SWINBURNE UNIVERSITY OF TECHNOLOGY

SWE30003
Software Architectures and Design

Lecture 1
Issues in Software Design

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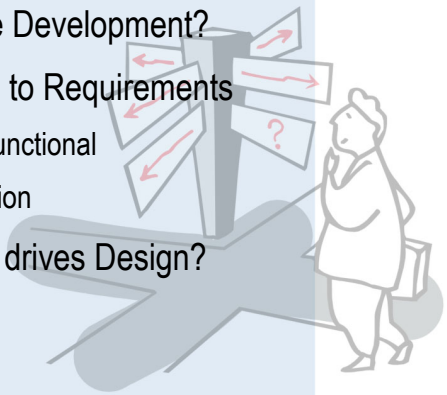
Outline

- **Unit of Study Overview**
- What Drives Software Development?
- From Business Goals to Requirements
  - ☐ Functional vs. Non-functional
  - ☐ Verification & Validation
- What is Design, what drives Design?



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Software Development Activities

Requirements Elicitation	Establish customer's needs
Requirements Analysis	Model and specify the requirements ("what")
Design	Model and specify a solution ("how")
Implementation	Construct a solution in software
Testing	Verify the solution against the requirements
Maintenance	Repair defects and adapt the solution to new requirements

NB: these are ongoing activities, not sequential phases!

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Focus of Unit of Study

Requirements Elicitation	Establish customer's needs
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What we will be talking about…

Abstraction

Software Architectures

Requirements

Communication

What is the relationship?

What do they have in common?

Why are they important?

Validation & Verification

Patterns

Domain Knowledge and Models

Risk

Decomposition

Design Methodologies

Hopefully this will become clear in a few weeks!

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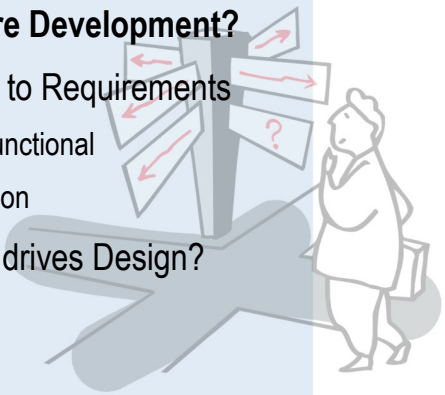

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Why do we build Software Systems?

- To keep/retain customers
- To increase customer base
- To improve customer relationships
- To improve productivity/efficiency (within organization/team)
- Technology used no longer supported/outdated
- Changes in environment (legal, social)

☞ *To achieve some "Business" Goals!*

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Categories of Business Goals

Business goals fall into five broad categories:

- Reduce cost of ownership: development, maintenance, deployment, operation.
- Improve the quality of the system(s) compared with its predecessors with respect to performance, modifiability, security, reliability etc.
- Improve the capabilities/functionality offered by the system compared to its predecessors.
- Improve organization's market position.
- Improve external confidence in either the organization or the system.

To address some "pain points"

☞ *A particular system has generally more than one goal!*

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Views of Stakeholders

- Many systems involve a variety of different stakeholders:
  - ☐ Customers
  - ☐ Developers
  - ☐ Managers
  - ☐ Users
- All of them have different *views* and *priorities*
  - ☞ *May even lead to conflicting goals*!
- ☞ Development approaches must be able to cater for different views and priorities!

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Business Goals (cont.)

Priority of goals need to be specified:

- Some goals are “nice to have”, others “need to have”, some “absolutely critical”
- Developers sometimes have to “push back” or make trade offs. Knowing priority gives insights.

Source of goals need be specified:

- Some goals are *inherent* to the system being developed
- Some goals are a result of market analysis
- Some goals are *arbitrary* - could cause problems!

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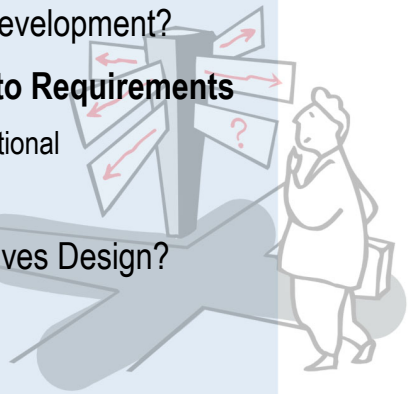

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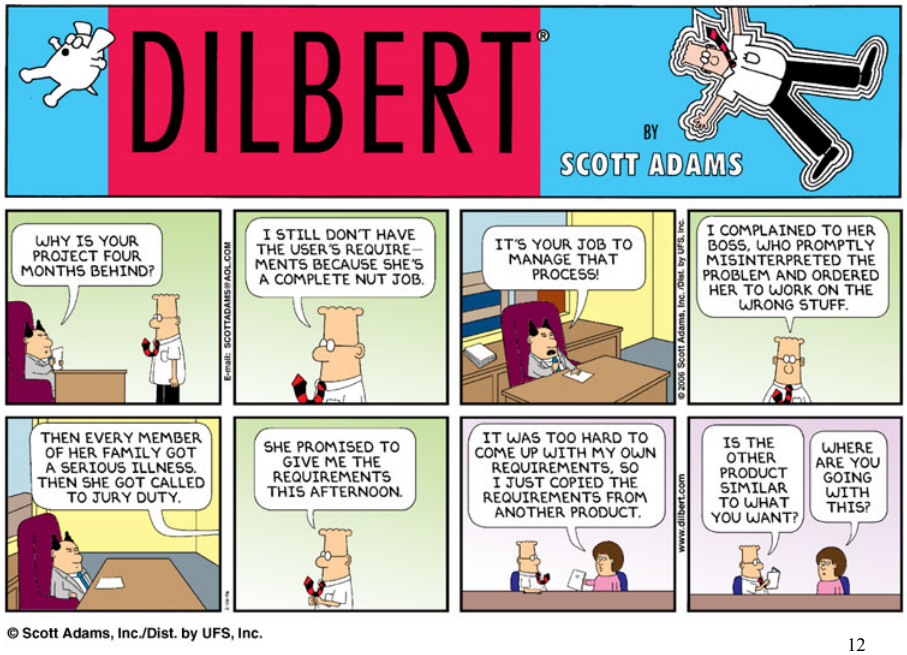

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http://en.wikipedia.org/wiki/Fair_use

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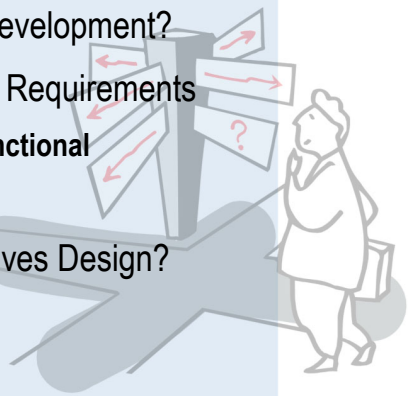

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Functional and Non-functional Requirements

Functional requirements describe system *services* or *functions*

- Compute sales tax on a purchase
- Update the database on the server ...
- ☞ *In essence, anything that can be directly expressed in code…*

Non-functional requirements (also known as ***quality*** *requirements*) are *constraints* on the services and/or the development process

- "Reducing cost of deployment" cannot be directly expressed in code…

Domain requirements stem from the application domain of a system

- may be functional or non-functional

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Non-functional Requirements

Product requirements:	specify that the delivered product *must behave* in a particular way *e.g. execution speed, reliability, etc.*
Organizational requirements:	are a consequence of *organizational policies* and procedures *e.g. process standards used, implementation requirements, etc.*
External requirements:	arise from *factors which are external* to the system and its development process *e.g. interoperability requirements, legislative requirements, etc.*

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Examples of Non-functional Requirements

Product requirement	It shall be possible for all communication between the console and the user to be expressed in the *standard ASCII character set.*
Organisational requirement	The *system development process* and deliverable documents shall conform to the process and deliverables defined in *XYZCo-SP-STAN-95.*
External requirement	The system shall provide facilities that allow any user to check if personal data is maintained on the system. *A process must be defined and supported in the software that will allow users to inspect personal data* and to correct any errors in that data.

☞ *We will talk more about non-functional requirements in Week 3*

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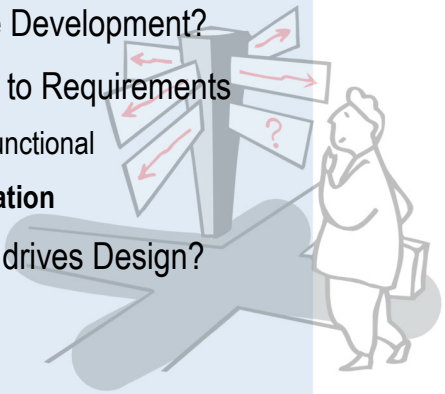

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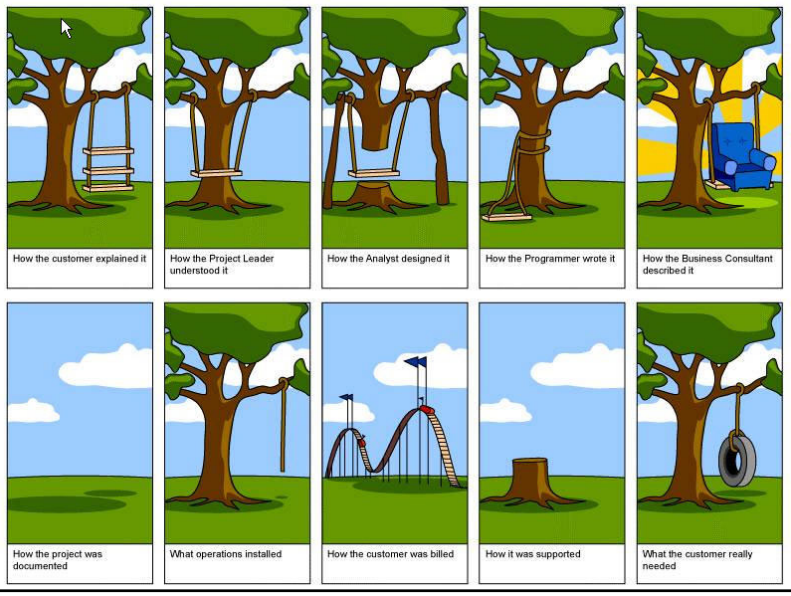
Impedance Mismatches



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Verification and Validation

Verification:

- Are we *building the product right*?
  - i.e., does it conform to the specification(s)?

Validation:

- Are we building the *right product*?
  - i.e., does it meet stakeholders' *expectations*?

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Requirements Verifiability

Requirements must be written so that they can be *validated* and ***objectively verified***.

Imprecise:

- *"The system should be easy to use by experienced controllers and should be organized in such a way that user errors are minimized."*

  Terms like "easy to use" and "errors shall be minimized" are *useless* as specifications as they are too *vague*.

Verifiable:

- *"Experienced controllers should be able to use all the system functions after a total of two hours training. After this training, the average number of errors made by experienced users should not exceed two per day."*

☞ *You will hear a lot about requirements verifiability throughout the semester!*

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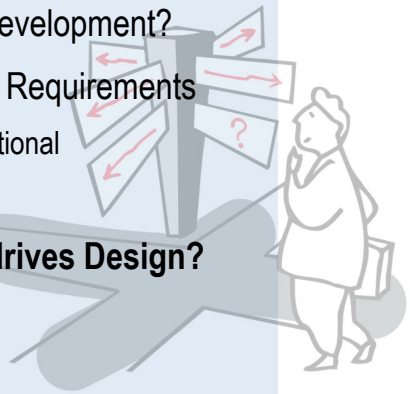

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Software Design – a "Definition"

"Software design is the activity of drawing UML class diagrams once a software system has been coded in order to satisfy the requirements of unit convener."

Would you trust the software of an air-traffic control system that was implemented without prior structural analysis etc.?

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Design vs. Design

"Design is the creative process of transforming the problem into a solution. The description of the solution is also called the design."

Activity & Artefact — Shari Lawrence Pfleeger, 1998

"The design of a system determines a set of components and inter-component interfaces that satisfy a specified set of requirements."

Artefact — DeMarco, 1982

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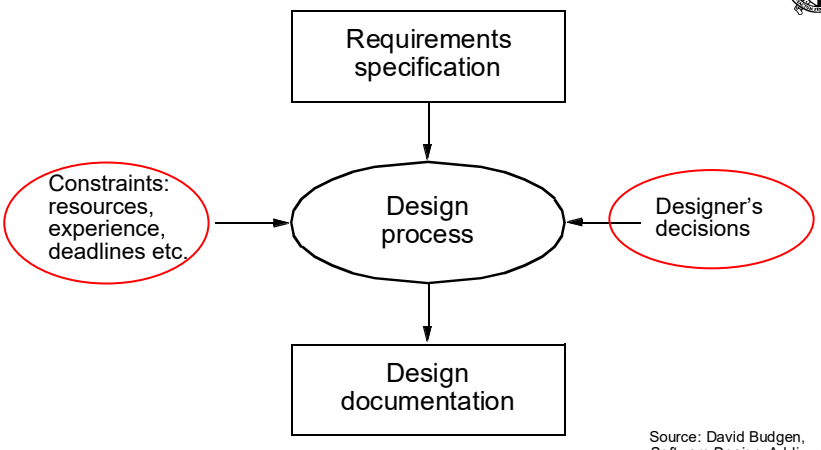
Design Process



Source: David Budgen, *Software Design*, Addison-Wesley, 1994

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The Process of Decomposition

Decomposition is a process that helps to manage the complexity of a software system

- ☐ Starting with a *high-level view* of the system.
- ☐ Creating the low-level details of the features of the system in turn.
- ☐ Stop when we are satisfied with the level of detail.
- ☞ Also known as *Divide-and-Conquer*.

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Models

- A model is a ***simplification*** *of reality*.
- Models are created for better understanding of the *problem*, the *domain*, or the *system* to be built.
- A model can capture and represent,
  - ☐ Structure (static model)
  - ☐ Behavior (dynamic model)
- Examples:
  - ☐ Architectural blue-print of a house
  - ☐ Hand-drawn UI screen (“wire-frame”)
  - ☐ Class diagram

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Q: *What has a bigger impact on the design structure of a software system: functional requirements or quality requirements?*

A: *Quality requirements determine most structural design decisions, not functional requirements!*

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Quality-Driven Design

- Quality requirements are those that *drive* the structural design of the software system.
- Leads to several questions:
  - How are quality requirements *specified*?
  - How are quality requirements *validated*?
    - ☞ *This is also important for functional requirements!*
  - How are quality requirements *achieved*?
  - How can understanding of the impact of quality attributes be used during the design process?
- ☞ *We will attempt to answer these questions over the next few weeks.*

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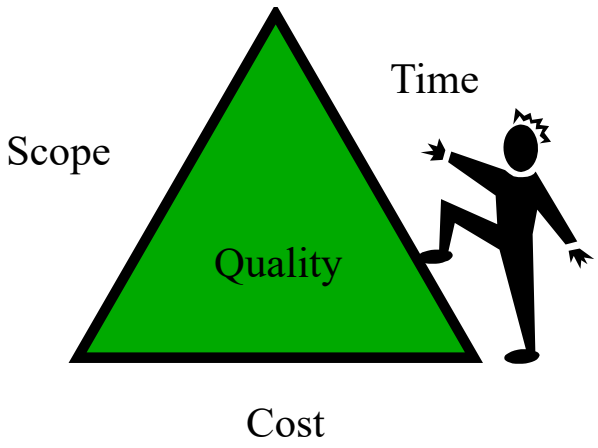
Forces in Software Projects



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Question to Answer - Week 1

In your own words, characterize the difference between verification and validation and discuss where in the software development lifecycle (SDLC) verification and validation activities should be conducted, respectively.

--- weekly submission within a week (see specific deadline on Canvas)

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Catch-up Reading Lecture 1

- Len Bass, Paul Clements, Rick Kazman, *Software Architecture in Practice* (**2nd Edition**), Addison-Wesley, 2003, Chapter 1 (available electronically through the Swinburne Library)

--- no weekly submission for this week 1 pre-reading

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Required Pre-Reading for Lecture 2

- Soren Lauesen, *Task Descriptions as Functional Requirements*, IEEE Software, March 2003. (on Canvas, under week 2)

--- weekly submission within a week (see specific deadline on Canvas)

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