Requirements Engineering: Modelling the User's Needs

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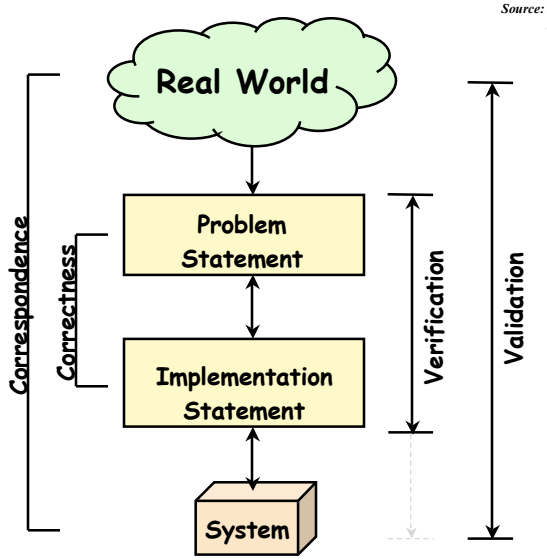
The "essential" software process

Source: *Adapted from Blum, 1992, p32*
see also: *van Vliet p11*



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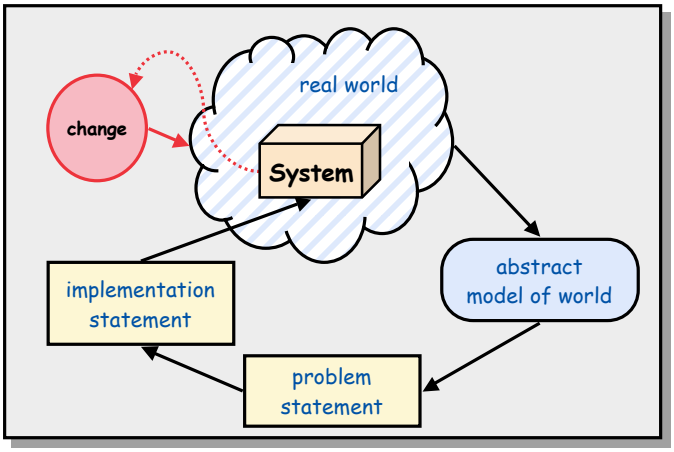
Design changes the world…



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Discovering Requirements

- Starting point
  - Some notion that there is a "problem" that needs solving
    - e.g. dissatisfaction with the current state of affairs
    - e.g. a new business opportunity
    - e.g. a potential saving of cost, time, resource usage, etc.
  - A Requirements Engineer is an agent of change
- The requirements engineer must:
  - identify the "problem"/"opportunity"
    - Which problem needs to be solved? (identify problem Boundaries)
    - Where is the problem? (understand the Context/Problem Domain)
    - Whose problem is it? (identify Stakeholders)
    - Why does it need solving? (identify the stakeholders' Goals)
    - How might a software system help? (collect some Scenarios)
    - When does it need solving? (identify Development Constraints)
    - What might prevent us solving it? (identify Feasibility and Risk)
  - and become an expert in the problem domain
    - although ignorance is important too -- "the intelligent ignoramus"

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Difficulties of Elicitation

- Thin spread of domain knowledge
  - The knowledge might be distributed across many sources
    - It is rarely available in an explicit form (I.e. not written down)
  - There will be conflicts between knowledge from different sources
    - People have conflicting goals
    - People have different understandings of the problem
- Tacit knowledge (The "say-do" problem)
  - People find it hard to describe knowledge they regularly use
    - Descriptions may be inaccurate rationalizations of expert behaviour
- Limited Observability
  - The problem owners might be too busy coping with the existing system
  - Presence of an observer may change the problem
    - E.g. the Probe Effect and the Hawthorne Effect
- Bias
  - People may not be free to tell you what you need to know
    - Political climate & organisational factors matter
  - People may not **want** to tell you what you need to know
    - The outcome will affect them, so they may try to influence you (hidden agendas)

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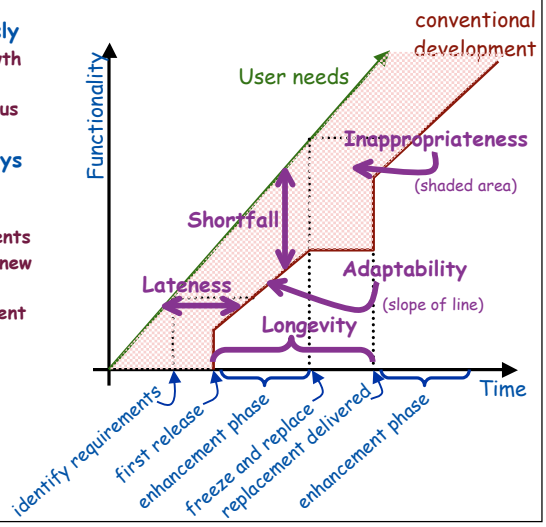
Requirements Growth

Source: *Adapted from Davis 1988, pp1453-1455*

- Davis's model:
  - User needs evolve continuously
    - Imagine a graph showing growth of needs over time
    - May not be linear or continuous (hence no scale shown)
  - Traditional development always lags behind needs growth
    - first release implements only part of the original requirements
    - functional enhancement adds new functionality
    - eventually, further enhancement becomes too costly, and a replacement is planned
    - the replacement also only implements part of its requirements,
    - and so on...



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What does correctness mean?

- Some distinctions:
  - Domain Properties are things in the application domain that are true whether or not we ever build the proposed system
  - Requirements are things in the application domain that we wish to be made true by delivering the proposed system
  - A specification is a description of the behaviours the program must have in order to meet the requirements
- Two correctness criteria:
  - The Program running on a particular Computer satisfies the Specification
  - The Specification, in the context of the given domain properties, satisfies the requirements
- Two validation criteria:
  - We discovered all the important requirements
  - We discovered all the relevant domain properties

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Source: *Adapted from Jackson, 1995, p170-171*

Validation Example

- Requirement R:
  - "Reverse thrust shall only be enabled when the aircraft is moving on the runway"
- Domain Properties D:
  - Wheel pulses on if and only if wheels turning
  - Wheels turning if and only if moving on runway
- Specification S:
  - Reverse thrust enabled if and only if wheel pulses on
- S + D imply R
  - But what if the domain assumptions are wrong?

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Source: *Adapted from Jackson, 1995, p172*

Another Example

- Requirement R:
  - "The database shall only be accessible by authorized personnel"
- Domain Properties D:
  - Authorized personnel have passwords
  - Passwords are never shared with non-authorized personnel
- Specification S:
  - Access to the database shall only be granted after the user types an authorized password
- S + D imply R
  - But what if the domain assumptions are wrong?

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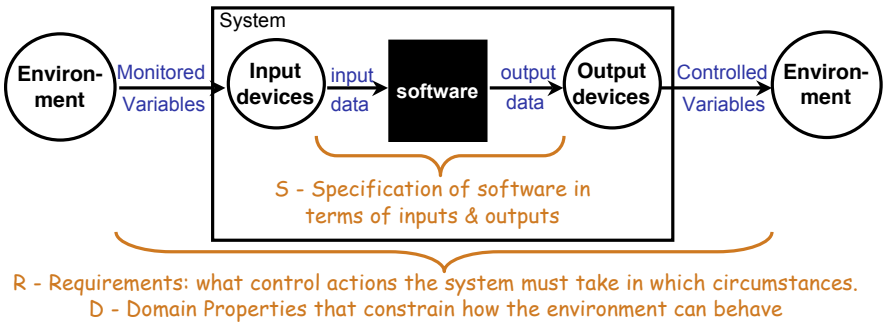
Source: Adapted from Jackson, 1995, p172

Setting the Boundaries

- How will the software interact with the world?
- E.g. the four variable model:
  - Fixes the input/output devices
  - Uses I/O data items as proxies for the monitored and controlled variables



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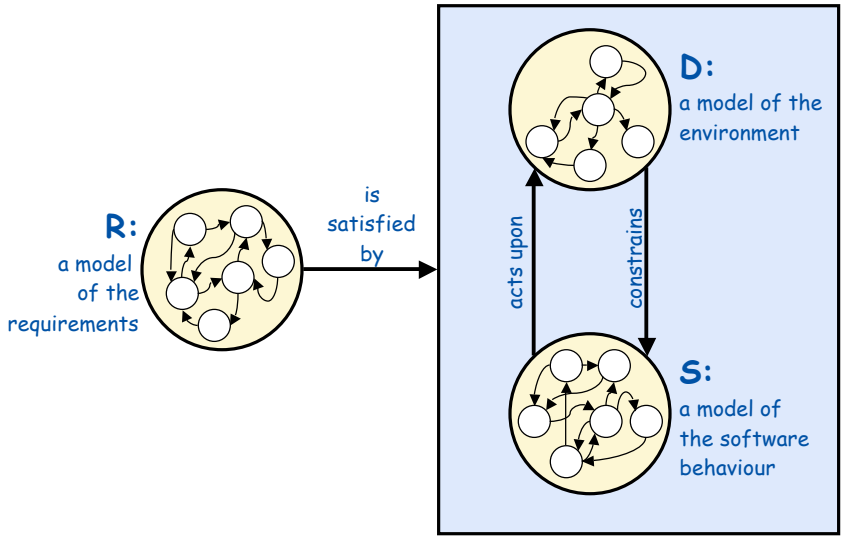
Three different models??



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Modeling…

- **Modeling can guide elicitation:**
  - Does the modeling process help you figure out what questions to ask?
  - Does the modeling process help to surface hidden requirements?
    - i.e. does it help you ask the right questions?
- **Modeling can provide a measure of progress:**
  - Does completeness of the model imply completeness of the elicitation?
    - i.e. if we've filled in all the pieces of the model, are we done?
- **Modeling can help to uncover problems**
  - Does inconsistency in the model reveal interesting things…?
    - e.g. inconsistency could correspond to conflicting or infeasible requirements
    - e.g. inconsistency could mean confusion over terminology, scope, etc
    - e.g. inconsistency could reveal disagreements between stakeholders
- **Modeling can help us check our understanding**
  - Can we test that the model has the properties we expect?
  - Can we reason over the model to understand its consequences?
  - Can we animate the model to help us visualize/validate the requirements?

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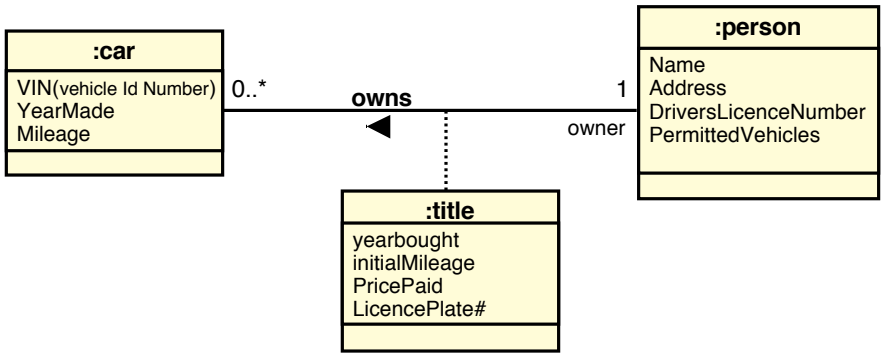
What models might we build?

→ (1) What kinds of information are we dealing with?

- What objects (classes of objects) are we dealing with?
- What are the relationships between those objects?
- What constraints are there on those relationships?

→ Example:



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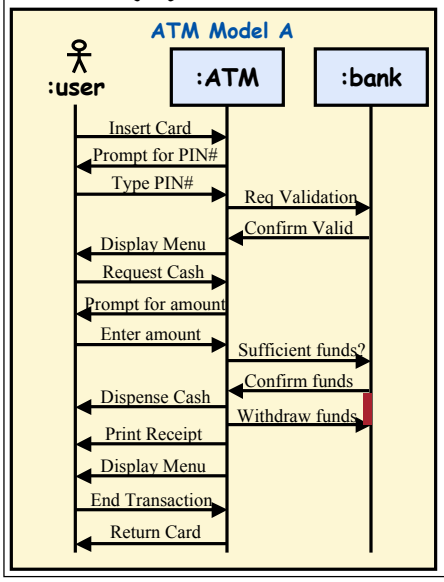
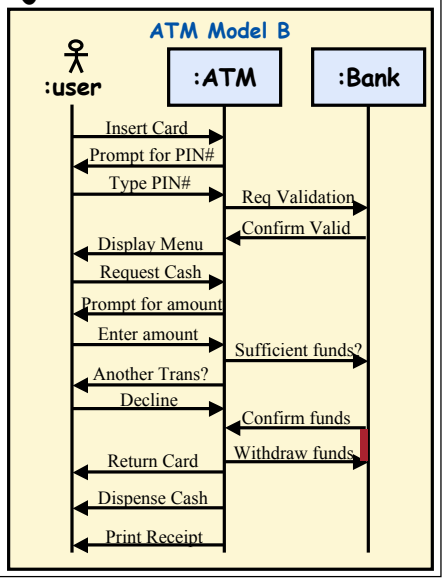
(2) How should objects interact?





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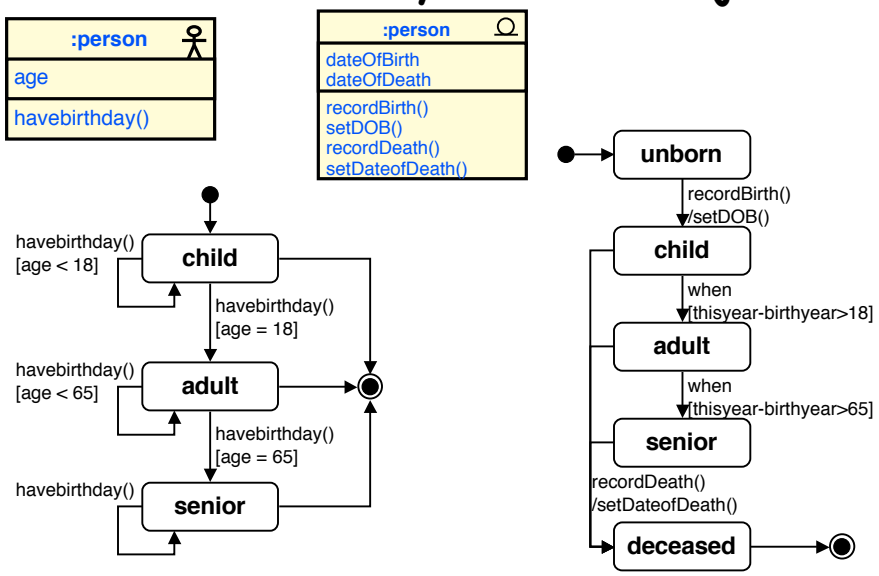
What is the lifecyle of each object?



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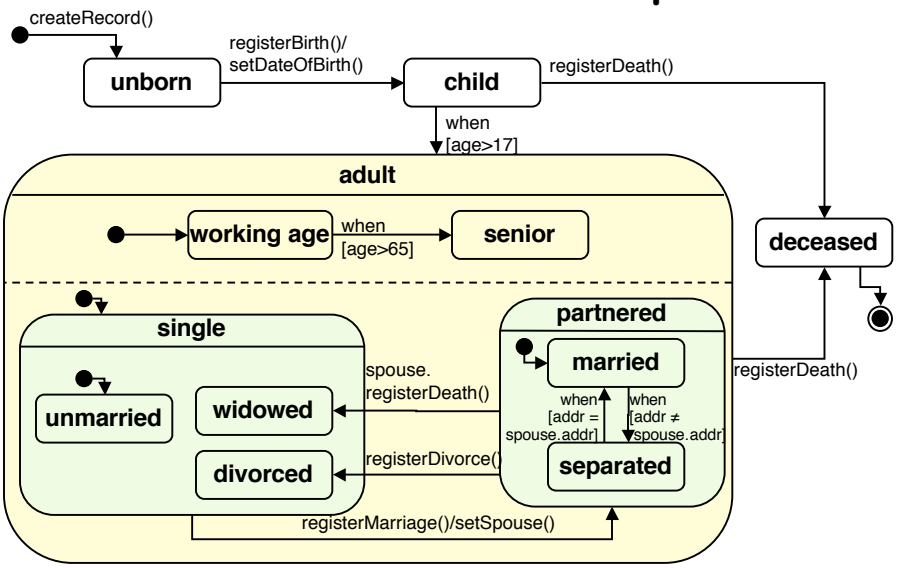
A more detailed example



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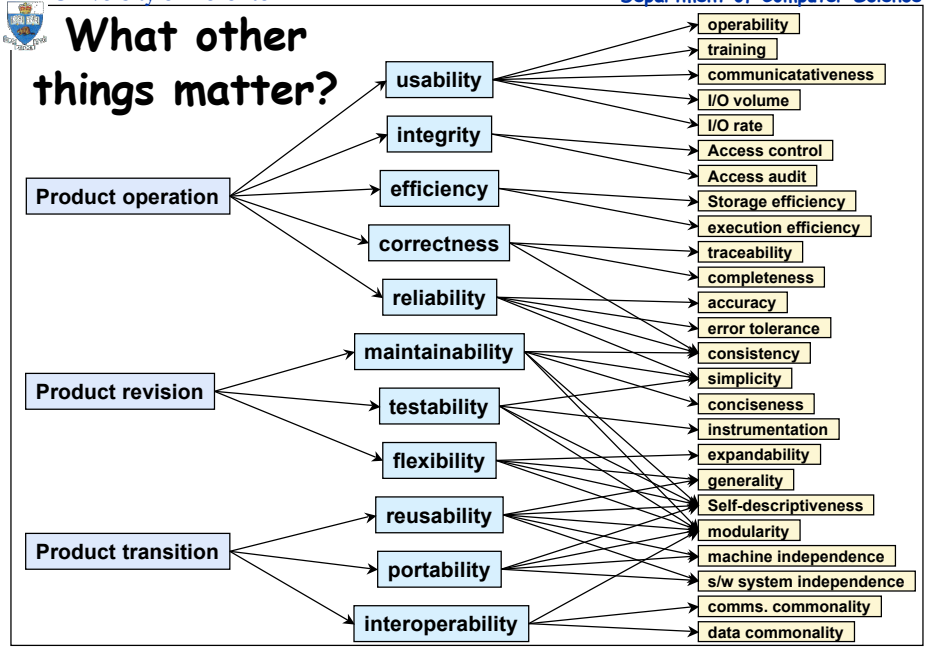
What other things matter?



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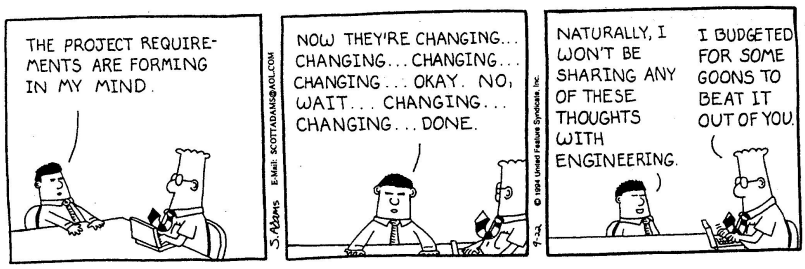
Summary



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