**Topics addressed**

- Definitions of architecture
- Need for architecture
- Types of architecture
- Stakeholders and their concerns
- Architecture principles
- Views and frameworks
- Role of the architect

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**Architecture definition: IEEE 1471-2000**

- "An architecture is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution."

Source: IEEE STD 1471-2000

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**Architectural description uses IEEE 1471-2000**

- Architectural descriptions are applicable to a variety of uses, by a variety of stakeholders, throughout the life cycle. These uses include, but are not limited to:
  - Analysis of alternative architectures
  - Business planning for transition from a legacy architecture to a new architecture
  - Communications among organizations involved in the development, production, fielding, operation, and maintenance of a system
  - Communications between acquirers and developers as a part of contract negotiations
  - Criteria for certifying conformance of implementations to the architecture
  - Development and maintenance documentation, including material for reuse repositories and training materials
  - Input to subsequent system design and development activities
  - Input to system generation and analysis tools
  - Operational and infrastructure support; configuration management and repair; redesign and maintenance of systems, subsystems, and components
  - Planning and budget support
  - Preparation of acquisition documents (e.g., requests for proposal and statements of work)
  - Review, analysis, and evaluation of the system across the life cycle
  - Specification for a group of systems sharing a common set of features, (e.g., product lines)

Source: IEEE Std 1471-2000

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**Architecture definition: TOGAF**

- The Open Group’s Architectural Framework (TOGAF)

- In TOGAF, “Architecture” has two meanings depending upon its contextual usage:
  - A formal description of a system, or a detailed plan of the system at component level to guide its implementation.
  - The structure of components, their interrelationships, and the principles and guidelines governing their design and evolution over time.

Source: The Open Group (www.opengroup.org/architecture)

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**Model for business strategy - IT strategy alignment**

Source: N. Venkatraman and J.C. Henderson in “IBM Systems Journal”
System development

- **Aim:**
  - Produce systems that conform to the desires
  - Including desires wrt the development process

- **Challenge:**
  - Reduction of uncertainty wrt the desiredness of:
    - a (future) system's behaviour
    - behaviour of the development process

Uncertainties

- **Who / what determines desiredness?**
- Agreement / commitment to specifications?
- Completeness of requirements?
- Completeness of designs
- Does the system / process match the specifications?
- ...

Trade-off

- Potential costs due to undesired behaviour vs.
- Potential costs of reducing uncertainty
- **Challenge:**
  - Requires insight into the issues involved
  - Requires decisions from stakeholders and designers
- **Means:**
  - Architecture?

Role of architecture

- Some goal / need to state common properties on the design of a class of systems:
  - Selecting among alternatives
  - Defining core characteristics of a family
  - Guiding evolution of incarnations
- Relative to some higher goal
  - Cost effectiveness?
  - Creating the architecture, maintaining and enforcing it
  - Versus the benefit of insight & control

Role of architecture

- A need to state, discuss, negotiate and communicate common properties:
  - Selecting among alternatives
  - Defining core characteristics of a family
  - Guiding evolution of incarnations
- Requirements on architecture as a means:
  - Provide relevant insight
  - Communicatable
  - SMART enough to govern / steer
  - ...

Architecture definition

- "In general, the design freedom of designers is undesirable large. The idea of architecture is to take advantage of this. Therefore, architecture is defined as normative restriction of design freedom. This idea of consciously applying normative restriction of design freedom is the really new thing. It makes architecture a prescriptive notion; any descriptive interpretation is cogently rejected"

Source: xAF/NAF
Definition & designing ...

- Each decision limits the solution space
- A restriction of design freedom!

- What makes architecture so special?
- There must be an explicit goal to
  - state, discuss, communicate or negotiate
    common properties of a
  - family, incarnations or equivalence class of systems

Defining & designing ...

Limiting design freedom

- Can be done by prescriptive
  - (partial) "models" / "reference models"
  - design principles

An architecture design may have varying levels of granularity

Enterprise architecture versus solution architecture

Different architecture levels
### Architecture ALWAYS delivers a solution to a business problem

<table>
<thead>
<tr>
<th>Business issue</th>
<th>Example</th>
<th>Architecture Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformation</td>
<td>E-business transformation</td>
<td>Create structure to build and support Business case Migration plan</td>
</tr>
<tr>
<td>Rationalisation</td>
<td>Clean up the mess after acquisitions &amp; mergers</td>
<td>Focus on defining standards etc to guide rationalization</td>
</tr>
<tr>
<td>Integration</td>
<td>Implement CRM to interface to 200 back office systems</td>
<td>Create (detailed) structure to be able to understand all the interfaces etc.</td>
</tr>
<tr>
<td>Optimisation</td>
<td>Reduce development Time-to-market</td>
<td>Raise the quality of the development process</td>
</tr>
<tr>
<td>Business – IT alignment</td>
<td>Link process development and its IT support</td>
<td>Provide better IT support</td>
</tr>
</tbody>
</table>

### Goals of architecture

- **Atlas for management**
  - For positioning decisions and making impact-of-change transparent
  - To increase alignment (business-ICT, strategic-operational)
- **Instrument for complexity control and reduction**
  - Coherence of parts, thus constraining tactical choices
- **Instrument for planning**
  - Definition of a programme of change
  - Means of communication
  - Framework for development
  - To control the content-coherence of change programs / projects

### Architecture

- **Architecture:**
  - Architecture is the visioning of requirements into a coherent style or structure to help the client make decisions,
  - The architecture of a system is the structure or structures of the system, which comprise services/components, the externally visible properties of those services/components, and the relationships among them,
  - Articulates business direction and focuses technology to support that business direction. It links **vision, strategy** and **IT feasibility**, focusing on usability, durability and effectiveness (implementation),
  - Maps a client’s requirements to a deployable solution
  - Provides a way to manage complexity and risk, the foundation and justification for IT strategy and provides views of the problem and solution that can be readily understood by all parties - both technical and non-technical.

**The key is structure, abstraction and communication**

### Architecture products

An architecture study delivers two kinds of products

1. **Visualisations**
2. **Specifications**

#### 1. Visualisations

- Example: Formal - communication with experts
- Informal - communication with clients

#### 2. Specifications

- Component x:
- Specification 1
- Specification 2
- Specification 3

- Standards:
- Specification 1
- Specification 2
- Specification 3

- Guidelines:
- Specification 1
- Specification 2
- Specification 3

Examples: Formal - communication with experts (e.g. UML model)

Also for documentation: traceability and maintainability

### Stakeholders & Concerns

![Stakeholders Diagram]

- **Object System**
- **Using System**
- **Concern**
- **Mission**
- **Stakeholder requirements**
- **System requirements**

### Different stakeholders, different interests

- **Management**
- **IT staff**
- **Architects**
- **Developers / Engineers**
- **Partners**
- **Sales**
- **End-users**

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*September 27th, 2006*  
SIKS course, Architecture for IKS
Architecture Is Founded in Principles

- Characteristics of principles
  - Give direction
  - Making implicit conditions explicit
  - Create delineation
  - Determine grouping criteria
  - Set priorities
  - Classify

Example principle

- Principle: Tasks are accessible to automated users in all locations where users need to work to carry out their tasks effectively and efficiently.
- Scope: Work processes
- Motivation: Location independency increases efficiency and flexibility of work processes. If several work locations are available, this allows work to move in case of a (technical) problem.
- Possible refinements:
  - Functionality should not be bound to one particular workstation. It should be made available on groups of workstations, or through a central server or the mainframe.
  - No single installations or stand-alone applications.

Stakeholders, Concerns and Views

Stakeholders
- Acquirer, Users
- Engineers
- Builders, Maintenance People

Concerns
- Fitness for purpose?
- Sustainability?
- Usability?
- Performance?

View Models
- Multiple views!

Views on a system ...

- One system domain
- ... multiple viewers
- ... multiple conceptions
- Multiple views!

Viewpoint

- Perspective:
  - “Perspective - A set of related interests in terms of which viewers may observe a domain”
  - Framework of sub-perspectives
  - Atomic: Business, Information, ...
- Viewing method + modeling methods

IEEE:
- A specification of the conventions for constructing and using a view. A pattern or template from which to develop individual views by establishing the purposes and audience for a view and the techniques for its creation and analysis.
Frameworks of viewpoints

- Several frameworks of viewpoints exist
  - UML, Zachman, Toaf, ArchiMate, ...
  - Capgemini, Belastingdienst, ...

- A jungle of viewpoints & frameworks

- Which one to use/when?
  - Subject of research!

What is a Framework?

- A containment structure:
  - context for model artifacts
  - interconnections between models
  - access to model components
  - model fidelity and consistency

PrimaVera Framework UvA

Information

Business and communication

Technology

Strategy

Structure

Operations

Zachman Framework for Enterprise Architecture

Position of an architect

Stakeholders

Architects

Developers

Solutions

Specifications

Design

Define

Visualize

Prescribe

Construction

Appearance

Architecture
Architecture interacts with Software Design

- Architecture provides the solution structure and guidelines to the Software Design process
- Software Design results can have impact on the architecture:
  - Propose new solutions
  - Discover new technical constraints
  - Discover new guidelines
  - Discover flaws in the structure

Architecture versus software development

- Architecture focuses on the Big picture:
  - IT support of the entire business (domain)
  - IT standards and guidelines
- Delivery focuses on ONE system
  - Low cost, Low risk, Quick results
  - Delivery Excellence
- Architecture & Delivery are complementary

- Architects & Engineers have different views on the same problem
  - System Use cases & IS Services for the same problem are NOT equal!
  - IS Services do provide useful input for System Use cases