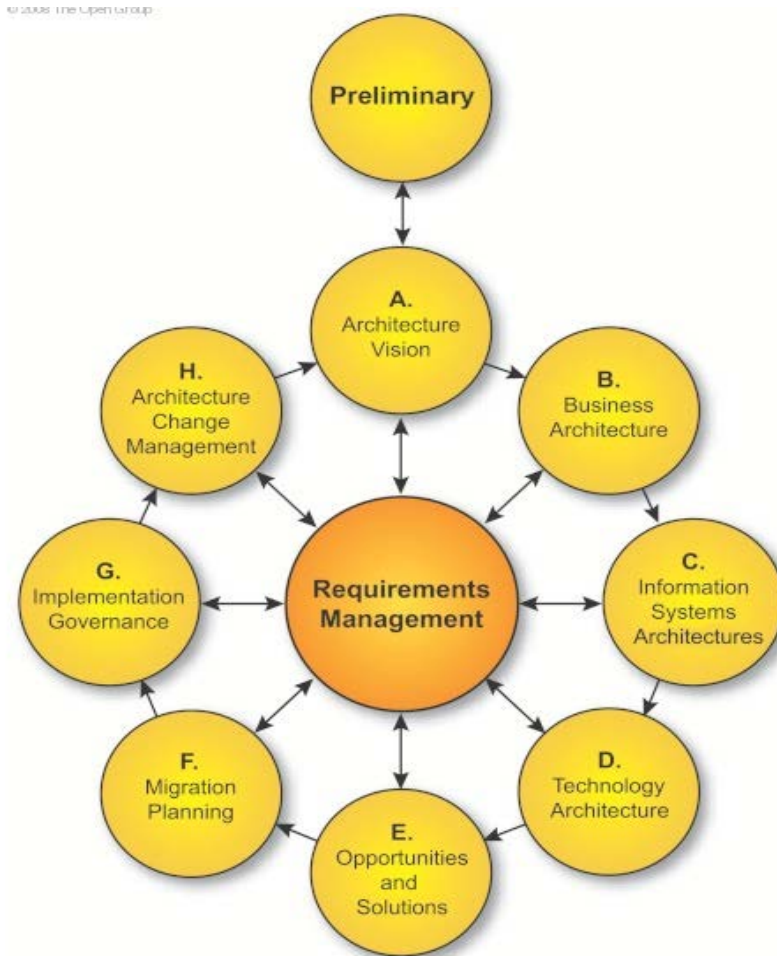
TOGAF Architecture Development Method (ADM)

© 2008 The Open Group

Preliminary

A. Architecture Vision

H. Architecture Change Management

B. Business Architecture

G. Implementation Governance

Requirements Management

C. Information Systems Architectures

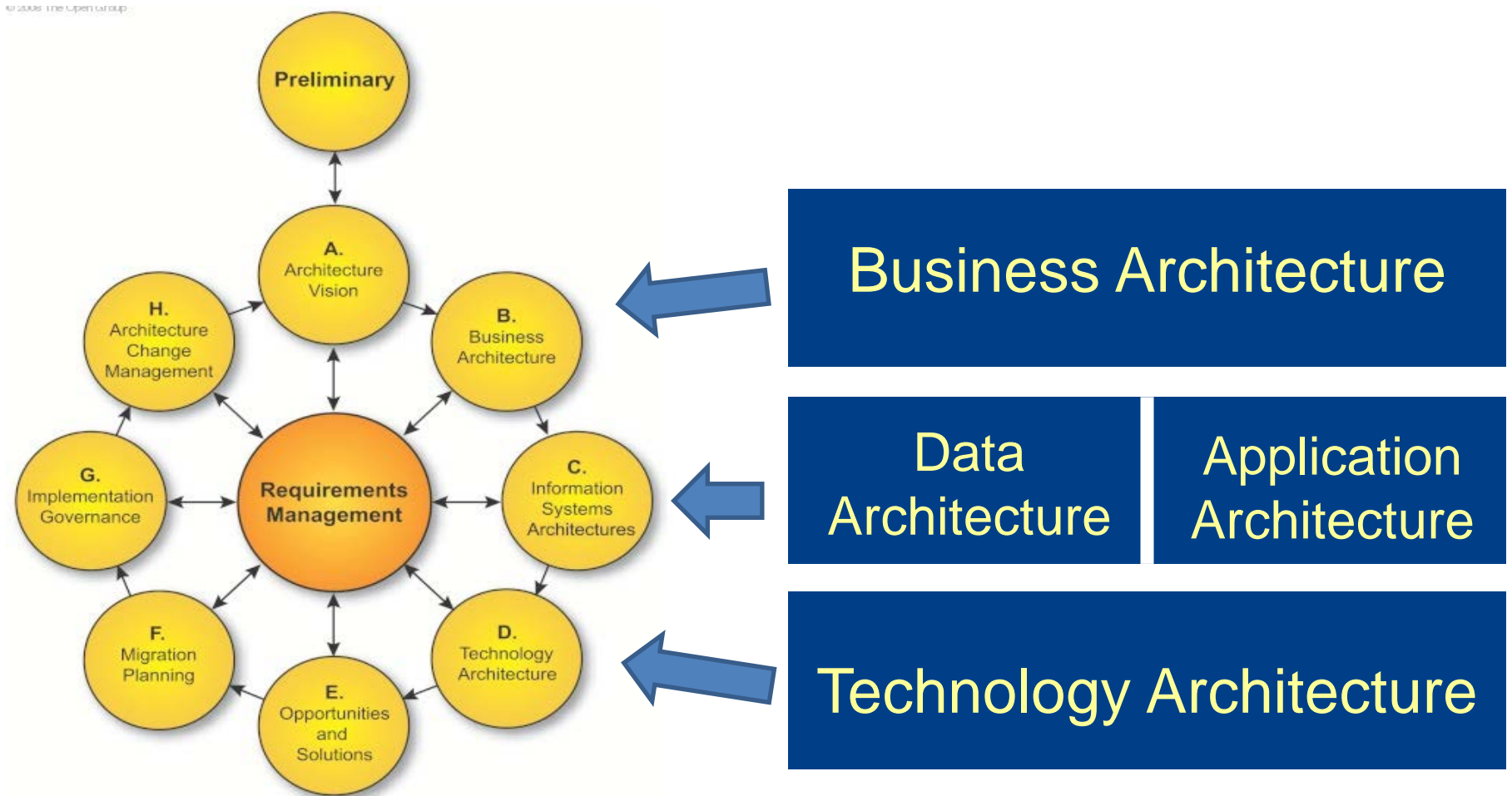F. Migration Planning

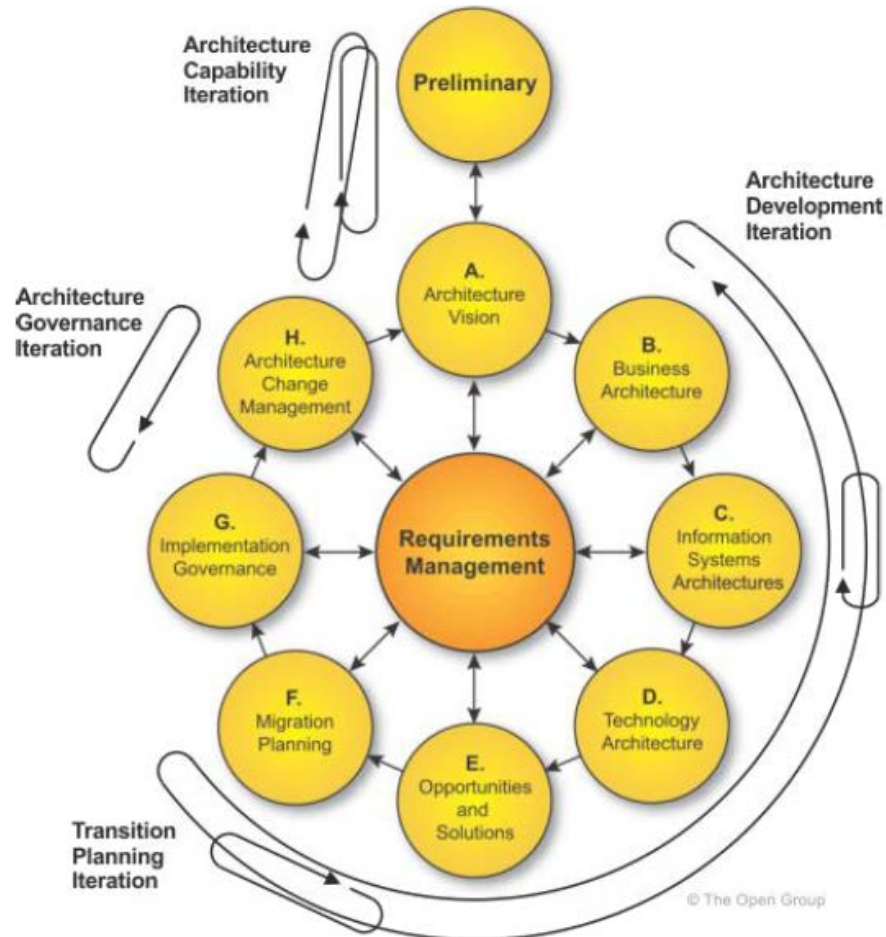D. Technology Architecture

E. Opportunities and Solutions

- TOGAF addresses the whole enterprise architecture lifecycle

- The TOGAF Architecture Development Method (ADM) is a generic method for developing an enterprise architecture

- The goals, approaches, required input, activities and deliverables are documented for each phase separately

- The ADM method is enriched by specific ADM guidelines and techniques.

(The Open Group 2009)
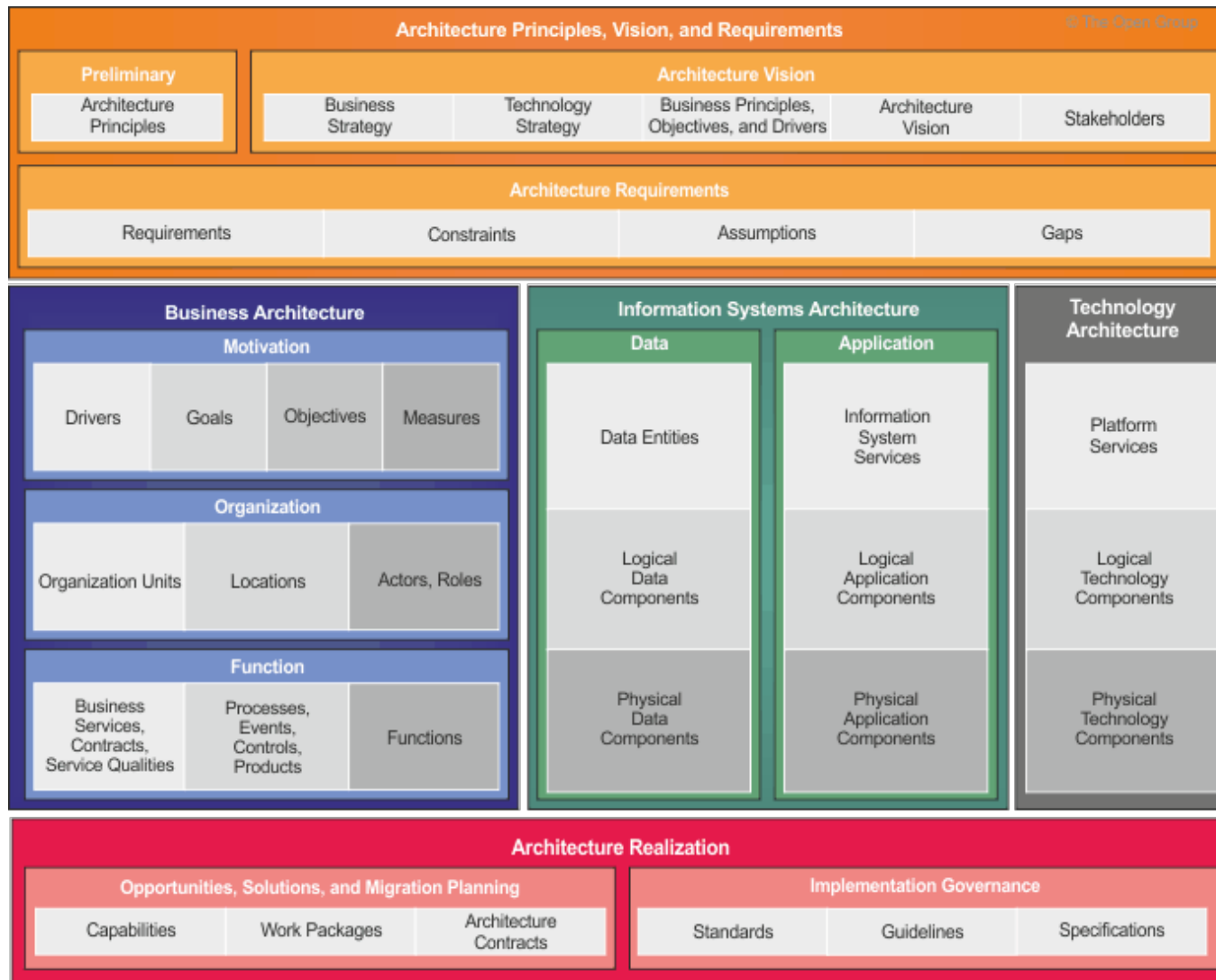
TOGAF Architecture Views

TOGAF Architecture Development Method (ADM)

Architecture Capability Iteration

Architecture Development Iteration

Architecture Governance Iteration

Preliminary

A. Architecture Vision

B. Business Architecture

H. Architecture Change Management

C. Information Systems Architectures

G. Implementation Governance

Requirements Management

D. Technology Architecture

F. Migration Planning

E. Opportunities and Solutions

Transition Planning Iteration

© The Open Group

- ■ Although originally represented as a sequential method, chapter 19.2 of TOGAF describes also iteration cycles
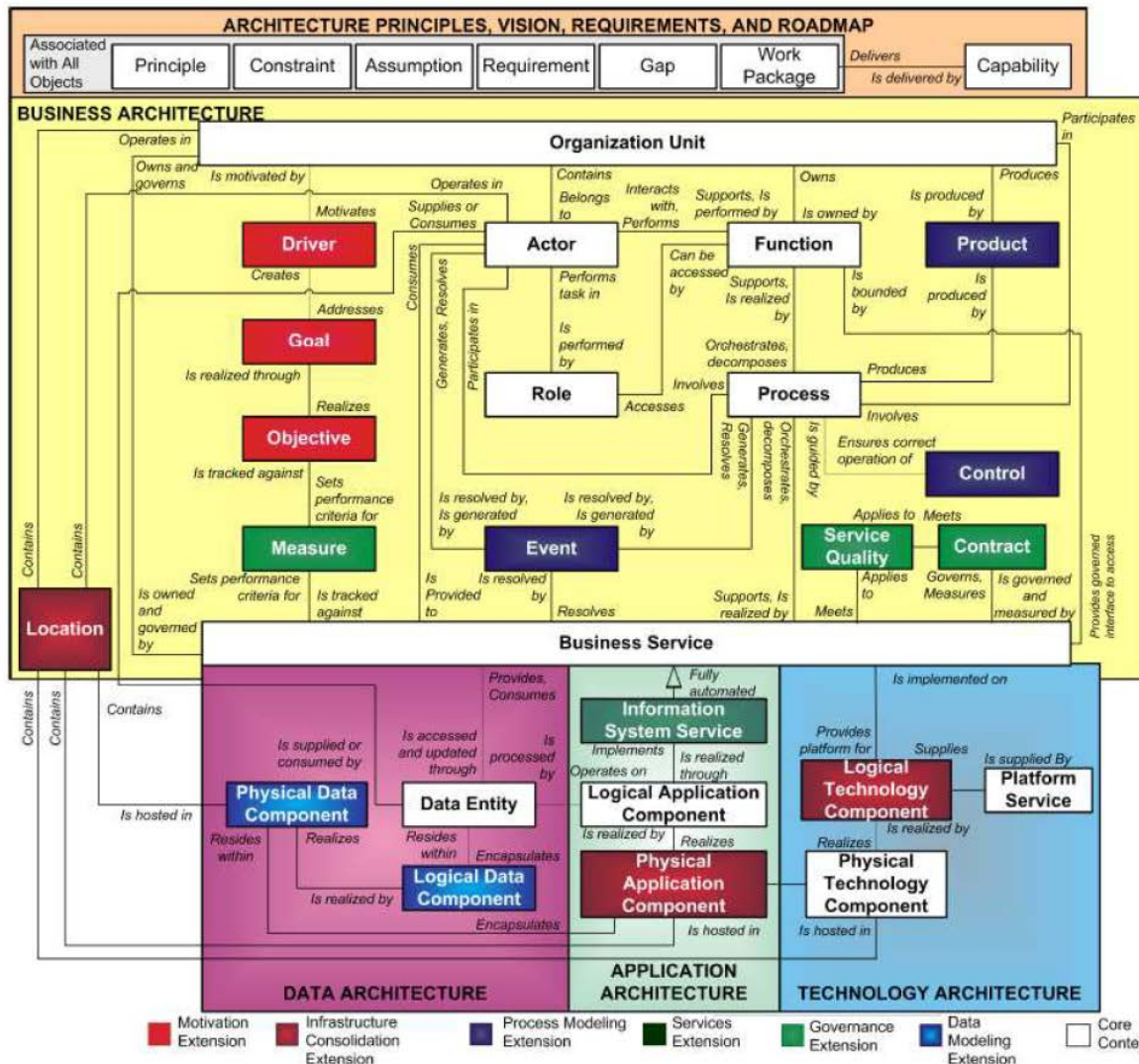
(The Open Group 2011)

TOGAF Content Metamodel

http://pubs.opengroup.org/architecture/togaf9-doc/arch/chap33.html (The Open Group 2011)

Prof. Dr. Knut Hinkelmann   Enterprise Architecture Frameworks   29

TOGAF Content Metamodel

■ The content metamodel provides a definition of all the types of building blocks that may exist within an architecture.

■ The content metamodel

♦ identifies all of these building block (i.e., application, data entity, technology, actor, and business service),

♦ shows the relationships that are possible between them, e.g.

● actors consume business services

● data entities are held within applications

● technologies implement applications

● applications support buiness users or actors

♦ identifies artifacts that can be used to represent them.

http://pubs.opengroup.org/architecture/togaf9-doc/arch/chap33.html   (The Open Group 2011, Part IV)

TOGAF: Architecture Content

The architecture content framework "provides a structural model for architectural content" and may also be substituted with other frameworks, such as the Zachman Framework (The Open Group, 2009, p. 361).
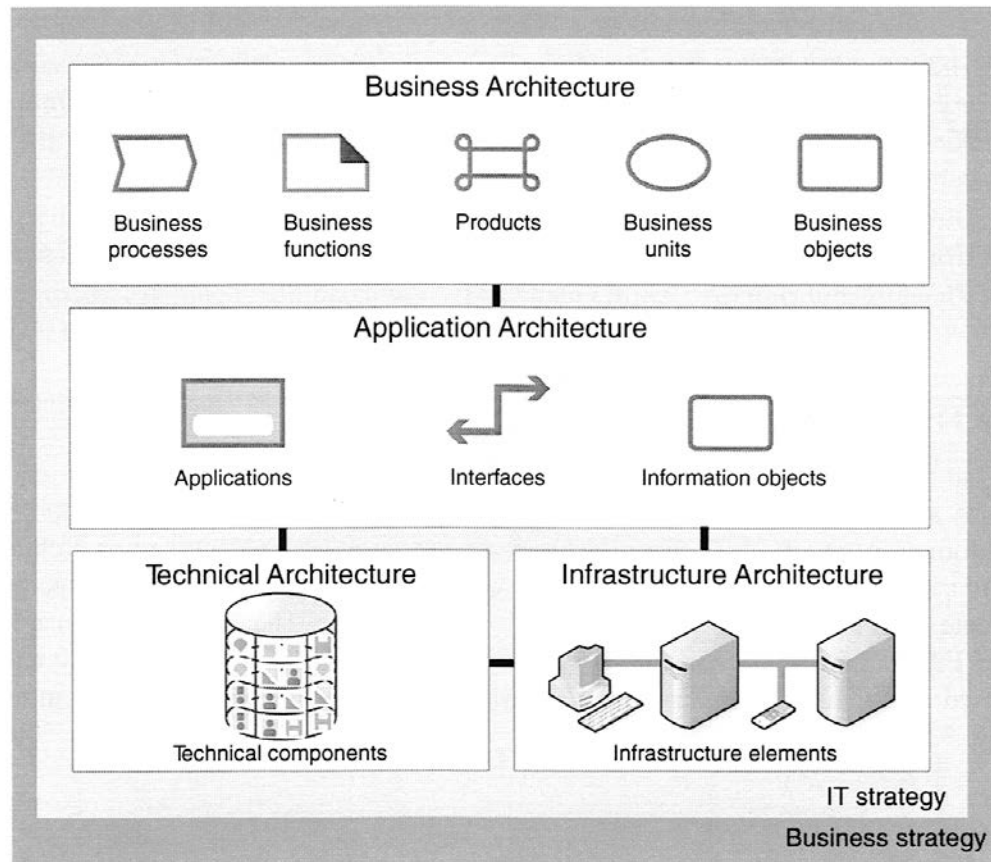
(The Open Group 2009, p. 379)

TOGAF: Architecture Content Framework

- The content framework is intended to allow TOGAF to be used as a stand-alone framework for architecture.

- However, some enterprises may opt to use an external framework (such as the Zachman Framework or ArchiMate) in conjunction with TOGAF.

- In these cases, the content framework provides a useful reference and starting point for TOGAF content to be mapped to other frameworks

Best Practice Enterprise Architecture

Best Practice Enterprise Architecture

Business Architecture

Business processes · Business functions · Products · Business units · Business objects

Application Architecture

Applications · Interfaces · Information objects

Technical Architecture — Technical components

Infrastructure Architecture — Infrastructure elements

IT strategy

Business strategy

- ■ The Bast Practice Architecture from Inge Hanschke (2010) is another example of a three-layer enterprise architecture framework.

- ■ In contrast to TOGAF
  - ♦ it is quite simple
  - ♦ it differentiates between the technical architecture and the infrastructure architecture
  - ♦ it does not have a separate data or information architecture

from (Hanschke, 2010)

Partial Architectures of the Best Practice Architecture

- **Business Architecture**
  - ♦ Describing main entities that determine the business: business processes, functions, products, business units and business objects.

- **Application Architecture**
  - ♦ documentation of the information systems landscape, i.e. information systems, their data und interfaces und the information flow
  - ♦ bridge between business architecture and the architectures of technology and infrastructure

- **Technology Architecture**
  - ♦ determination of enterprise-specific technical standards for information systems, interfaces and infrastructure

- **Infrastructure Architecture**
  - ♦ Entities of the infrastructure, on which the information systems are running

Enterprise Architecture Modeling

Overview: ArchiMate

Detailed Models

Overview: Zachman

Business Motivation

BPMN

Data/Documents

Organisation Model

Business Rules

Fact Type Model

UML class diagram

UML sequence diagram

UML component diagram

UML activity diagram