Requirements engineering and use cases

Nigel Goddard

School of Informatics
University of Edinburgh

Requirements capture

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- not being sure what was required in programming exercises
- as a user, software not doing The Right Thing...

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In small systems, fairly easy. Not sure? Go and ask.

In large systems, much harder – need to budget (time and money), negotiate scope; difficulty of resolving questions; significant effort needed before anything can be demonstrated and checked.

Inadequate requirements capture is the major source of project failure (e.g. according to Standish CHAOS reports).

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Also known as requirements elicitation.

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You may be aiming to

- replace/out-compete existing software that does a similar job
- automate a process that is currently done manually
- introduce novel functionality.

Regardless, you need to know who wants the software to do what.

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- Who do you write requirements documents for?
- Who pays?
- Who can cancel the project at each stage?

All these people are stakeholders: they have a relevant interest in influencing the software, and you need their input.

They may find it difficult to articulate their requirements.

They may have different importance.

Requirements elicitation techniques

(More detail in SWEBOK Ch2)

- Interviews
- Scenarios
- Prototypes
- Facilitated meetings
- Observation

Requirements elicitation: interviews

Traditional method: ask them what they want, or curruntly do

Watch for:

- Do they know what they want?
- Leading questions
- Interview methodologies

Requirements elicitation: scenarios

Provides a "context" or framework for questions.

Allows "what if" or "how would you do this" questions.

Includes use cases and user stories

Requirements elicitation: prototypes

Can include

- screen mock-ups
- storyboards
- limited system

Like scenarios, but more "real". High quality feedback.

Requirements elicitation: facilitated meetings

Get group discussion going in a structured manner, to refine requirements

Helps with:

- Requirements that are not about individual activities
- Surfacing / resolving conflicts

Needs a trained facilitator.

Requirements elicitation: observation

Immersive method. Expensive.

Helps with:

- Surfacing complex / subtle tasks and processes
- Finding the nuances that people never tell you

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Requirements analysis is the process of getting to a single consistent set of requirements, classified usefully, that will actually be implemented.

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  `3.1.4.4 The system shall...`
- a use case model with supporting text
- a formal specification in a mathematically-based language.

Probably reviewed, may be contractual.

Requirements classification

Traditional to distinguish *functional* from *non-functional* requirements.

Functional requirements: What the system should do.

Non-functional requirements: How fast it should do it; how seldom it should fail; what standards it should conform to; etc.

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Some projects will have several requirements documents for different purposes, e.g., one written in the customers' terms, one in developers'.

User Stories

Used in "agile" (low ceremony, lightweight) development processes e.g. Extreme Programming (XP) – more on process later, but for now note the

Assumption: there is a single person empowered and able to make decisions on the spot about the requirements and their prioritisation, and that person ("the customer") is always available to the developers.

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User stories are brief, written by the customer on an index card. E.g.

```
10.  User A leaves the office for a short time
(vacation etc.)  and assigns his access privileges to
user B, so B can take care of A's tasks while A is
gone. Source: user; Risk: M
```

Pros and cons of user stories

Pros:

- ▶ can really be owned by the customer: so more likely to be correct
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Cons:

- ▶ May be incomplete, inconsistent
- ▶ Only work in conjunction with good access to the customer
- ▶ Not suitable to form the basis of a contract

Now we go on to medium-ceremony approaches.

The Unified Modeling Language

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Often used just for documentation, but in model-driven development, a UML model may be used e.g. to generate and update code and database schemas automatically.

Many tools, including free ones, support UML. In this course you are not required to use any, but you might want to (e.g. the very basic UMLet, or fully-featured ArgoUML, or Eclipse UML2 tools).

DICE: Umbrello

UML: Use cases

Document the behaviour of the system *from the users' points of view*. They help with three of the most difficult aspects of development:

- ► capturing requirements
- ► planning iterations of development which are good for users
- ► meaningful system testing

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First introduced by Ivar Jacobson (early '90s), developing from *scenarios*. Independent of OO – strength or weakness??

A set of use cases is *summarised* in a UML use case diagram.

Simple use case diagrams are easy to understand: can be useful for communication between customers and developers.

A simple use case diagram
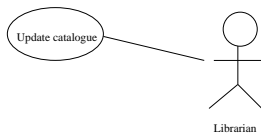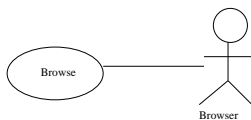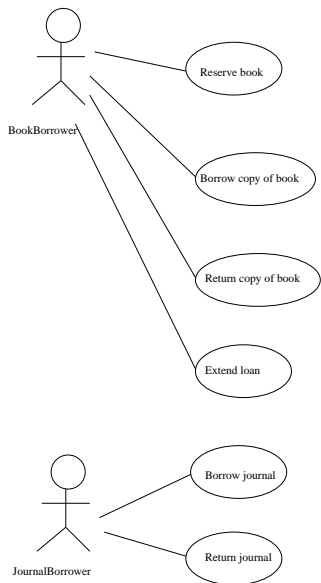
UML use cases: Actors

An **actor** – shown as a stick figure – can be:

- a human user of the system *in a particular rôle*
- an external system, which *in some rôle* interacts with the system.

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- an external system, which *in some rôle* interacts with the system.

Not a user: a particular *kind* of user. E.g., Bank Customer.

The same human user or external system may interact with the system in more than one rôle: he/she/it will be (partly) represented by more than one actor. (e.g., a bank teller may happen also to be a customer of the bank).

Requirements capture organised by use cases

Use cases can help with requirements capture by providing a structured way to go about it:

1. identify the actors
2. for each actor, find out
   - what they need from the system
   - any other interactions they expect to have with the system
   - which use cases have what priority for them

What is a use case?

A **task** involving the system which has value for an actor, e.g. `Borrow copy of book`.

Shown on diagram as named oval.

Also includes (textual) description of the (a?) sequence of messages exchanged between the system and any actors, and actions performed by the system, in order to realise the functionality.

Use case descriptions can be combined with other forms of requirements documentation.

Use cases: scope and connections

A use case:

- ▶ may include logic to handle unusual or alternative courses, e.g. "if the BookBorrower has the maximum number of books on loan already, refuse this loan" *even though these may result in the actor being unsatisfied*;

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- may be associated with other UML models which show how it is realised;
- includes text which may reference other requirements documentation.

A use case diagram summarises all the tasks performed by the system (or subsystem, etc.)

Politics

If we capture requirements in terms of use cases, we should understand *what is important to whom*.

Make sure system delivers added value:

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- to all the people who might scupper it
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Why: so the project isn't cancelled. Supposedly...

Analysis vs design

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For example, consider a `FindBook` use case of a library, in which the user enters details of a book and wants to end up with a copy of it. Maybe the system will give the user directions to where the book is on the shelf. Maybe it will alert a librarian to go and fetch it. In the latter case, should the librarian be shown as actor? In some sense, the choice is a design decision.

Using use cases in development

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Use cases are not limited to documenting the whole system: they may describe many kinds of entities (*UML: classfier*), e.g. subsystem, class, component.

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For example, UML does not permit associations between actors: you cannot legally use a use case diagram to show an interaction between two humans followed by one of them using a system. E.g., library member and librarian.

There are extensions to UML to allow business process modelling, not considered here.

Reading

Required: SWEBOK 2004, Chapter 2, Software Requirements.

Suggested: Somerville chapters on requirements.

Suggested: Stevens Chapter 7.