

# 3 REQUIREMENTS ENGINEERING

course “software requirements and architecture”

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# contents

- 1 Definition of requirements engineering
- 2 Activities
- 3 Challenges and problems

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- 3 Challenges and problems

# definition

- The term **requirements engineering** is relatively new.
- It designates all the activities related to requirements discovery, negotiation, documentation, and maintenance.
- alternative designation: **analysis**
- Requirements engineering is inherently broad, interdisciplinary and is constantly open.
- It is related to the transformation of informal descriptions of the real world into specifications in languages with a rigorous basis.

# definition

- Requirements engineering consists in the study of a problem that leads to the system development, before taking any design or implementation action.
- Requirements engineering, in the scope of software engineering, is focused on the real-world objectives established for the functionalities and the restrictions of software systems [Zave, 1997].
- Requirements engineering is the process of discovery, analysis, documentation and checking the services and restrictions related to the operation and development of software systems.
- It is a set of structured activities that, with respect to a system, aid in obtaining an understanding about the domain, the restrictions of operation, the functionalities requested by the stakeholders and the essential characteristics.

# objectives

- Requirements engineering aims to help one to better understand the problem that has to be faced.
- The objective is to increase the chances of the system under development to satisfy the future users.
- Requirements engineering seeks to ensure the three following objectives:
  - ① all the relevant requirements are explicitly known and comprehended at the intended level of detail;
  - ② a reasonable and wide agreement about the requirements is obtained among the stakeholders;
  - ③ all the requirements are duly documented, in conformity with the established formats and templates.

## separation from the solution

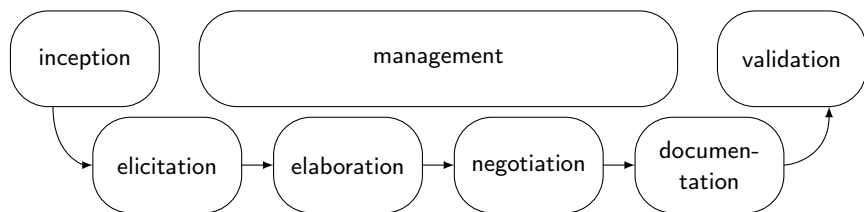
- Requirements engineering determines what the system must do to meet the necessities of users and not how it should be built.
- Analysing a system consists in studying it without taking into account issues related to the implementation technology.
- One dedicates an appreciable effort to systematise the knowledge of the problem domain.
- It is desirable keeping the requirements strictly separated from their own solutions.
- The requirements of a given system are necessary, clear, correct, complete, viable, traceable, verifiable and negotiable.

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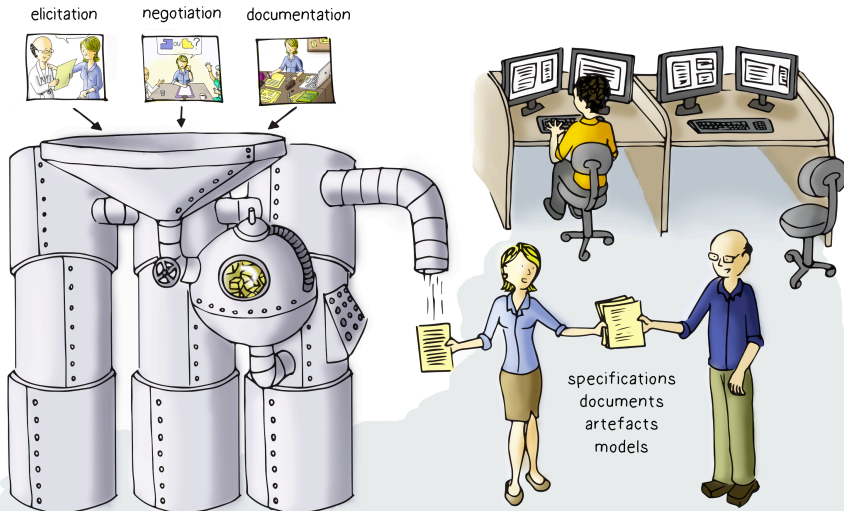
- 1 Definition of requirements engineering
- 2 Activities**
- 3 Challenges and problems



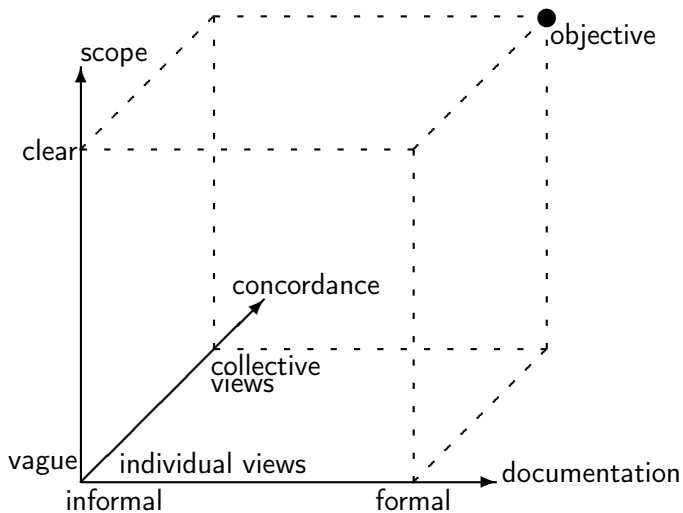
## process



## process



## dimensions of requirements engineering



# inception

- Any project requires some inception mechanism.
- Someone must initiate the process, based on some necessity or business expectation.
- The perception of that necessity usually occurs due to the dissatisfaction in relation to the current situation.
- This recollection must be done in width and not in depth.
- At the end, the requirements engineer should be able to describe what is the client vision and return on investment.
- One must also evaluate if what the client needs is already available in the market.

# elicitation

- This activity handles how requirements should be captured.
- The requirements elicitation techniques must:
  - 1 identify the sources of requirements;
  - 2 aid the various stakeholders to correctly describe the requirements.
- This activity is inherently communicational, since it requires an in-depth interaction with the stakeholders.
- Requirements elicitation techniques: interview, survey, introspection, ethnography, focus group, cooperative work, domain analysis, object-orientation, prototyping, scenario, goal modelling, and persona.

# elaboration

- This activity aims to analyse and classify the elicited, but not yet handled, requirements.
- It is usual to organise the requirements in cohesive groups.
- The analyst must intervene, whenever the requirements:
  - do not make sense;
  - are in contradiction among them;
  - are incoherent;
  - are incomplete;
  - are vague.

# negotiation

- Requirements engineering involves communication and negotiation among various stakeholders.
- It is inevitable that **conflict** situations arise among the requirements.
- One needs to promote negotiation mechanisms among the stakeholders.
- Its result can have a significant impact on the acceptance of the final system.
- Another form of handling conflicts consists in adopting **prioritisation** techniques, to sustain the choice of the requirements subset to be implemented at each instant.



Image courtesy of artur84 at FreeDigitalPhotos.net

# documentation

- Requirements documents serve as the principal reference to the subsequent phases of the development process.
- The requirements document is organised according to two distinct perspectives:
  - ① user requirements, that describe the expectations and the necessities of the users;
  - ② system requirements, that establish the agreement between the client and the development team.
- The structure/formality of the documentation should vary in line with the system characteristics and the adopted process.



Image courtesy of Stuart Miles at FreeDigitalPhotos.net



# validation

- The objective is to ensure that the requirements define the system desired by the client.
- One should examine the requirements document through inspections or technical reviews of the specifications, to evaluate if it describes the intended system.
- Validation is a testing activity.
- While the requirements engineering activities are conducted, it is necessary to execute tasks that allow requirements to be verified and validated.

# management

- The requirements set is constantly changing.
- Mechanisms to manage that instability context are needed, in order to evaluate the impact that the changes in the requirements can have on the project.
- One must reject changes that imply:
  - 1 a significative increase in cost;
  - 2 a postponement of the final delivery;
  - 3 a system devaluation for the user.
- The requirements management activity seeks to aid the development team to identify, control and trace the requirements and their changes.

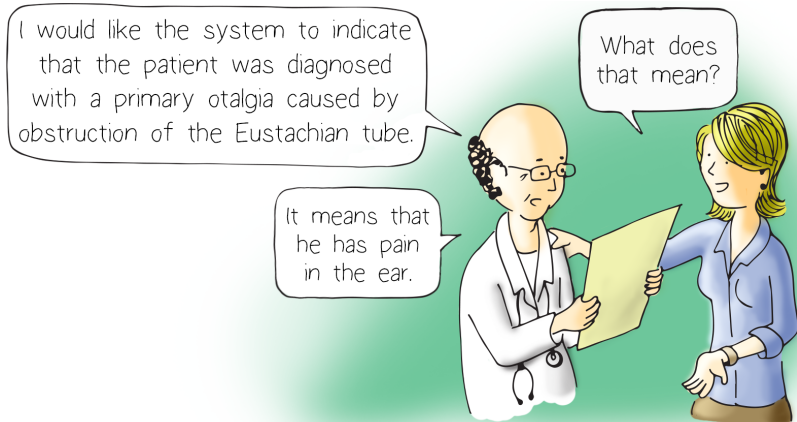
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- 1 Definition of requirements engineering
- 2 Activities
- 3 Challenges and problems

# difficulties

- Requirements engineering tries to characterise with rigour the problem in hand.
- The other process activities define and refine a given solution for the system to be developed.
- This distinction is due to the fact that the requirements engineering activities are intrinsically hard to execute.
- Communication problems between requirements engineers and users are common.
- Users have generally some difficulties in expressing their real necessities, in a perceptible and precise way.
- In many situations, the users only have a vague idea of what they really want.

# use of professional jargon



# difficulties and solutions

## difficulty

the client is not able to verbalise what he desires

the client did not notice that he explained incorrectly the problem until he receives a solution that does not satisfactorily solve it

the engineer thinks he knows more about the problem of the client than the client himself

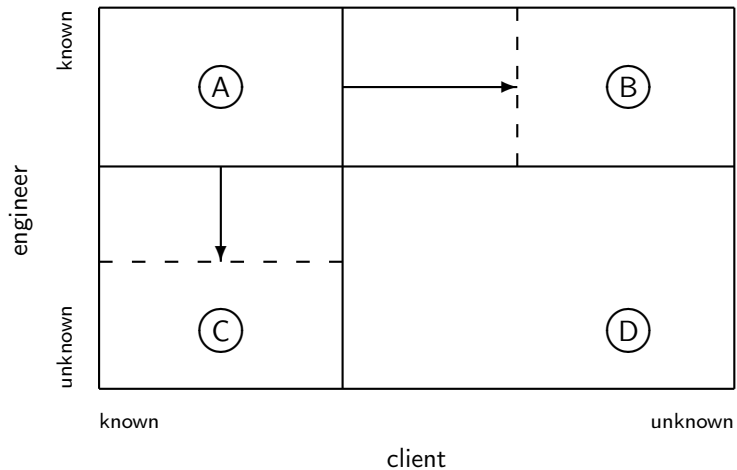
## solution

to observe the users performing their functions in the real context

to make sure that, prior to start the development, the problem to be handled is well formulated and corresponds to the reality

make the engineer feel the difficulties faced by the users in the real context

# Johari window



# requirements change

- Requirements change frequently throughout the development.
- Microsoft products have typically, at the end of the project, changes of 30% or more when compared to the initial requirements set [Cusumano, 2004].
- Changes in the requirements must be considered as a natural fact and not as the result of an initial request poorly formulated.
- One needs to find the adequate mechanisms that allow changes in the requirements to be incorporated, without major perturbations in the work previously developed.
- The development team of a system must be prepared to cope with the various changes.



## difficulty of the task

- Requirements engineering is one of the most difficult activities to be executed in the scope of software engineering.
- It is convenient to choose the most adequate approaches to the context under consideration.
- No technique used in isolation is sufficient to elicit the requirements of a system.
- Requirements engineers must select the techniques that are appropriate to the complexity of the system at hand and to the development context.

# Summary

- Requirements engineering aims to establish communication channels between the problem holders and those that will build the solution.
- The requirements engineering process includes seven main activities: (1) inception, (2) elicitation, (3) elaboration, (4) negotiation, (5) documentation, (6) validation, and (7) management.
- Requirements engineering allows the functionalities and the restrictions of the system to be elicited, negotiated, and documented.
- The clear definition of the requirements has a decisive influence on the quality and utility of the final system.
- After discussing the problem, interviews and discussions with the stakeholders should be organised.
- A project hardly constitutes a success, if all stakeholders do not provide their opinion w.r.t. the requirements.

## bibliography

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