Enterprise Architecture – Introduction
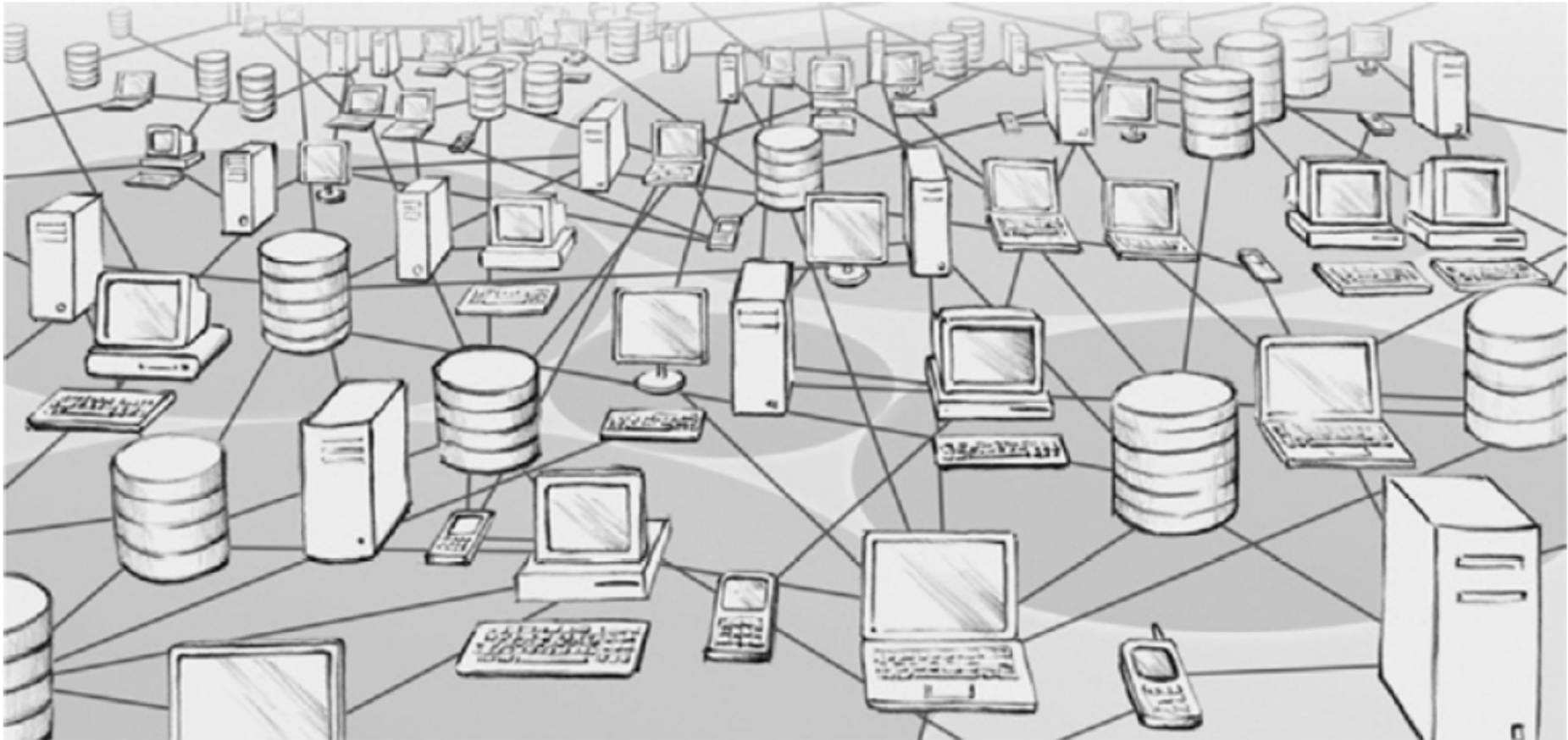
Prof. Dr. Knut Hinkelmann

Chapter 1: Introduction to Enterprise Architecture

- Motivation:Strategic IT Management
  - ♦ Agility
  - ♦ Business-IT Alignment

- Approach: Enterprise Architecture
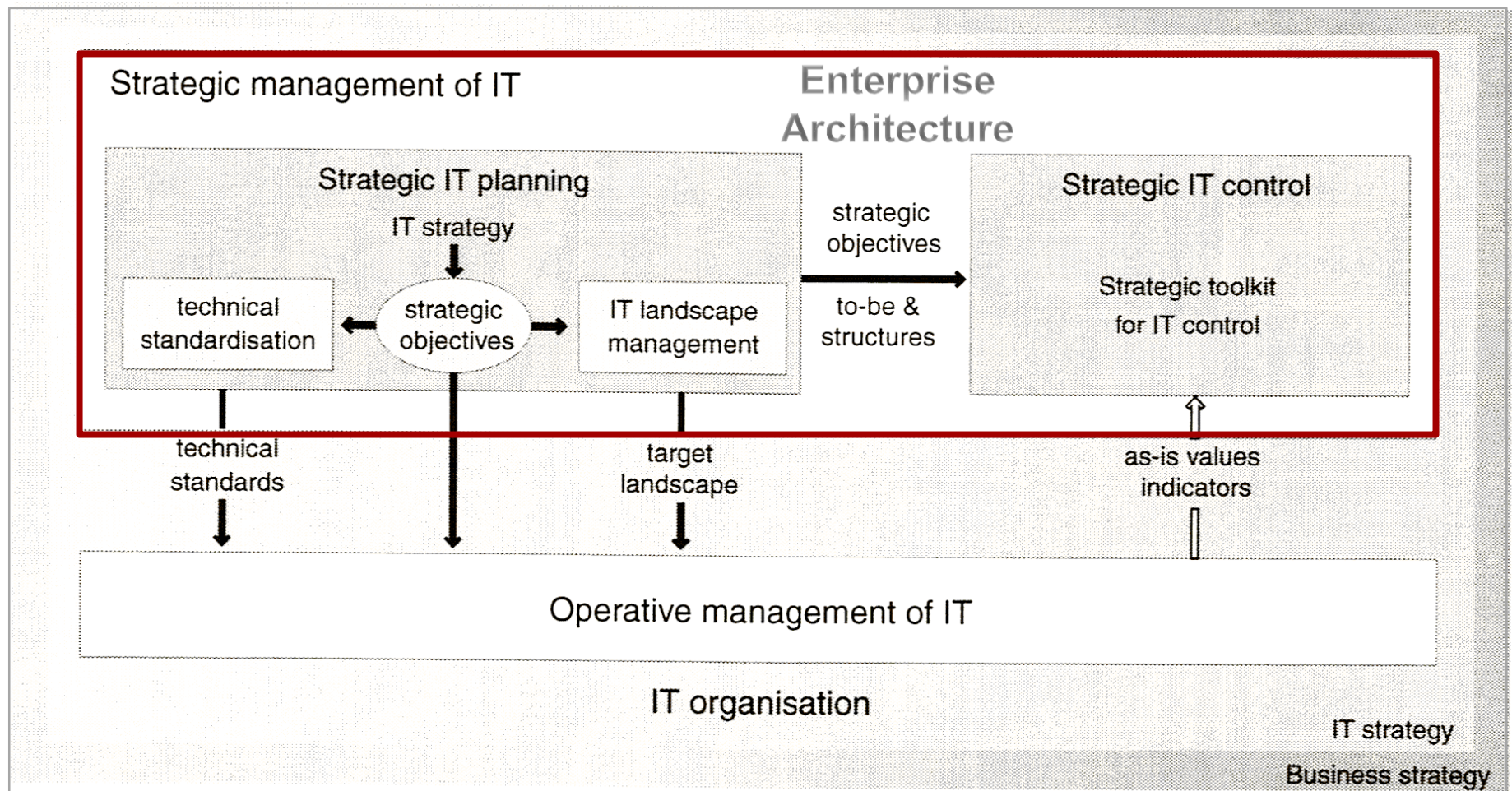
- Enterprise Architecture Frameworks

A Common Situation

Heterogenuous and complex IT landscapes: patchwork of systems, processes, technologies etc.

(Hanschke 2010, p. 1f)

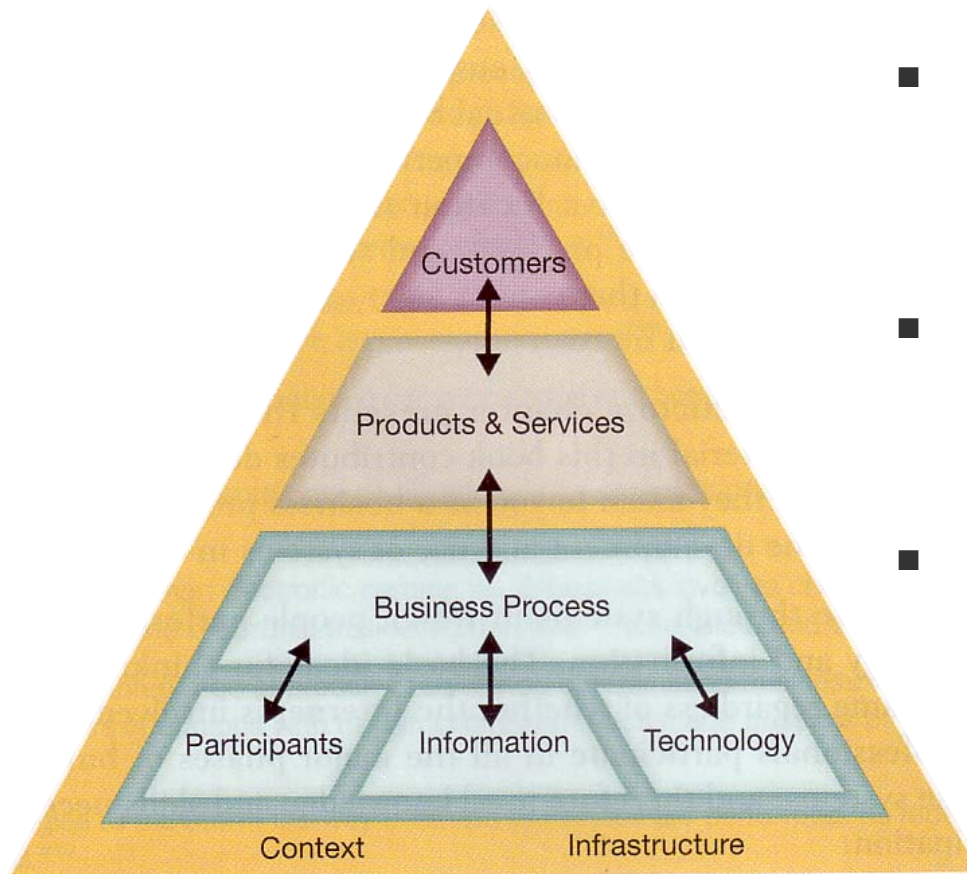# IT Management

(Hanschke 2010, p. 3)

Strategic Planning of Information Technology

The objective of planning IT strategically is to **align** it with overarching corporate goals and business requirements and make it **agile** enough to deal with constant change in the company and ist environment

(Hanschke 2010, p. 7)

➢ **Business-IT alignment**
➢ **Agility**

Work-Centered Analysis

Customers

Products & Services

Business Process

Participants   Information   Technology

Context   Infrastructure

- Value creation: processes realise products and services for a customer

- Processes…
  - … are executed by people (participants)
  - … use, create and communite information
  - … apply information technology

- The two-headed arrows imply that the elements should be in balance
  - ◆ Change in one element usually requires change in other elements

- Mutual dependencies
  - ◆ products and services are appropriate for customers and customers demand services
  - ◆ business processes are appropriate for producing the products and services
  - ◆ participants, information and technology are appropriate for the business processes – and vice versa

(Alter 2002, p. 46f)

Alignment of Business and Information Technology (IT)

■ Almost all processes have become IT reliant, if not fully automated

■ The alignment of business and IT has to deal with problems like the following:

  ♦ What happens to IT if the company has to react on market requirements?

  ♦ What IT innovations are needed to remain competitive?

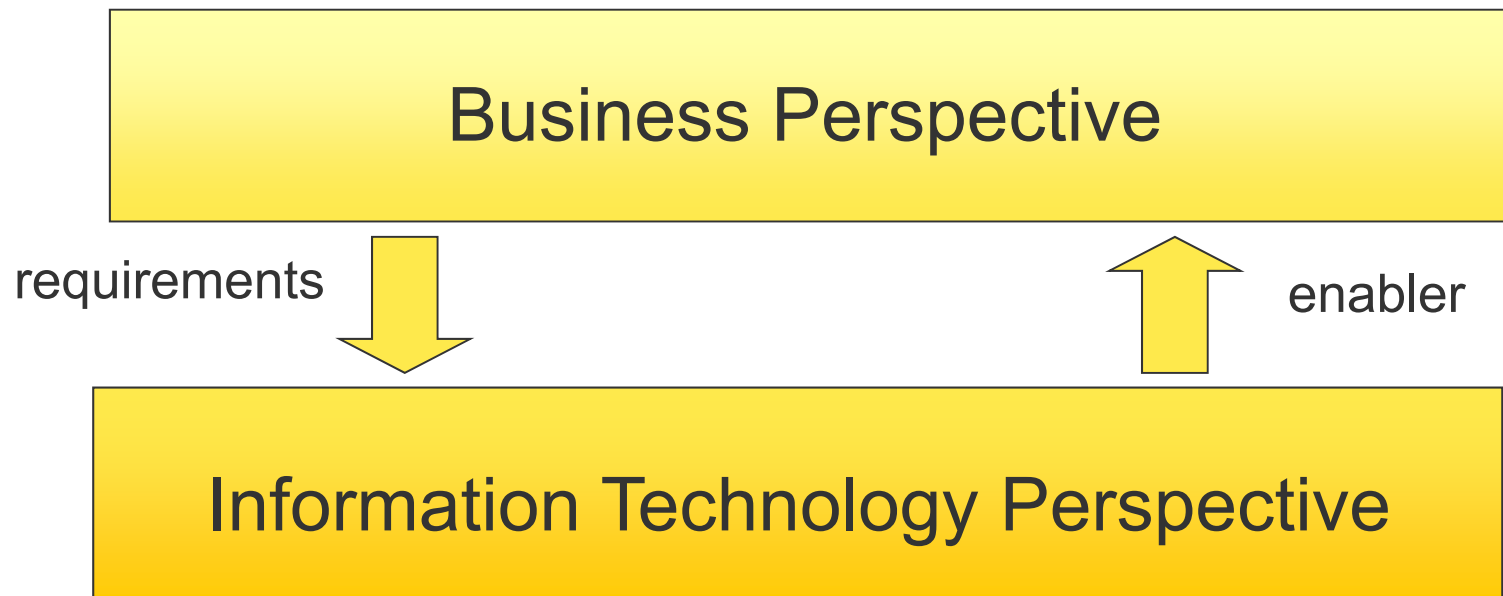 ♦ How do changes in the IT affect the business?

Strategic Alignment of IT
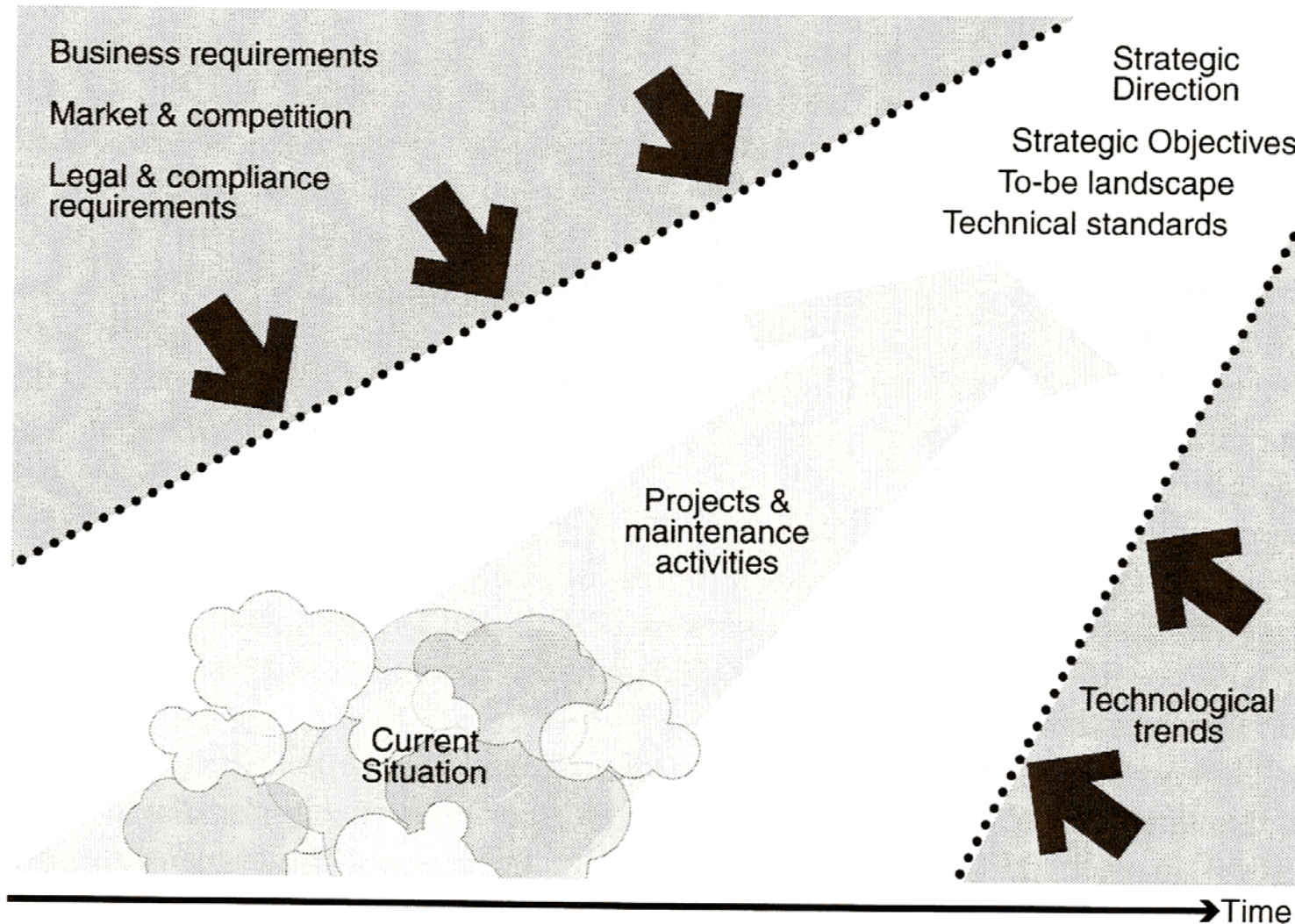
(Hanschke 2010, p. 11)

Alignment of Business and IT

- Top-down: Business as driver
  - ♦ Business defines requirements for IT
  - ♦ use IT effectively to achive business objectives

- Bottom-up: IT as driver:
  - ♦ IT as an enabler for new ways of making business

Mutual Dependencies between Business and IT

■ Change in the enterprise is usually a compromise, e.g.

♦ Business requirements cannot be fully satisfied, because

● there are *already systems available* that cannot be replaced (reasons can be costs or other dependencies)

● standards set by IT strategy avoid unmanagable varieties and ensure reliability

● centralisation reduces costs at the expense of specialisation

♦ Chances of IT innovations cannot be implemented, because of

● missing skills of employees

● business processes or organisation are not appropriate

● incompatibility with business strategy

Drivers for Business-IT Alignment

■ **Internal Drivers**

- ♦ Business Process Management / Optimisation
- ♦ Reorganisation
- ♦ Migration of Information Systems
- ♦ Changes in IT infrastructure

■ **External Drivers**

- ♦ Pressures from
  - ● customers (new integrated services, individual products, …)
  - ● suppliers and other business partners
  - ● regulatory bodies (e.g. SOX, Basel II, and laws in general)
- ♦ Market Opportunities, new business models
- ♦ Innovations

Deriving IT Goals

External constraints

Corporate goals
Business requirements
Strategic Positioning

Internal constraints

ANALYSIS & IDENTIFICATION

ELABORATION & DEFINITION

Business requirements

IT requirements

IT goals
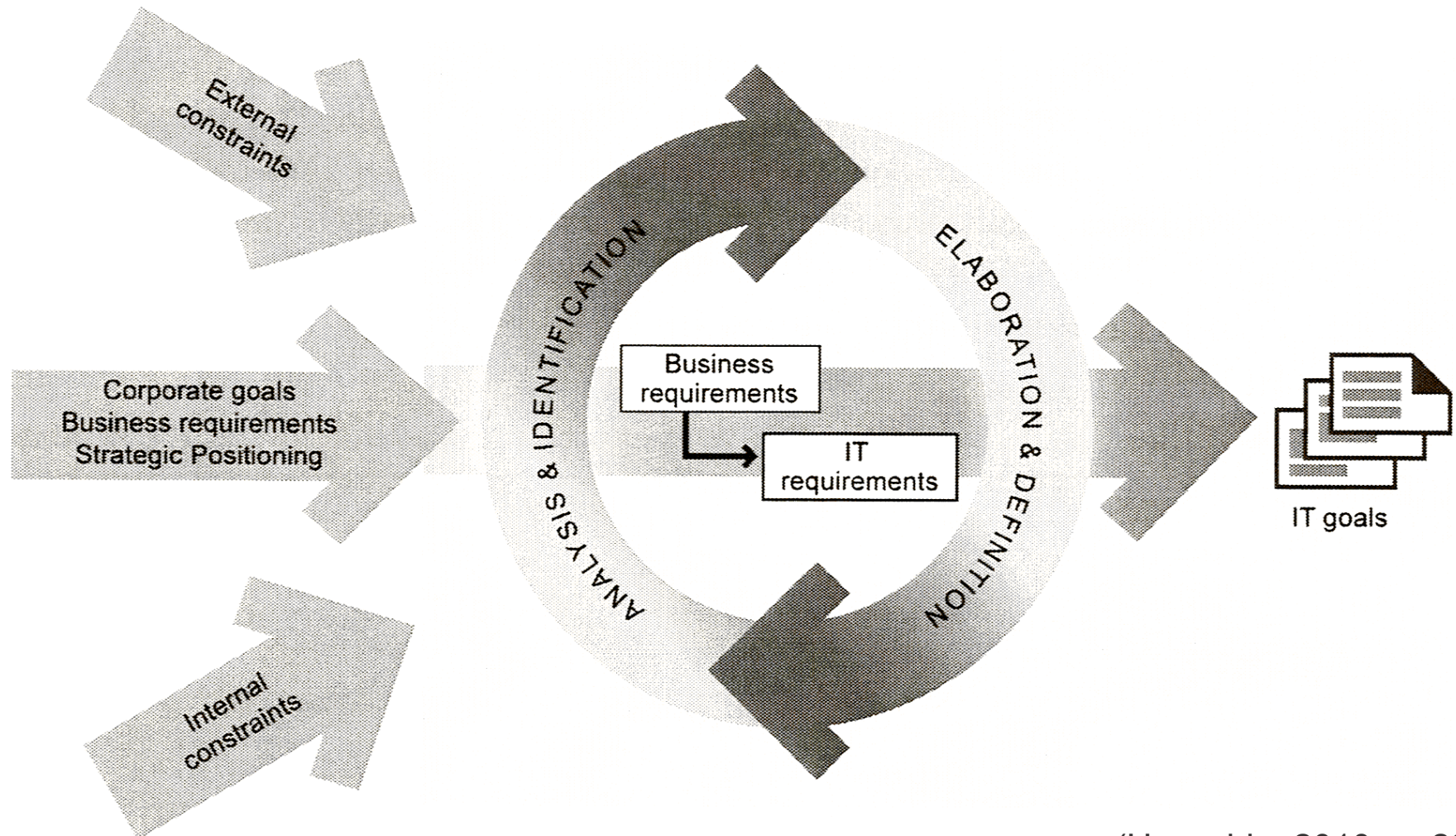
(Hanschke 2010, p. 23)

Strategic Alignment Model of Henderson and Venkatraman (1993)
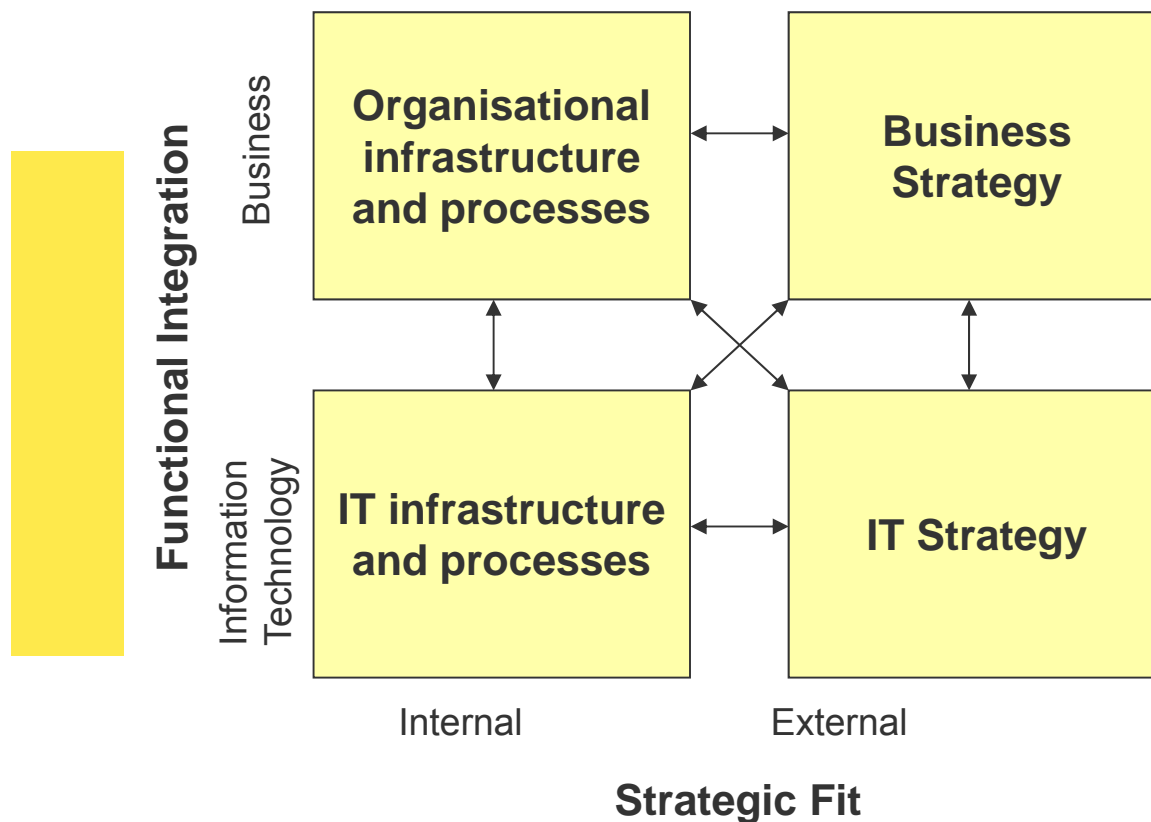
- Four dominant perspectives to tackle alignment (see figure)

- Two dimensions
  - ♦ Functional Integration: Aligning business and IT
  - ♦ Strategic Fit: Aligning interal and external drivers

- Two principle approaches for alignment:

  top-down: take the business strategy as the starting point and derive the IT infrastructure

  bottom-up: focus on IT as an enabler: start from IT strategy deriving organisational infrastructure

Functional Integration

Business

Information Technology

Organisational infrastructure and processes	Business Strategy
IT infrastructure and processes	IT Strategy

Internal   External

Strategic Fit

(Lankhorst et al. 2005, p. 6f)

Challenges confronting an Enterprise

Achieving Competitive Advantage

New laws and regulations

Mergers and Acquisition

Compliance

New business models

Corporate Governance

Service improvement

Collaboration/ Integration

Efficiency

Outsourcing

Shifting powers in the value chain

Novel technologies

Customers

Products & Services

Business Process

Participants   Information   Technology

Context   Infrastructure

Business-IT alignment has to be adpated to constant changes: → Agility

Demand for Agility

#113 – "AGILE DEVELOPMENT, EXAPLAINED" – BY SALVATORE IOVENE, FEB. 21ST 2009   HTTP://WWW.GEEKHEROCOMIC.COM/

Challenge: Agility

- Increasingly dynamic environment because auf mergers, acquisitions, innovations, new regulations etc.

- To improve chances of survival, enterprises need to be agile

- Agility is the ability to
  - quickly adapt themselves to changes in their environment and
  - seize opportunities as they avail themselves

- Agility has become a business requirement in many lines of business, e.g.
  - car industry (new model within few months instead of 6 years)
  - banking industry (time to market for new product in few weeks instead of 9-12 months)

Agility is not yet a Reality in Today's Enterprises

In practice, enterprises see themselves hampered in their ability to change in several ways:

♦ being uninformed about their own products, services, capabilities, internal structures

♦ traditionally, organisations were designed with efficiency and effectiveness in mind rather than agility

♦ no common understanding and governance of key data resources

♦ a plethora of legacy applications and infrastructures

♦ duplicated functionality in terms of people and/or technology

♦ interwoven and unclear responsibilities

♦ organisational silos, self-contained business units who operate on their own, with no sharing of data

♦ silo applications, i.e. self-contained and isolated applciations, which only provide functionality to a specific business process

Source: Op 't Land, M.; Proper, E.; Waage, M.; Cloo, J. and Steghuis, C.: Enterprise Architecture - Creating Value by Informed Governance, Springer-Verlag 2009, page 6. http://www.springerlink.com/content/k8jp3r/#section=132347&page=2&locus=10

Enterprise Architecture: Achieving Visibility

■ Any organisation benefits from haven a clear understanding of its

  ♦ structure, products, operations, technology etc.

  ♦ the relations tying these together and

  ♦ relations connecting the organisation to its surroundings
  (Lankhorst et al. 2005, p. 6)

■ Visibiliy is a key input for strategic IT control

  ♦ Clarity on the interdependencies that exist in the landscape

  ♦ A clear statement of progress made toward goals

  ♦ The extent to which planning and business requirements have been enacted

  (Hanschke 2010, p. 3)

Enterprise Architecture

- **An Enterprise Architecture** is a coherent whole of principles, methods, and models that are used in the design and realisation of an enterprise's organisational structure, business processes, information systems, and infrastructure

- An Enterprise Architecture contains all *relevant*

  - ♦ Business structures
  - ♦ IT structures
  - ♦ and their relationships

- Enterprise Architecture gives an overall view on the enterprise

  - ♦ merge distributed information from various organisational entities and projects into a whole
  - ♦ show the interconnectedness and dependencies between these information

➢ Show which information systems contribute to which business processes.

Objective of Enterprise Architecture

- Ensuring alignment of business strategy and IT investments

- Describing the interaction between business and information technology

- Making dependencies and implications of changes in business and IT visible

- Supporting communication between different stakeholders by appropriate models

Enterprise Architecture and Work-Centered Analysis
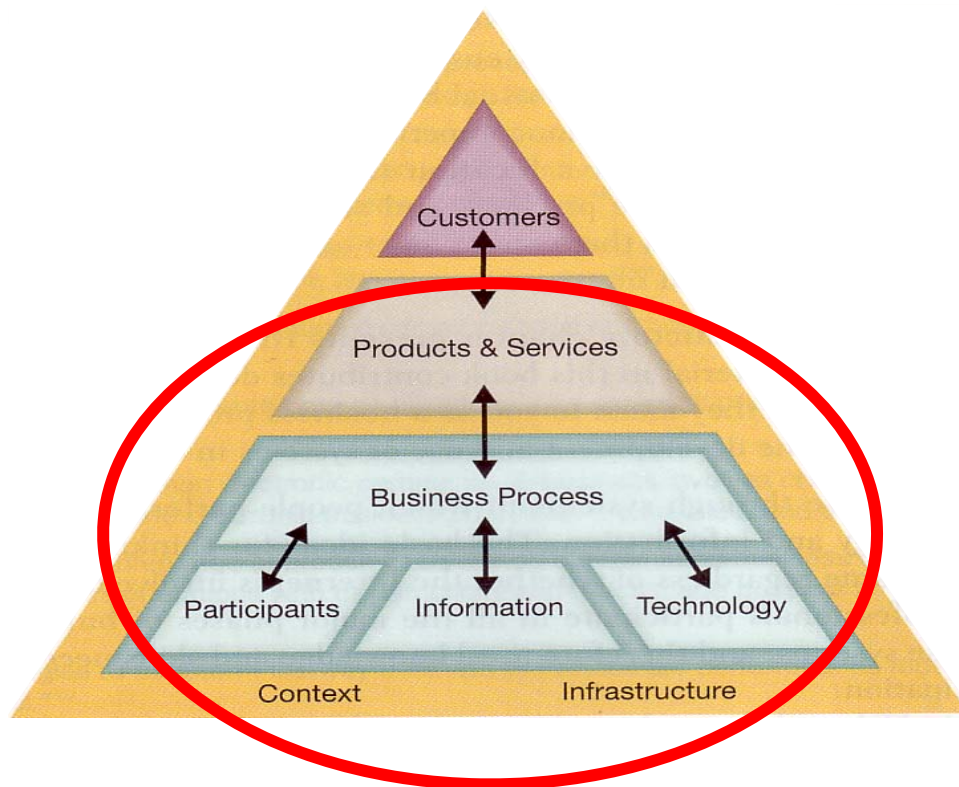
- ■ The Enterprise Architecture

  - ♦ represents the main elements of the work centered analysis and their relations

  - ♦ models both business and IT perspective

  - ♦ relates to strategy (motivation)

Quelle: Alter, Steven: Information Systems – The Foundation of E-Business, 4. Auflage, Prentice Hall, New Jersey, 2002

Example: Zachman Framework – each cell contains models

Aspects

Perspectives

		What (Data)	How (Function)	Where (Locations)	Who (People)	When (Time)	Why (Motivation)
Business	**Scope {contextual}** **Planner**	List of things important to the business	List of processes that the business performs	List of locations in which the business operatses	List of organizations important to the business	List of events/ cycles important to the business	List of business goals/strategies
	Enterprise Model {conceptual} **Business Owner**	e.g. Semantic Model	e.g. Business Process Model	e.g. Business Logistics System	e.g. Workflow Model	e.g. Master Schedule	e.g. Business Plan
	System Model {logical} **Designer**	e.g. Logical Data Model	e.g. Application Architecture	e.g. Distributed System Architecture	e.g. Human Interface Architecture	e.g. Process Structure	e.g. Business Rule Model
Information Technology	**Technology Model {physical}** **Implementer**	e.g. Physical Data Model	e.g. System Design	e.g. Technology Architecture	e.g. Presentation Architecture	e.g. Control Structure	e.g. Rule Design
	Detailed Representation {out-of-context} **Subcontractor**	e.g. Data Definition	e.g. Program	e.g. Network Architecture	e.g. Security Architecture	e.g. Timing Definition	e.g. Rule Definition
	Functioning System	e.g. Data	e.g. Function	e.g. Network	e.g. Organization	e.g. Schedule	e.g. Strategy

Zachman Framework

- The Zachman framework is regarded the origin of enterprise architecture frameworks (although originally called "Framework for Information Systems Architecture")

- John A. Zachman published the first version in 1987, which he extended in 1992 together with John F. Sowa

- The Framework is often referenced as a standard approach for expressing the basic elements of enterprise architecture

- The framework is a logical structure for classifying and organising the descriptive representations of an enterprise that are significant to
  - the management of the enterprise
  - the development of the enterprise's systems (Lankhorst et al. 2005, p. 24)

Dimension 1 – Perspectives

Zachman uses the analogy of classical architecture

For the different stakeholders different aspects of a building are relevant - models of the building from different perspectives

Bubble charts: conceptual representation delivered by the architect

Architect's drawing: transcription of the owner's perceptual requirements – *owner's perspective*

Architect's plans: translation of the owner's requirements into a product – *designer's perspective*

Contractor's plans: phases of operation, architect's plans contrained by nature and technology – *builder's perspective*

Shop plans: parts/sections/components of building details (out-of-context specification) – *subcontractor's perspective*
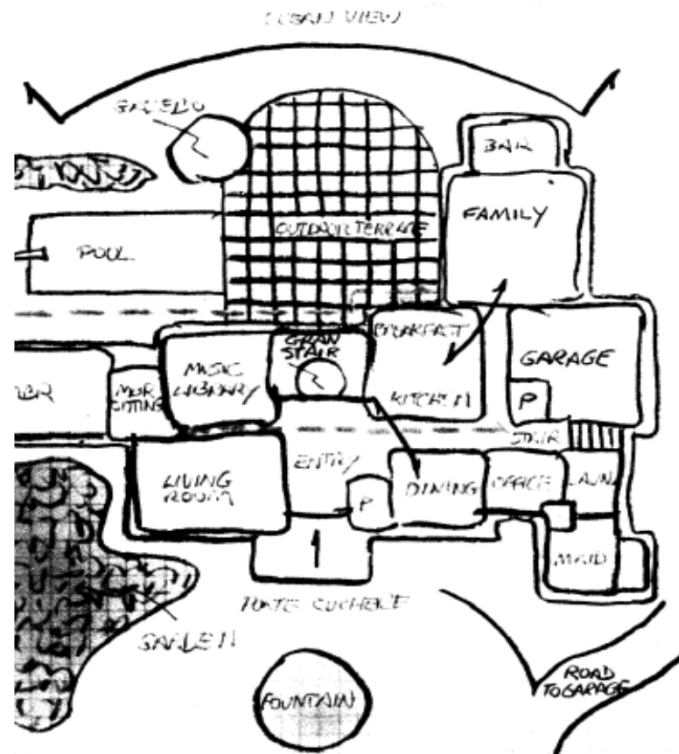
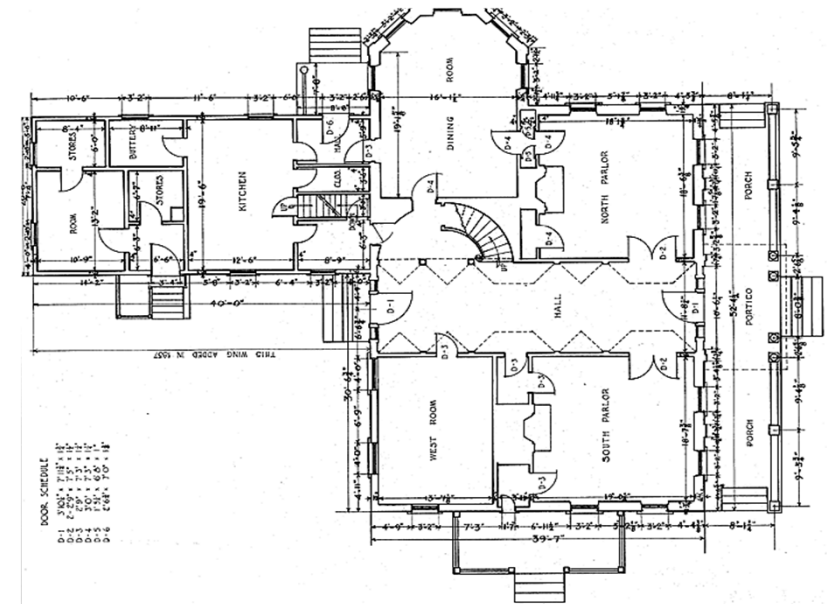**The building:** physical building itself

(Zachman 1987)

Dimension 1: Architectural Representations with analogies in Building and Information Systems

Generic	Buildings	Information Systems
Ballpark	Bubble charts	Scope/objectives
Owner's representation	Architect's drawings	Model of the business (or business description)
Designer's representation	Architect's plans	Model of the information system (or information system description)
Builder's representation	Contractor's plans	Technology model (or technology-constrained description)
Out-of-context representation	Shop plans	Detailed description
Machine language representation	—	Machine language description (or object code)
Product	Building	Information system

(Zachman 1987)

Bubble Chart
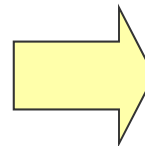
Architect's Plan

(Zachman 1987)

Dimension 1 - Perspectives

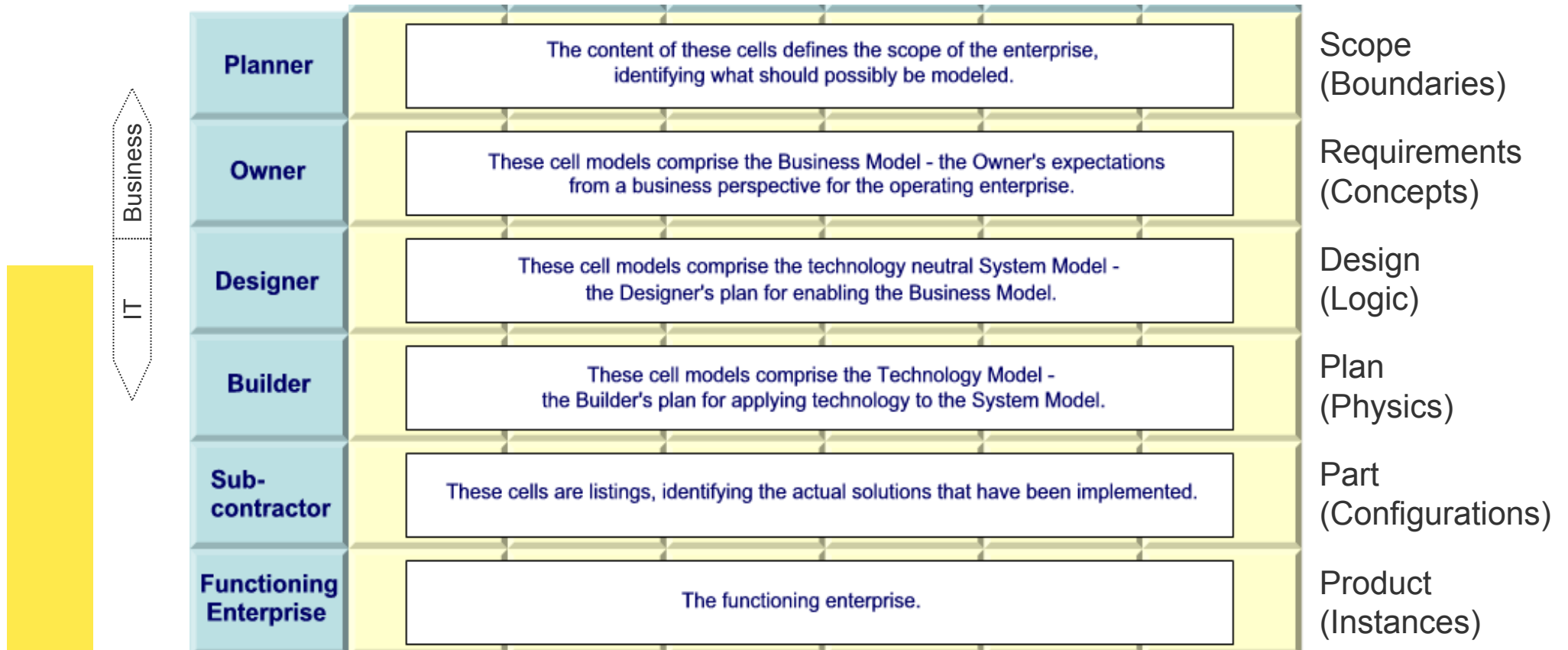| Planner	The content of these cells defines the scope of the enterprise, identifying what should possibly be modeled.	Scope (Boundaries)
Owner	These cell models comprise the Business Model - the Owner's expectations from a business perspective for the operating enterprise.	Requirements (Concepts)
Designer	These cell models comprise the technology neutral System Model - the Designer's plan for enabling the Business Model.	Design (Logic)
Builder	These cell models comprise the Technology Model - the Builder's plan for applying technology to the System Model.	Plan (Physics)
Sub-contractor	These cells are listings, identifying the actual solutions that have been implemented.	Part (Configurations)
Functioning Enterprise	The functioning enterprise.	Product (Instances)

(left axis: Business / IT)

- ■ Each representation is different in nature, in content, in semantics from the others – representing different perspectives

- ■ Representations do not correspond to different levels of details – level of detail is an independent variable, varying within one representation

Dimension 2: Aspects of an Architecture

- There exist different types of descriptions oriented to different aspects

- Zachman associates each aspect with question word

WHAT	material description
HOW	functional description
WHERE	location description
WHO	organisational description
WHEN	temporal description
WHY	motivational description

(Zachman 1987)

Combination of the two ideas

For each different type of description there are different perspectives:

	What	How	Where	Who	When	Why
Planner	The content of these cells defines the scope of the enterprise, identifying what should possibly be modeled.					
Owner	These cell models comprise the Business Model – the Owner's expectations from a business perspective for the operating enterprise.					
Designer	These cell models comprise the technology neutral System Model – the Designer's plan for enabling the Business Model.					
Builder	These cell models comprise the Technology Model – the Builder's plan for applying technology to the System Model.					
Sub-contractor	These cells are listings, identifying the actual solutions that have been implemented.					
Functioning Enterprise	The functioning enterprise.					

Relations between Models and Model Elements

	What (Data)	How (Function)	Where (Locations)	Who (People)	When (Time)	Why (Motivation)
Scope {contextual} Planner	List of things important to the business	List of processes that the business performs	List of locations in which the business operates	List of organizations important to the business	List of events/ cycles important to the business	List of business goals/strategies
Enterprise Model {conceptual} Business Owner	e.g. Semantic Model	e.g. Business Process Model	e.g. Business Logistics System	e.g. Workflow Model	e.g. Master Schedule	e.g. Business Plan
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Functioning System	e.g. Data	e.g. Function	e.g. Network	e.g. Organization	e.g. Schedule	e.g. Strategy

- There are relations between (elements of) the models

- **Horizontal Relations**: In same perspective, e.g.
  - ♦ Data used in a process
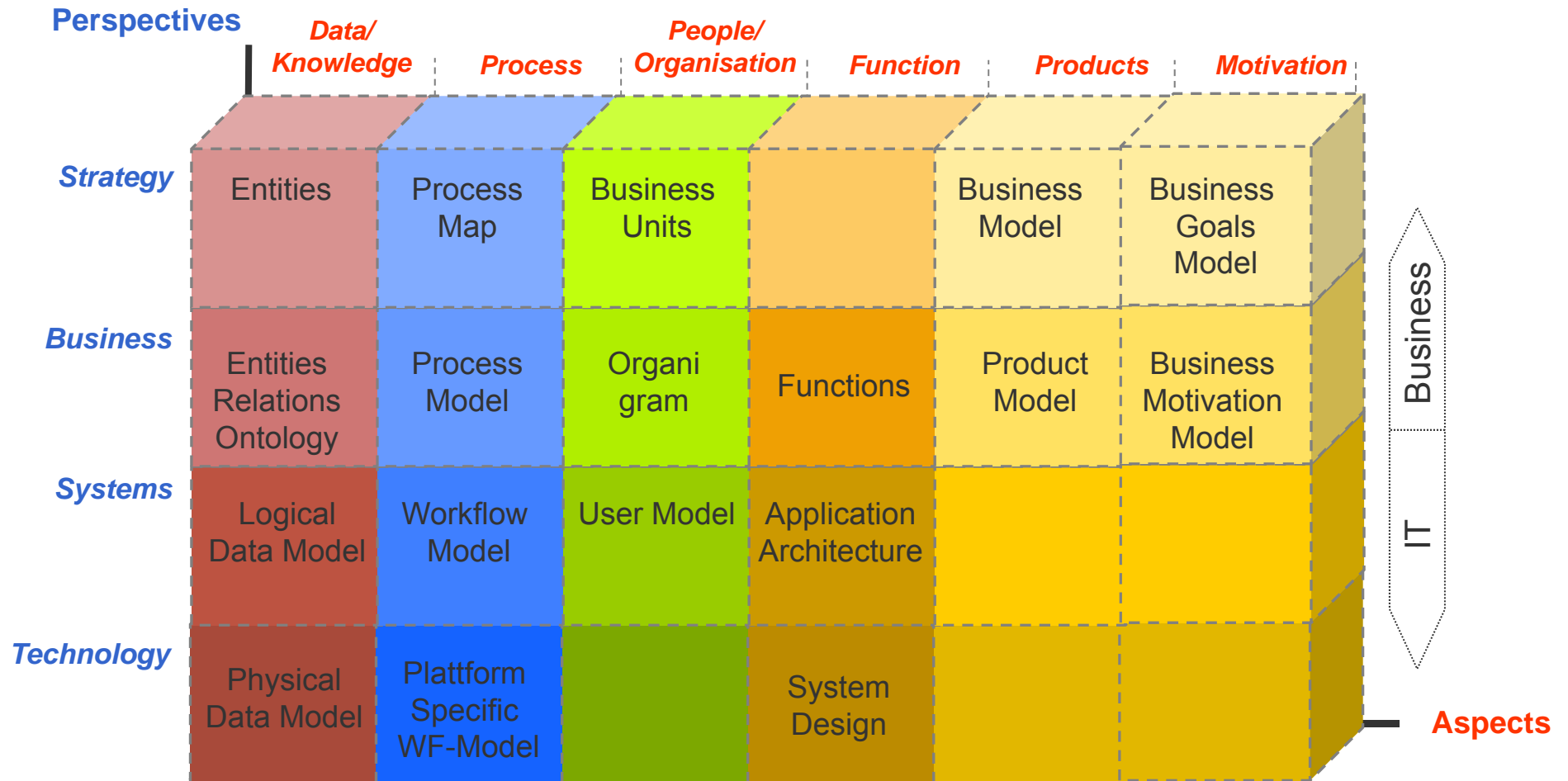 - ♦ Application implementing a process activitiy

- **Vertical relations:** Between different perspectives
  - ♦ Implementation of an application
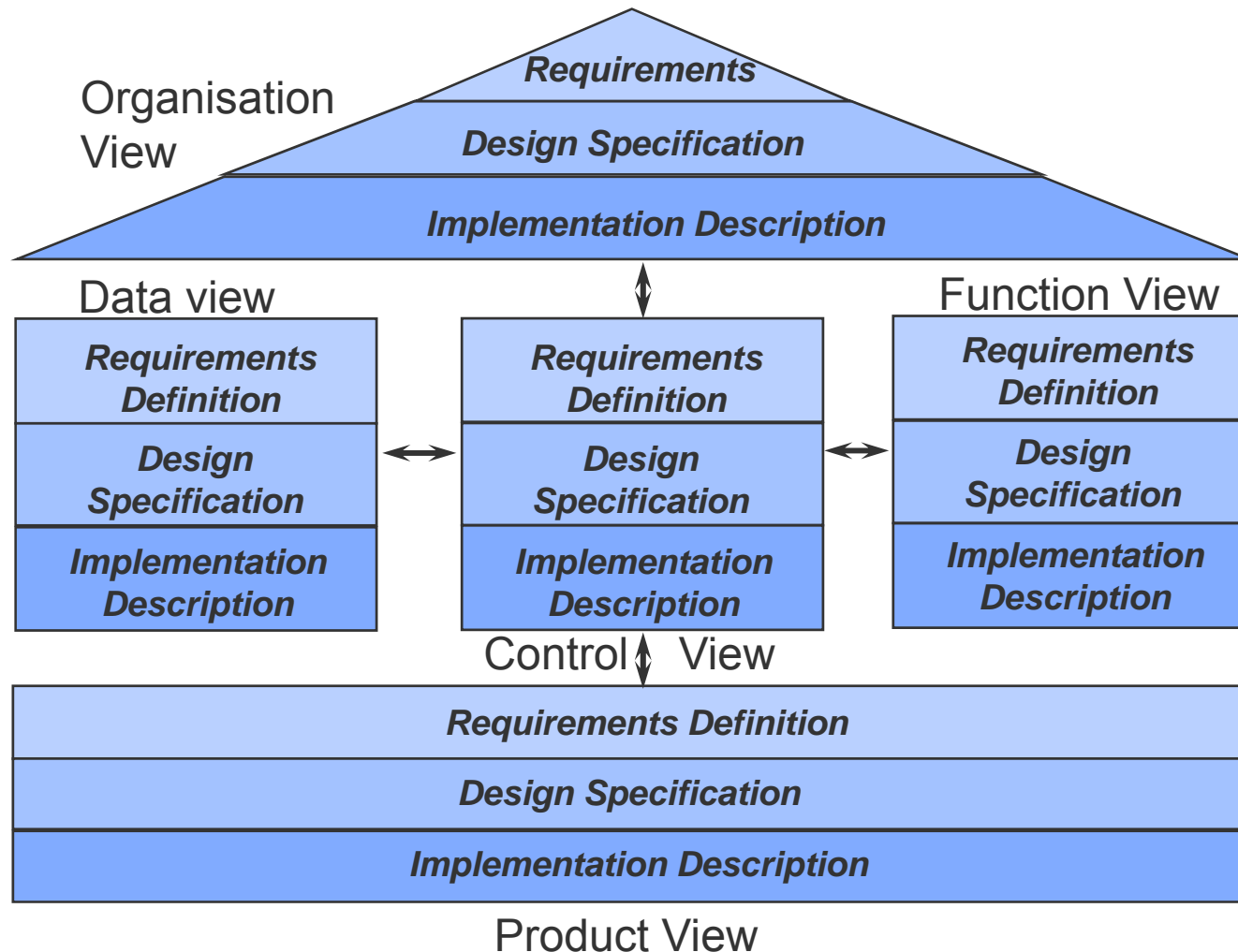 - ♦ Database model for an entity relationship model

Alternative Frameworks

- Die distinction between perspectives and aspects can be found in various other frameworks, e.g.

  - Zachmann Framework

  - PlugIT Modelling Framework

  - ARIS – Architecture of Integrated Information Systems

  - TOGAF - The Open Group Architecture Framework

  - ArchiMate

  - Best Practice Enterprise Architecture

- They vary in the number and concrete definition of perspectives and aspects

Perspectives and Aspects in the Project plugIT

	Data/ Knowledge	Process	People/ Organisation	Function	Products	Motivation
Strategy	Entities	Process Map	Business Units		Business Model	Business Goals Model
Business	Entities Relations Ontology	Process Model	Organi gram	Functions	Product Model	Business Motivation Model
Systems	Logical Data Model	Workflow Model	User Model	Application Architecture		
Technology	Physical Data Model	Plattform Specific WF-Model		System Design		

Perspectives ... Aspects

Business ... IT

plugIT is a project funded by the EU http://plug-it-project.eu/

Prof. Dr. Knut Hinkelmann
MSc BIS

ARIS – Architecture for integrated Information Systems

Organisation View

Requirements

Design Specification

Implementation Description

Views correspond to aspects
Levels correspond to prespectives

Data view

| Requirements Definition |
| Design Specification |
| Implementation Description |

Control View

| Requirements Definition |
| Design Specification |
| Implementation Description |

Function View

| Requirements Definition |
| Design Specification |
| Implementation Description |

Requirements Definition

Design Specification

Implementation Description

Product View

TOGAF

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

- current version, TOGAF V9, from 2009

- TOGAF provides building blocks (description of predefined components) and a process model to help organisations define their particular enterprise architecture.

- At the heart of the framework is the Architecture Development Method (ADM)

- http://www.opengroup.org/togaf/

TOGAF Architecture Views

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

  - ♦ **Business Architecture**
    - ● Strategies, governance, organisation and business processes of the enterprise

  - ♦ **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 and infrastructure

  Data Architecture and Application Architecture together are the **Information System Architecture**

TOGAF Architecture Development Cycle (ADM)

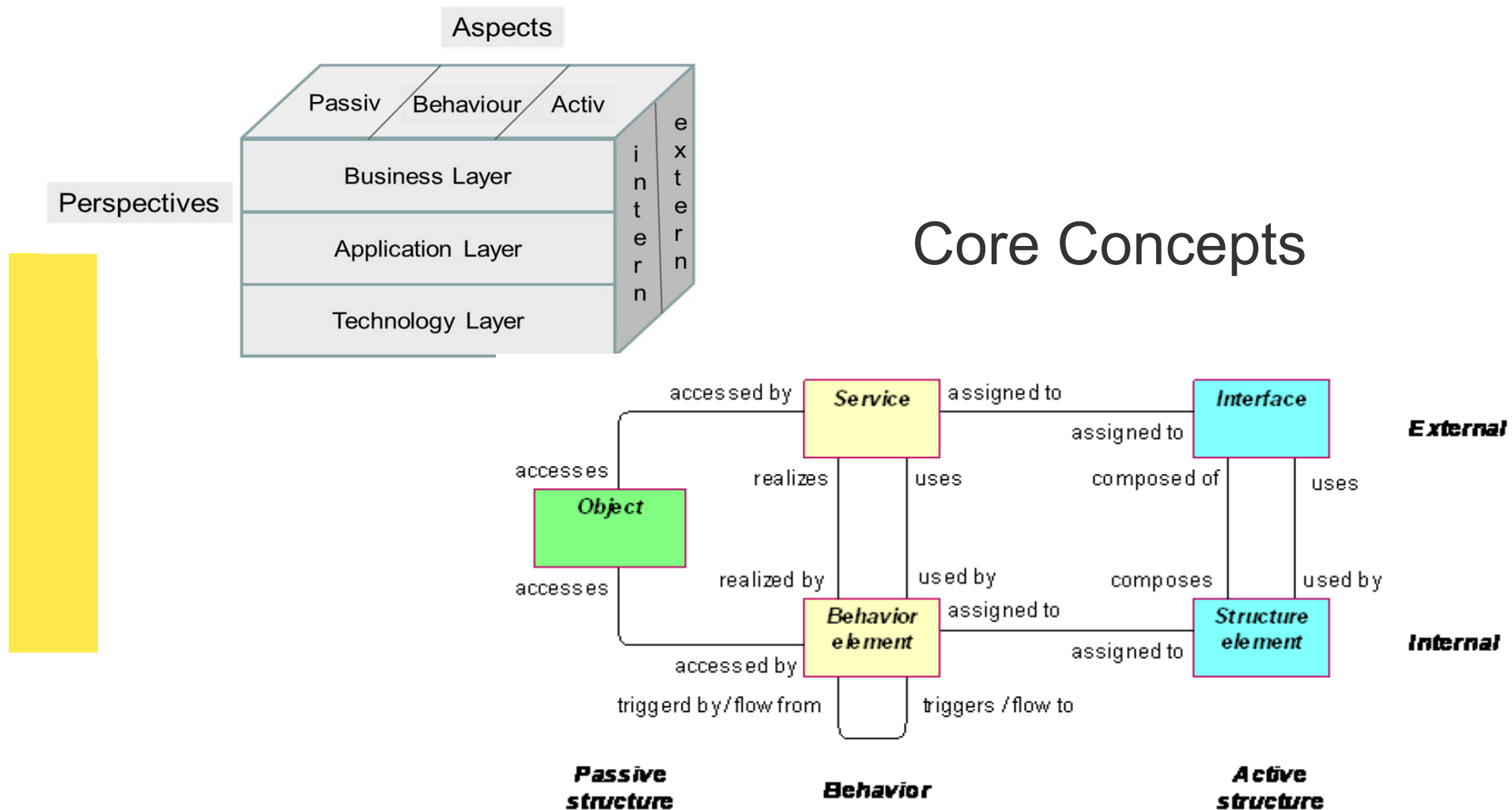TOGAF addresses the whole enterprise architecture lifecycle
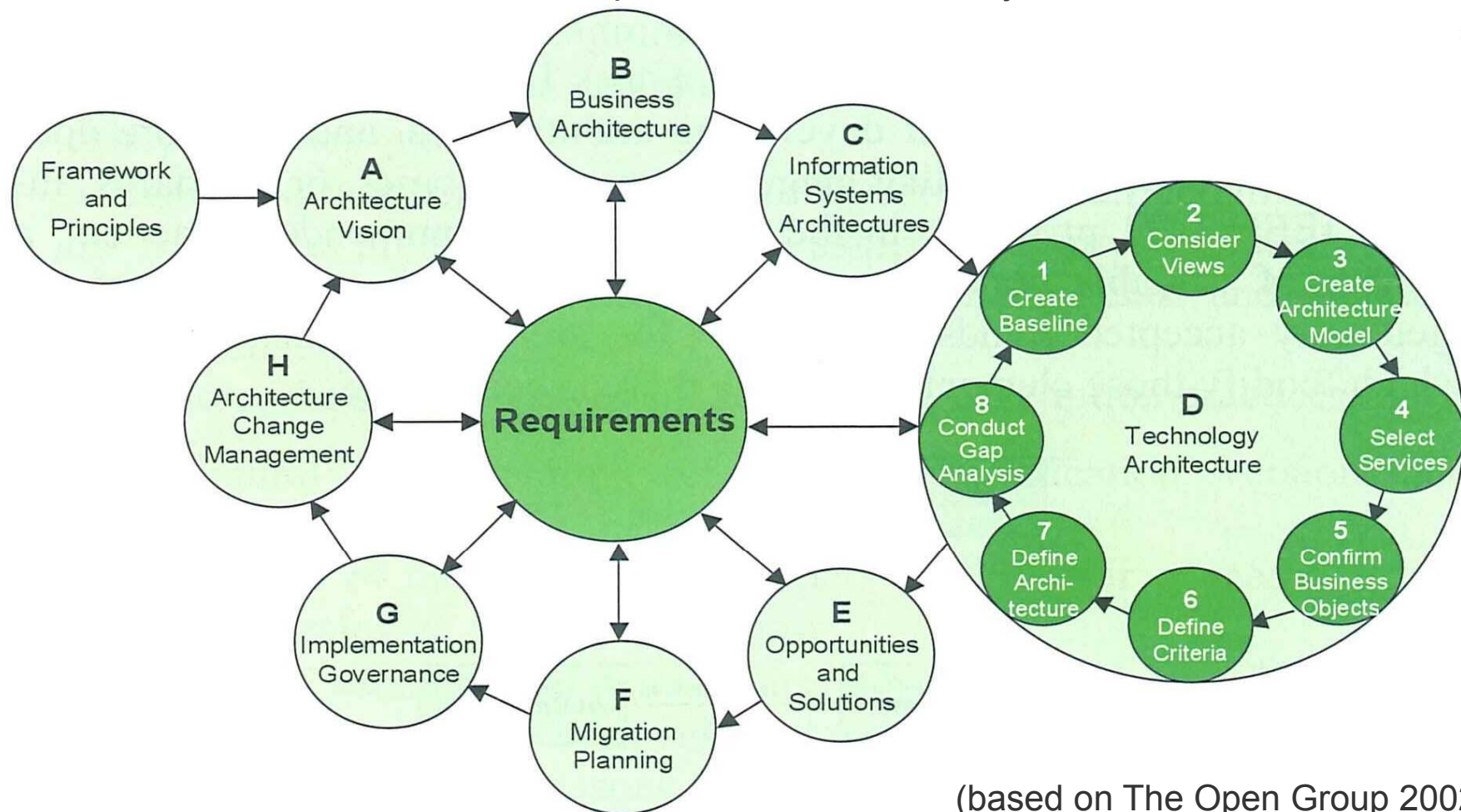
(based on The Open Group 2002)

ArchiMate

- Developed 2005 and evolved by members of The ArchiMate Forum

- Current version: ArchiMate 1.0, from 2005

- Management framework for the overall architecture

- Defines a terminology to describe core architecture elements and their relations («a high level modelling language»)

- http://www.opengroup.org/archimate/doc/ts_archimate/

ArchiMate Generic Metamodel

Aspects

Passiv / Behaviour / Activ

intern / extern

Business Layer

Perspectives

Application Layer

Technology Layer

Core Concepts

http://www.opengroup.org/archimate/doc/ts_archimate/

# *Using ArchiMate with an Architecture Method (e.g. TOGAF)*

- TOGAF's ADM process refers to artifacts and deliverables; those artifacts could be represented in 'ArchiMate-Style'

- TOGAF is concerned with the application portfolio rather than application design. ArchiMate provides a language (kind of UML representation) for application design

- ArchiMate is probably best used at the level of system or solution architecture, whereas TOGAF is used at the level of cross-organisational strategic enterprise architecture

- The most important disparity between TOGAF and ArchiMate is that ArchiMate deals with the relationships between architectural layers, whereas TOGAF's views are confined to a single architectural layer

Source: Berrisford, G., & Lankhorst, M. (2009). Using ArchiMate with an Architecture Method A conversation. Via Nova Architectur.
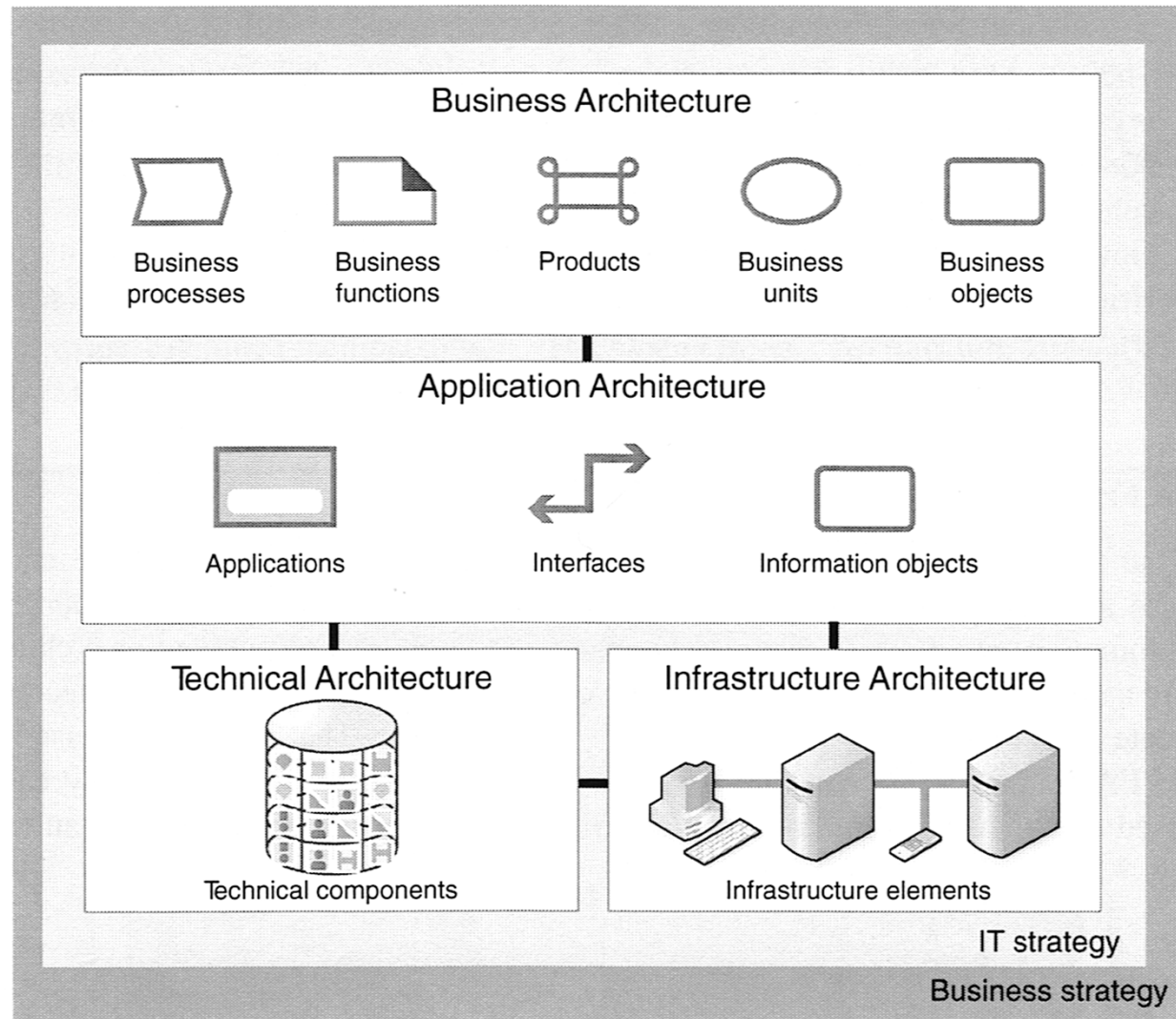Lankhorst, M., & Drunen, H. V. (2007). Enterprise Architecture Development and Modelling. Via Nova Architectura.

TOGAF and ArchiMate
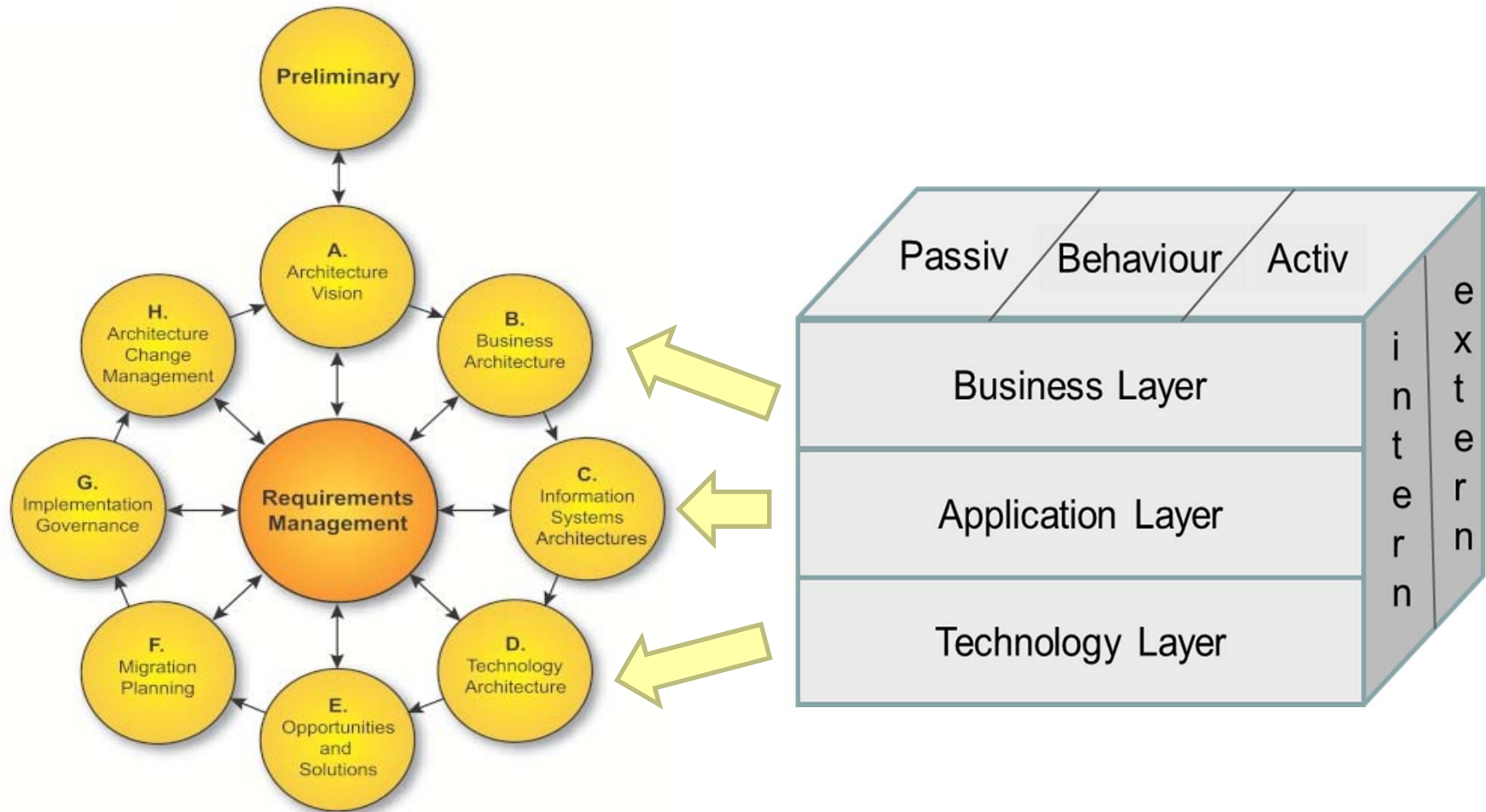
Best Practice Enterprise Architecture

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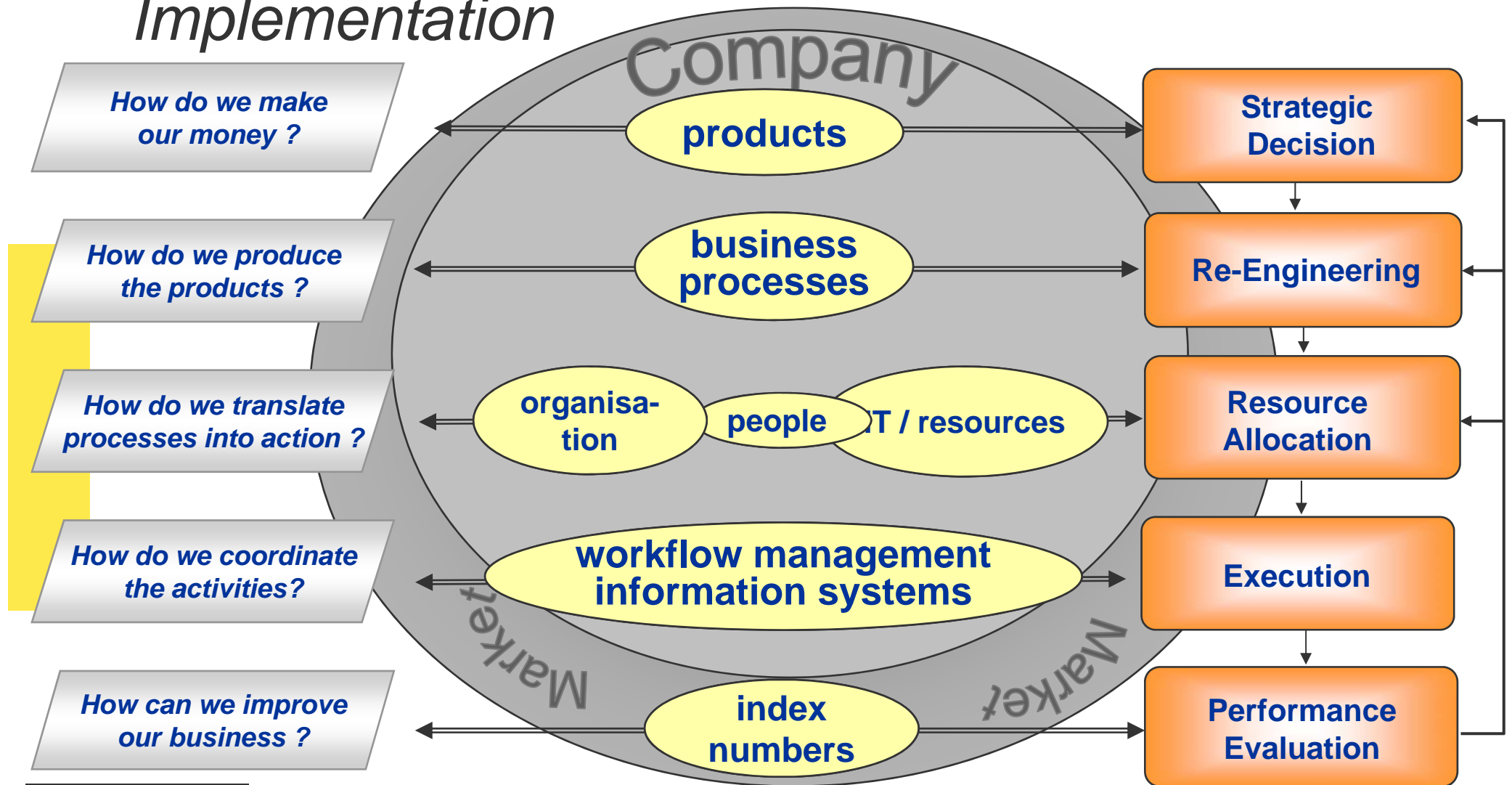
- **Infrastructure Architecture**
  - ♦ Entities of the infrastructure, on which the information systems are running

Enterprise Architecture vs. Business Process Management

■ From the *business process perspective*, enterprise architecture achieves enterprise integration through

♦ capturing and describing processes, strategies, organisation structures, information and material flow, resources etc.

♦ concentration on how to perform core business processes in an organisation

♦ considering the information and material flow in the entire process

■ In this sense, business process management (BPM) relies on enterprise architecture

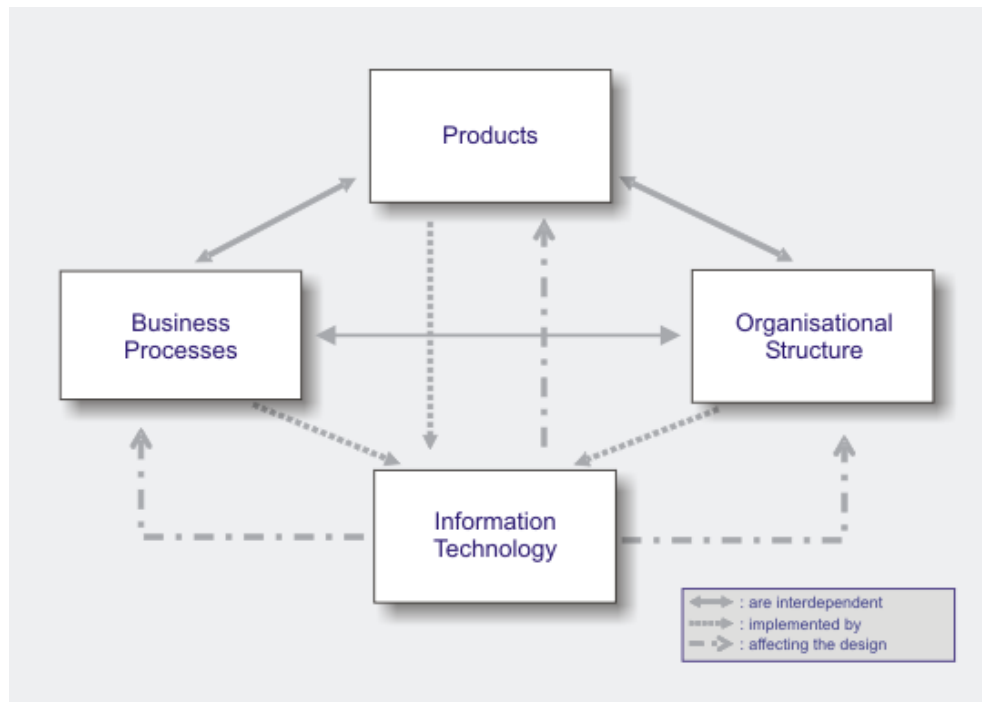■ *Tools for BPM are part of the toolset of enterprise architecture*

(Bernus et al. 2003, p. 9f)
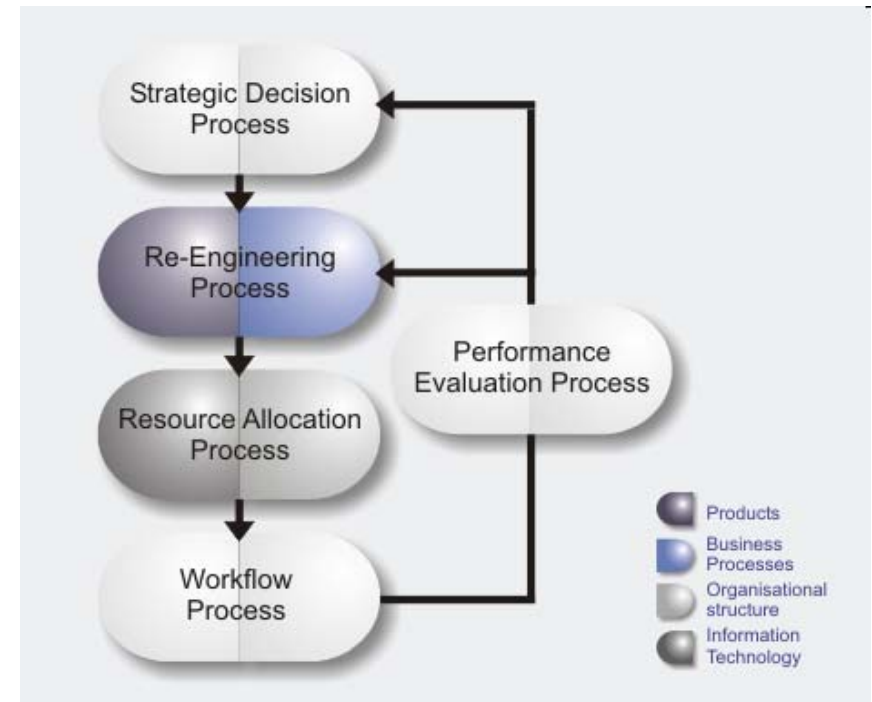
The BPMS*)-Paradigm – From Strategy to Implementation

Company

How do we make our money ?

How do we produce the products ?

How do we translate processes into action ?

How do we coordinate the activities?

How can we improve our business ?

products

business processes

organisa-tion | people | IT / resources

workflow management information systems

index numbers

Market

Strategic Decision

Re-Engineering

Resource Allocation

Execution

Performance Evaluation

*) BPMS - Business Process Management Systems - developed by Prof. Karagiannis, University of Vienna, BOC GmbH

Aspects und Perspectives of the BPMS Paradigm (Business Process Management Systems)

Aspects:

Perspectives:

http://www.boc-eu.com

Summary: Enterprise Architecture, Alignment and Agility

Planning

Design

Implemen-
tation

Operation

Re-
Planning

Re-Design

Implemen-
tation
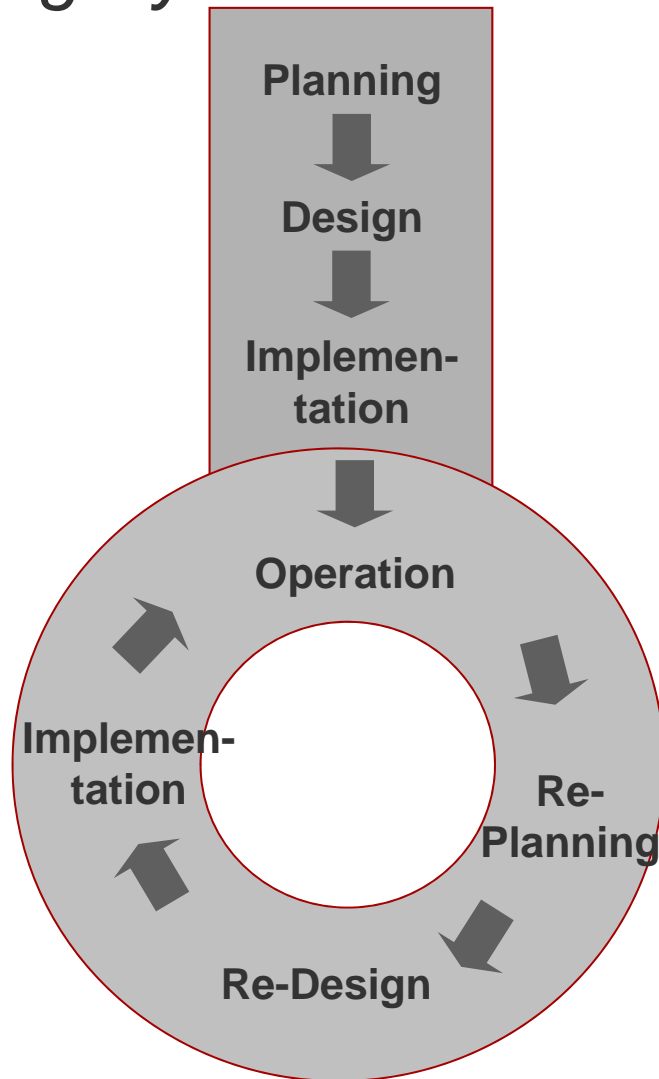
- Use of the EA models
  - ♦ Designing a new business/company (analogy: building a new house)
  - ♦ Reorganisation of the enterprise
    - Business Process Re-Engineering
    - migration of an IT infrastructure
    - exchanging/upgrading an information system
  (analogy: reconstructing a building)

- Any re-organisation must ensure alignment of Business and IT

- Enterprise Architecture supports agility by
  - ♦ providing transparency of context in case of business IT alignment
    - requirements of business for IT
    - influences of IT changes on business

- On the other hand, any re-organisation project leads to changes of the Enterprise Architecture