


SWINBURNE
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UNIVERSITY OF
TECHNOLOGY


SWE30003
Software Architectures and Design

Lecture 1
Issues in Software Design

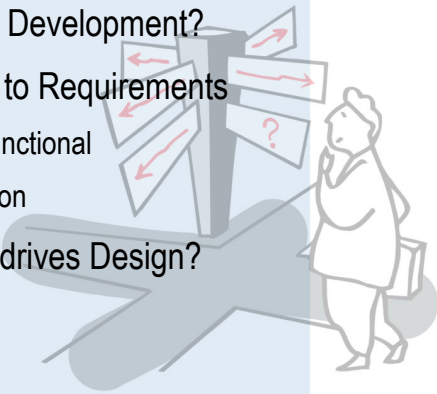


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Outline



- **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

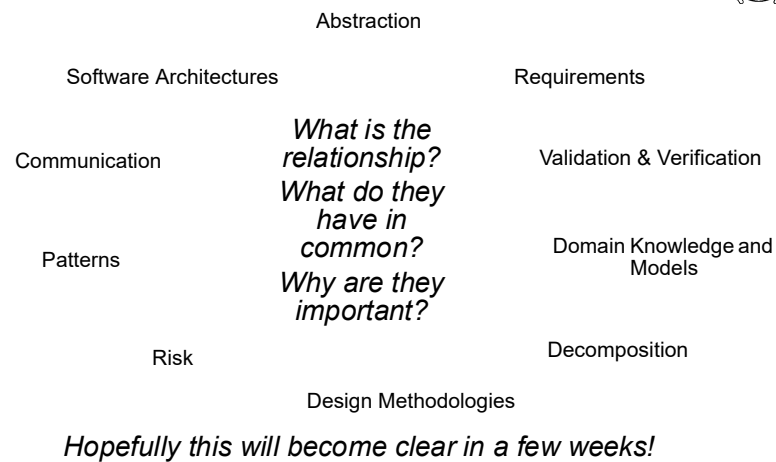


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What we will be talking about...



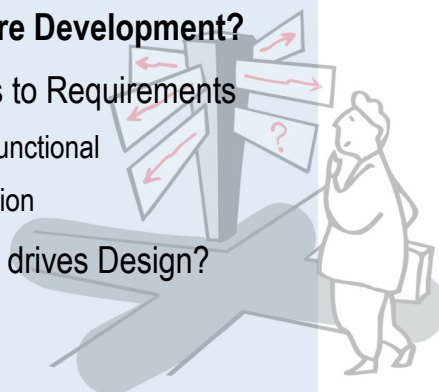
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Why do we build Software Systems?



- 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- Technology used no longer supported/outdated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

☞ *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!

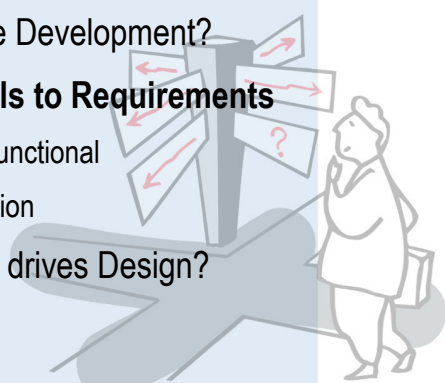
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Outline

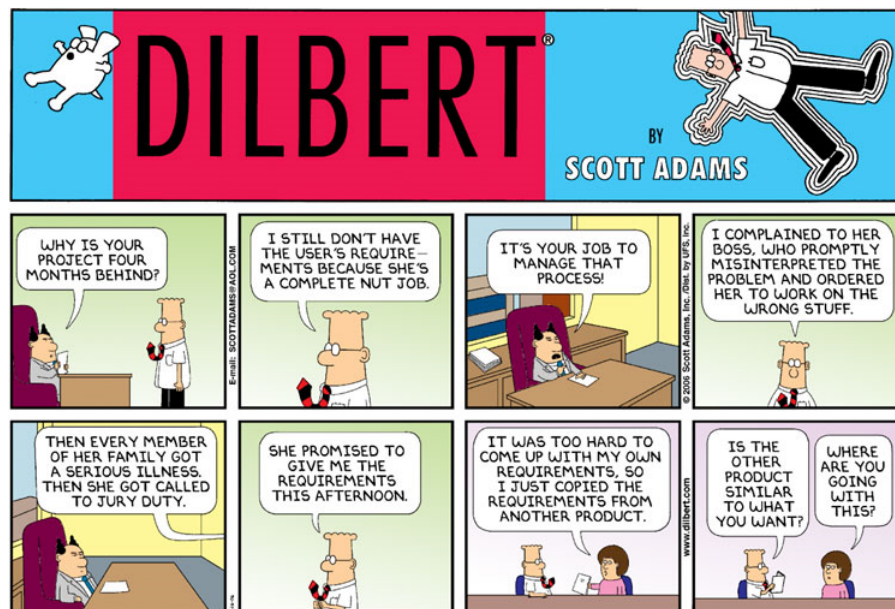


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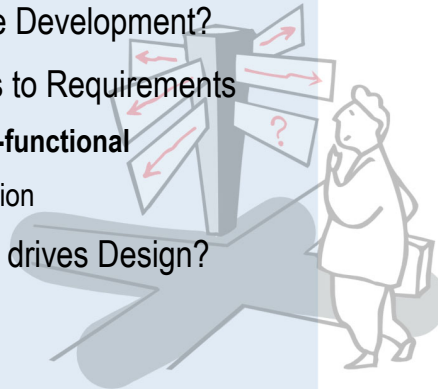
http://en.wikipedia.org/wiki/Fair_use

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

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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 <i>standard ASCII character set</i> .
Organisational requirement	The <i>system development process</i> and deliverable documents shall conform to the process and deliverables defined in <i>XYZCo-SP-STAN-95</i> .
External requirement	The system shall provide facilities that allow any user to check if personal data is maintained on the system. <i>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.</i>

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

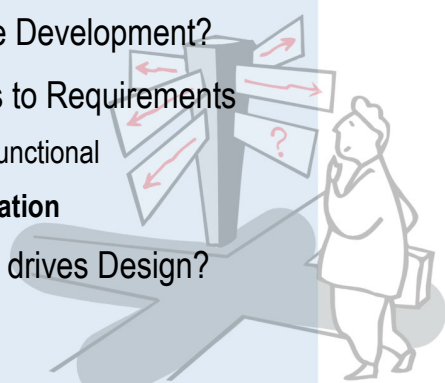
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Outline



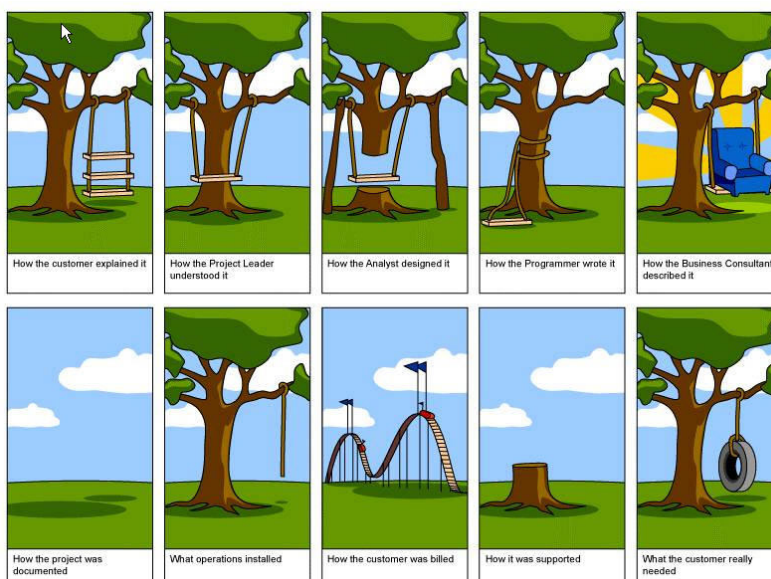
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Impedance Mismatches



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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!

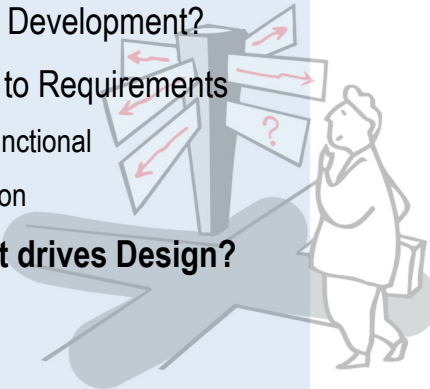
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Software Design – a “Definition”



“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

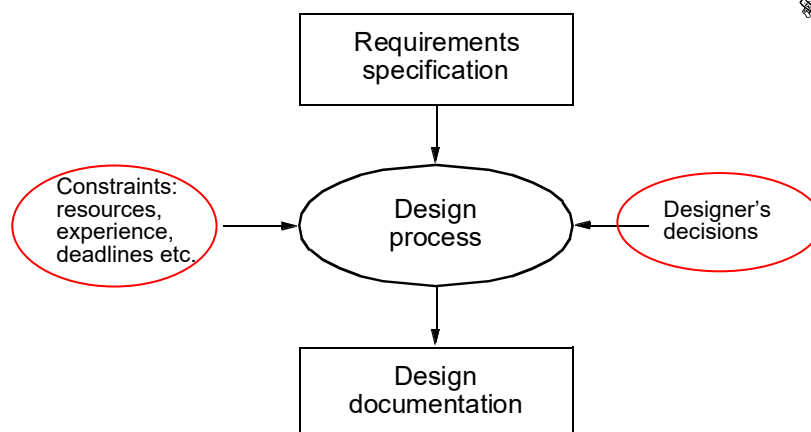
“The design of a system determines a set of components and inter-component interfaces that satisfy a specified set of requirements.”

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 build.
- A model can capture and represent,
 - ☐ Structure (static model)
 - ☐ Behavior (dynamic model)
- Examples:
 - ☐ Architectural blue-print of a house
 - ☐ Hand-drawn 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

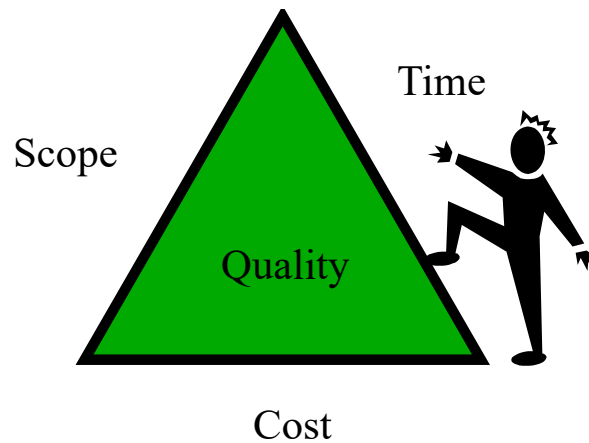


- Quality requirements are those that *drive* the structural design of the software system.
- Leads to several questions:
 - ☐ How are quality requirements *specified*?
 - ☐ How are quality requirements *validated*?
 - ☞ *This is also important for functional requirements!*
 - ☐ How are quality requirements *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.*

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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)

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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)

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