

Requirements

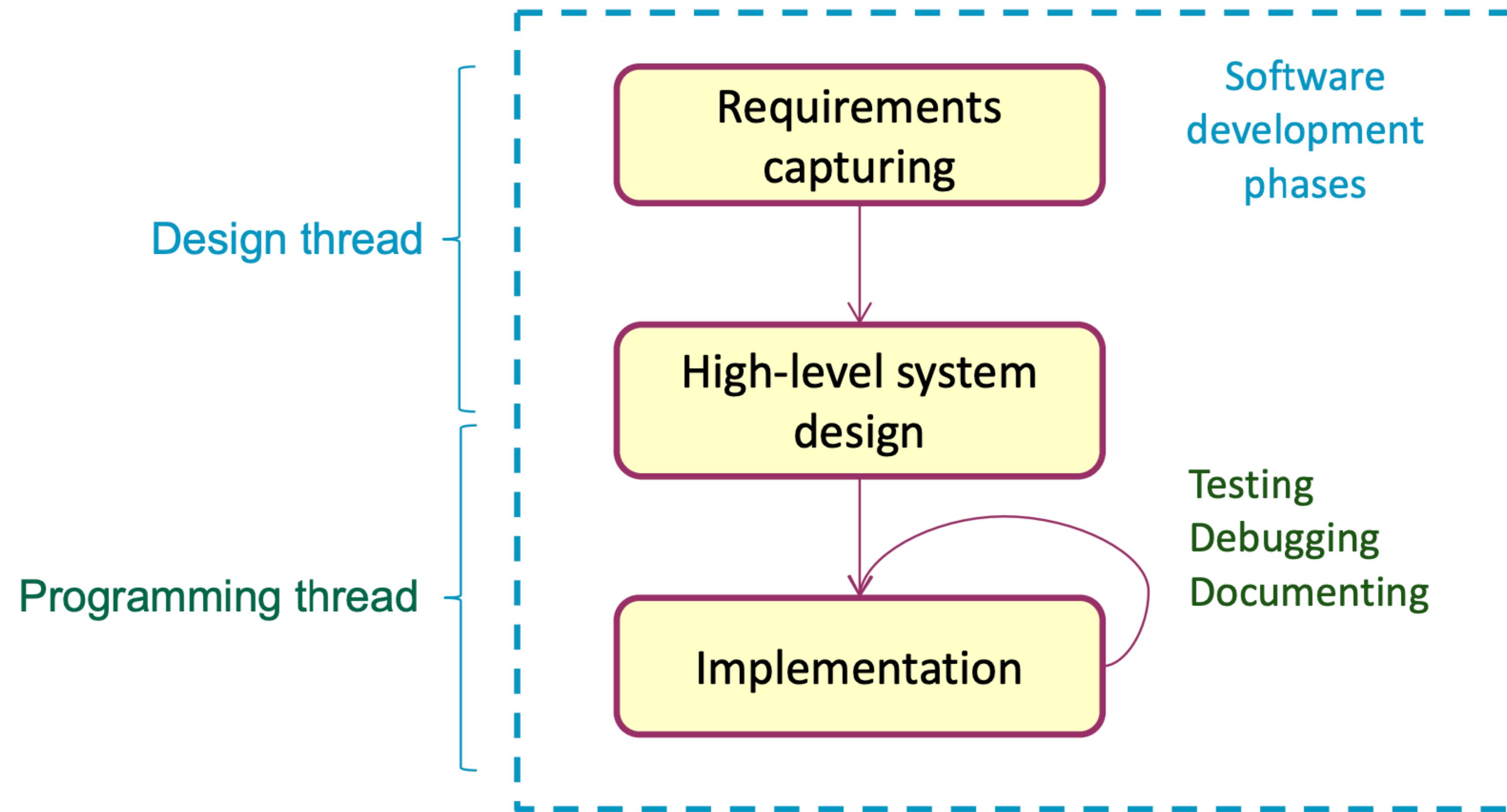
Workshop 2

Georgiana Caltais, University of Twente

MODULE COHERENCE

Skills

Managing a software development team



Requirements Overview

- **Importance**
- Definition, Formats & Types
- Elicitation
- Specification / Documentation
- Validation

Importance of Requirements In Software Development

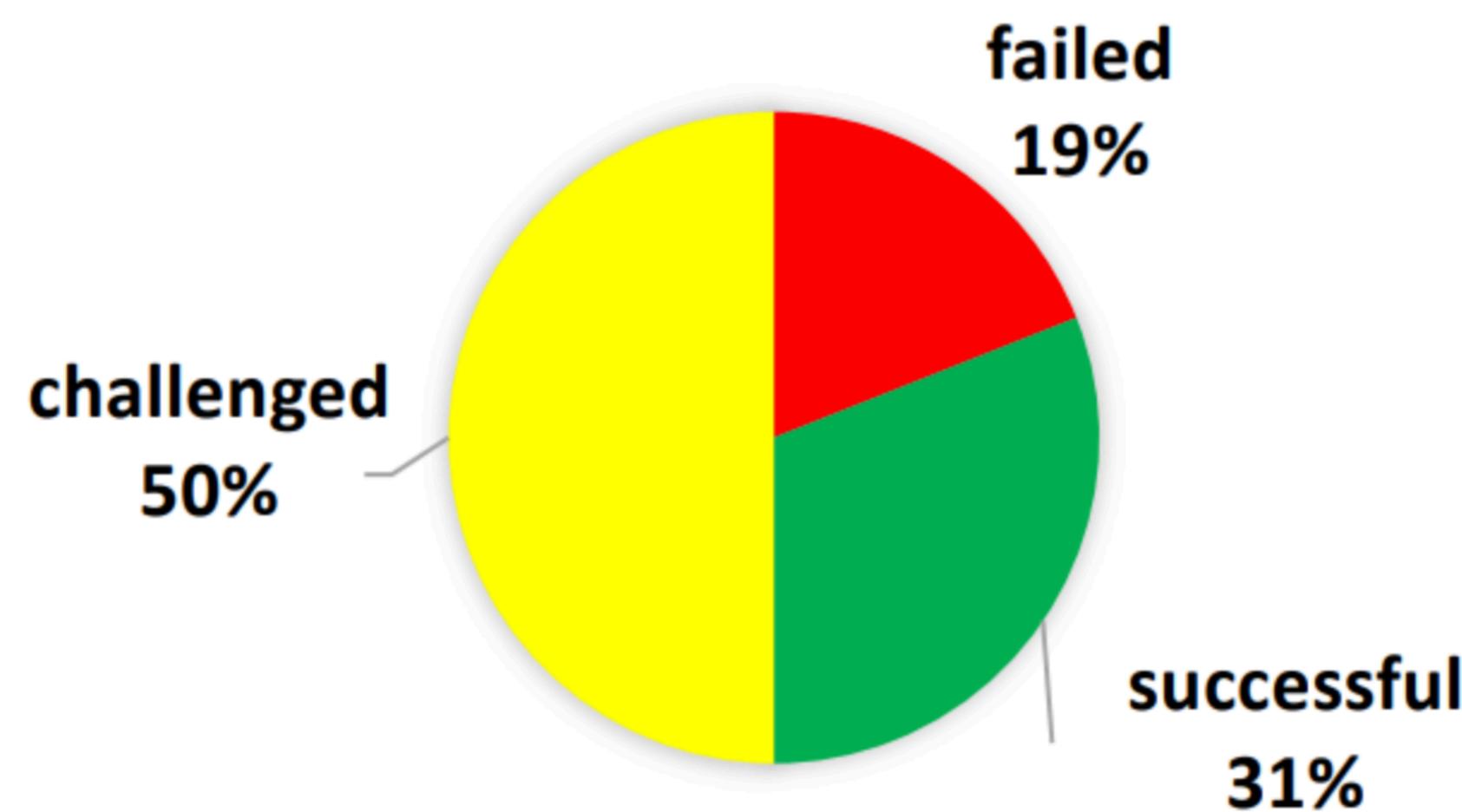
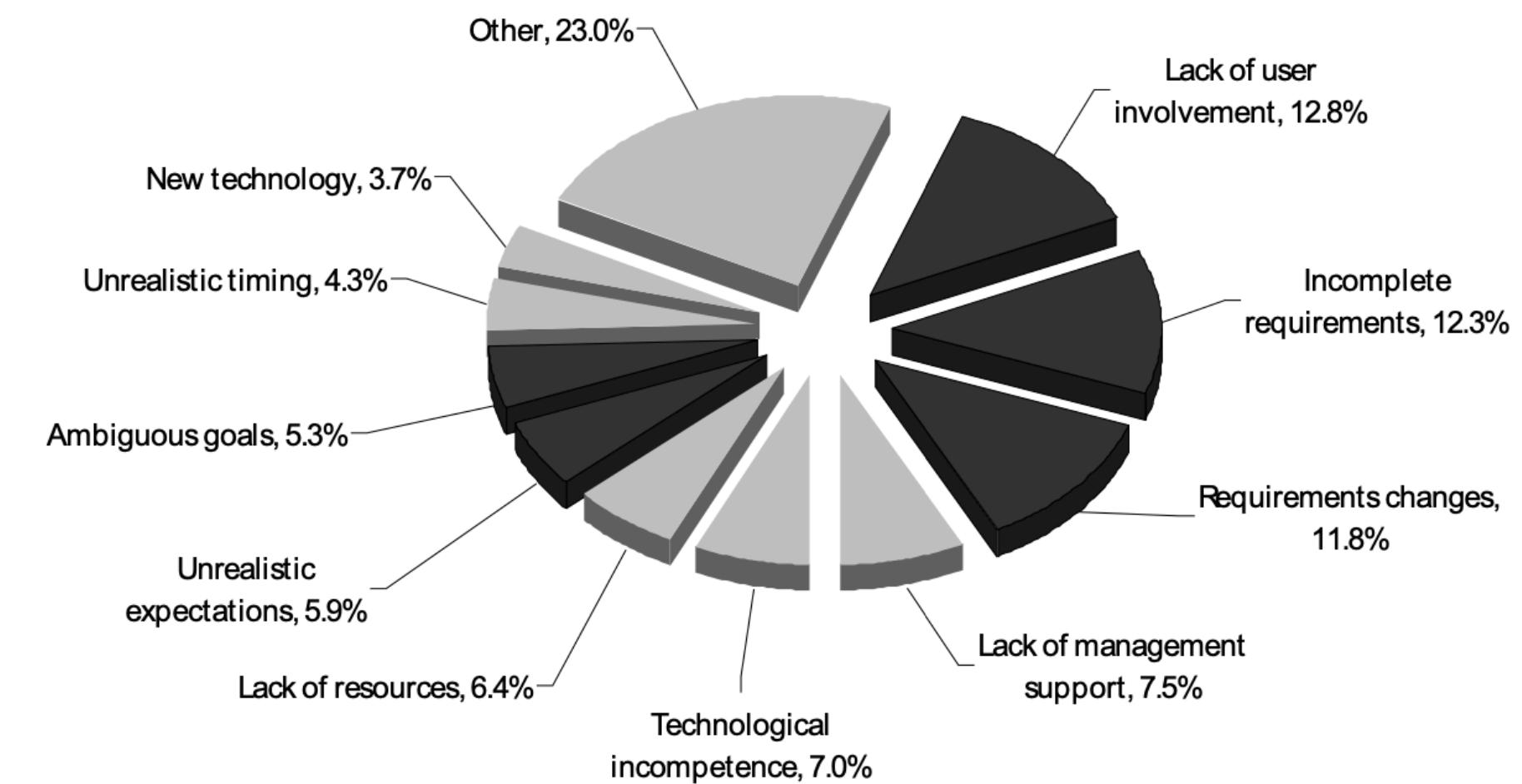


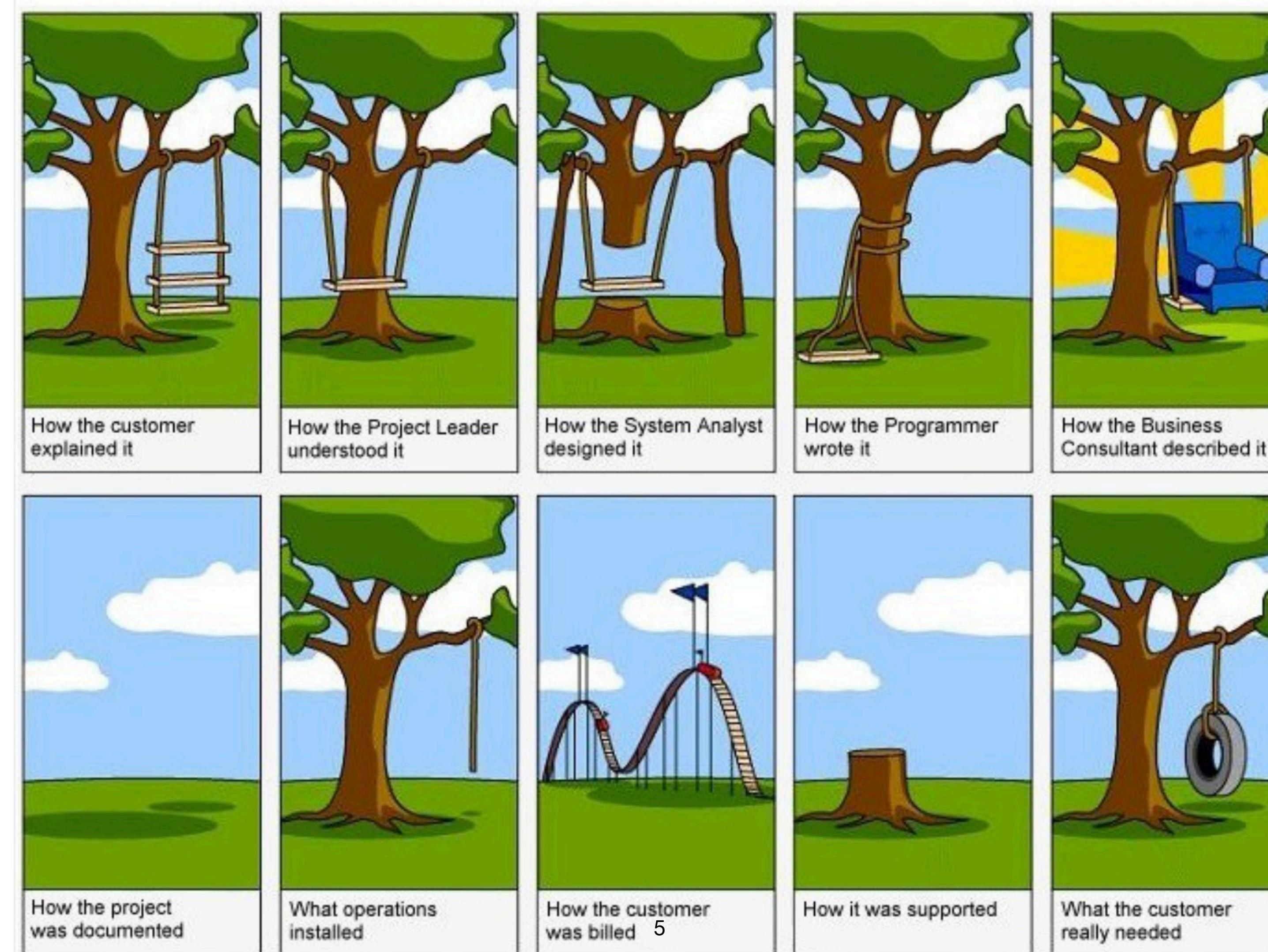
Figure 1.1: Summary of 2020 Standish Group CHAOS report.

Fig. 1–3 Reasons for resource overspend and/or functional restrictions (based on data from [The Standish Group 1995])



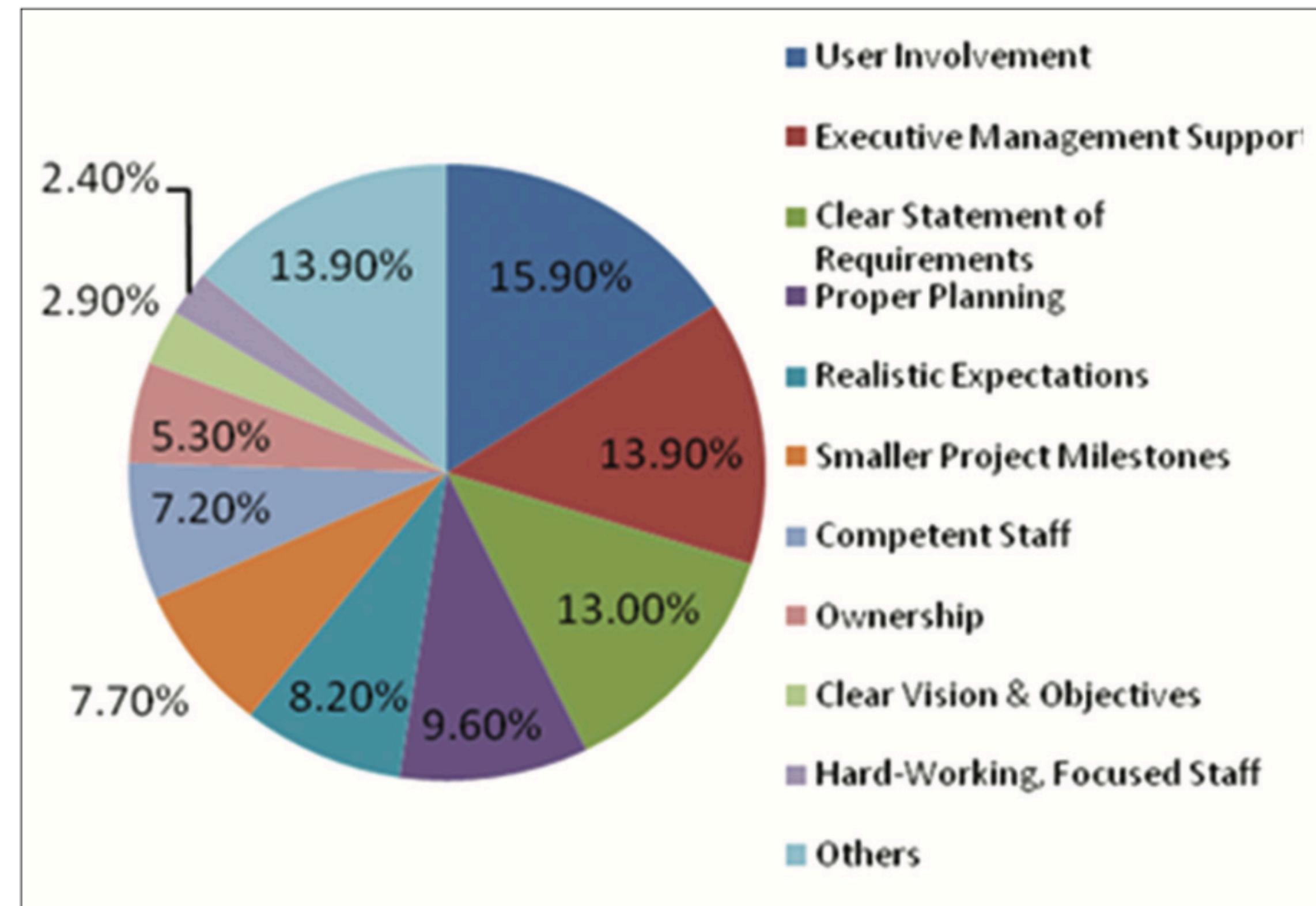
Importance of Requirements

In (Software) Development



Importance of Requirements In Software Success

Figure 1: Project success factors



Source: Project Smart (2014)

Credits: The Role of Requirements in the Success or Failure of Software Projects [Hussain et al.]

Importance of Requirements

Examples

- High impact on project success
 - Many projects failed or finished with overspend and/or restricted implemented functionality
 - Requirements defects are reason for approximately 50 % of the cases
- Example: [London Ambulance Service](#)
 - Poor requirements process that did not involve ambulance crews
 - Result: system was not able to operate under realistic conditions (i.e. sending too many ambulances to an incident) which [endangered patients lives](#)
- Defects in Requirements Engineering cause [high costs](#)
 - Defect found during programming increases costs by factor 20
 - Defect found during acceptance test increases const by factor 100!

Requirements Overview

- Importance
- Definition, Formats & Types
- Elicitation
- Specification / Documentation
- Validation

Requirements

Definition

- (1) A condition or capability needed by a user to solve a problem or achieve an objective.
- (2) A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed documents.
- (3) A documented representation of a condition or capability as in (1) or (2).

[IEEE 610.12-1990]

- The **part of reality** that is relevant for the requirements of a system is called the **system context** (influenced by: e.g., people, events, documents, systems in operation)

The system context is the part of the system environment that is relevant for the definition as well as the understanding of the requirements of a system to be developed.

Requirements

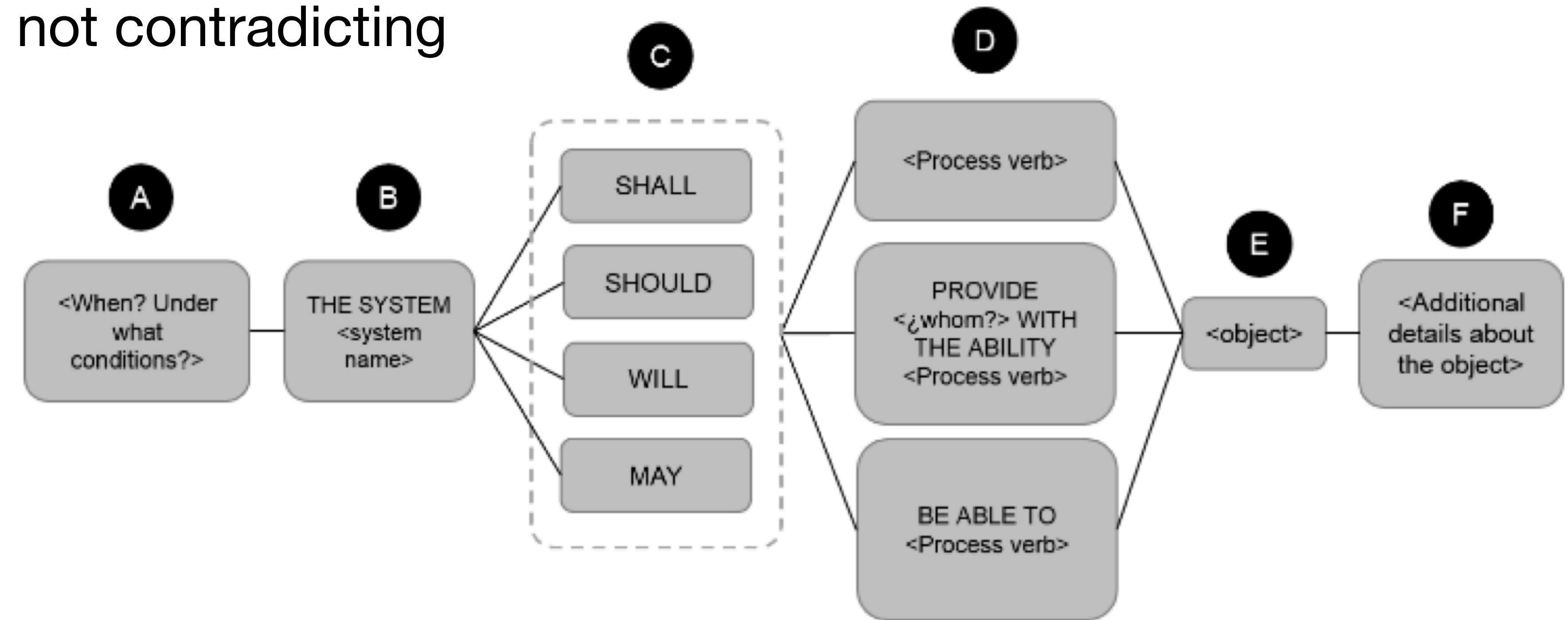
Goals vs. Requirements

- Goals describe intentions of stakeholders or groups of stakeholders. Goals can potentially conflict with one another.
- Requirements describe detailed functions and qualities that the system to be developed shall implement or possess. In addition, system requirements provide complete and precise information to serve as input for subsequent development steps.

Requirements Formats

Natural Language

- Must avoid ambiguity, inaccuracy, and inconsistency
- Must be concise, not contradicting
- Rupp's format:



Requirements Formats

Rupp's format

(A) Conditions: The first space is a condition or a set of conditions, usually optional, at the beginning of the requirement. A condition can be logical: composed by the conjunction “If”; or temporary: composed by the conjunction “as soon as” or “after that”.

(B) The System: The second space is the name of the system, the subsystem or component of the system that is specified for the requirement.

(C) Degree of obligation: The third space establishes the degree of obligation that the requirement can acquire. The template establishes four levels of obligation nature.

- The mandatory requirements, using the verb “shall”
- The recommended requirements, using the verb “should”
- The future requirements, using the modal verb “will”
- The desirable requirements, using the verb “may”

(D) Functional activity: The fourth space characterizes the functional activity that the system can assume, which includes the process verb object of the requirement. There are three types of activities:

- Autonomous requirement of the system: Indicates a functionality that the system performs independently without the need for interaction with users.
- User interaction: Indicates a functionality that the system provides to users.
- Interface requirement: Indicates a functionality that the system performs to react to events with other systems.

(E) Object: The fifth space is the object for which the behavior specified in the requirement is performed.

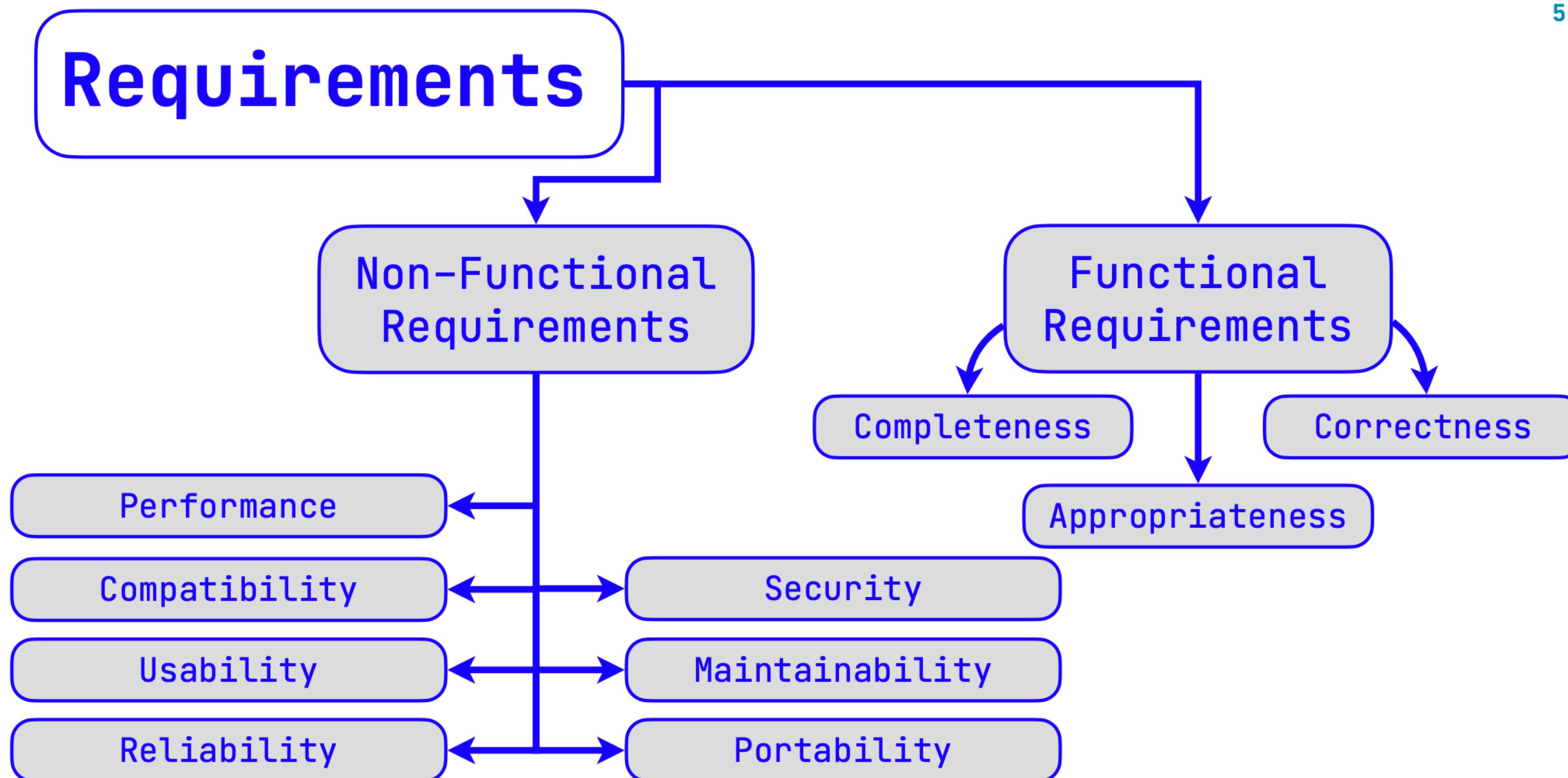
(F) Object details: The sixth and last space corresponds to the additional details (optional) about the object, the adjectives that qualify it or the characteristics that the object can possess.

Rupp's Format Examples

- The system should check whether the guest is registered.
- After the guest has selected the function “Place order”, the system shall display the menu to the guest.
- The system shall provide the guest with the ability to place his order.
- If the chef has rejected the guest's order, the system should ask the guest whether the guest would like to choose another dish.

Requirements Types

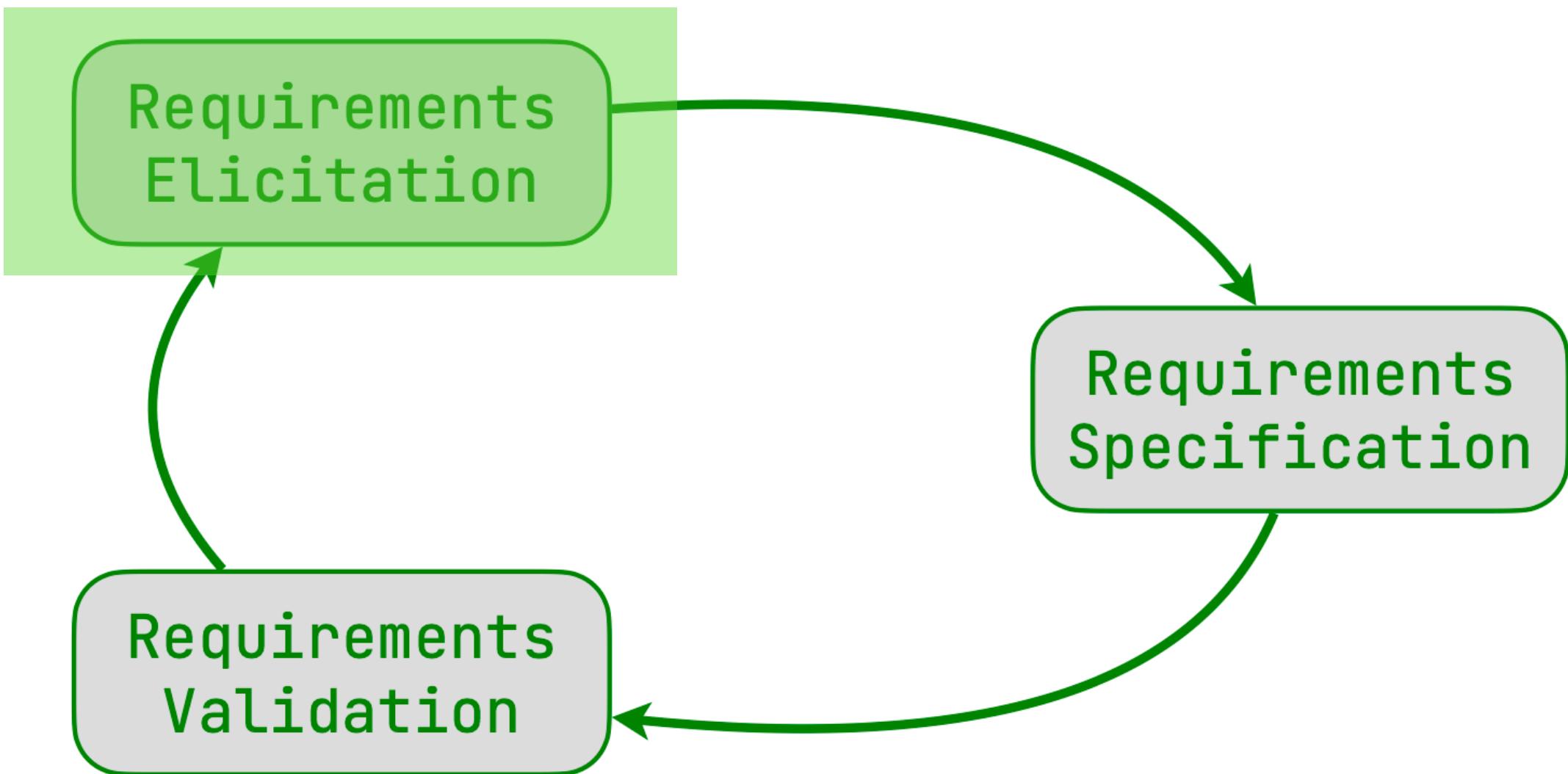
5



Requirements Overview

- **Importance**
- **Definition, Formats & Types**
- **Elicitation**
- **Specification / Documentation**
- **Validation**

Requirements Engineering

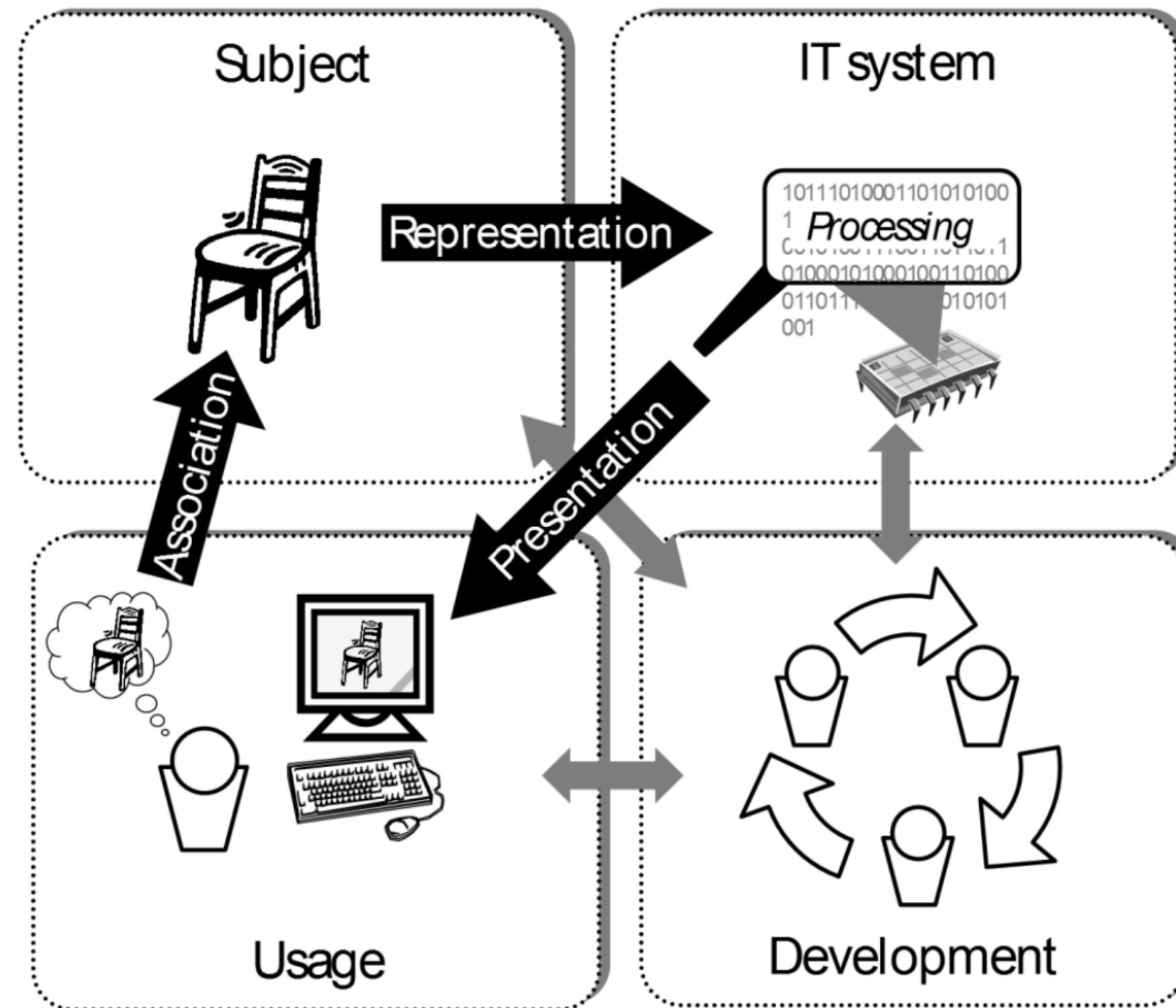


Omar Elgabry, [Requirements Engineering – Introduction](#) (2013)

- **Elicitation:** During requirements elicitation, different techniques are used to **obtain requirements from stakeholders** and other sources and to refine the requirements in greater detail.
- **Specification:** During documentation, the **elicited requirements are described adequately**. Different techniques are used to document the requirements by using natural language or conceptual models
- **Validation:** In order to guarantee that the predefined quality criteria are met, **documented requirements must be validated** and negotiated early on.

Requirements Elicitation

Facets



- **Subject facet**
 - Objects and events relevant for the system
 - E.g., elements the system must store or process information about
- **Usage facet**
 - Aspects concerning the usage by people or other systems
- **IT system facet**
 - Objects and elements of the IT system environment of the system
 - E.g., existing hardware and software components to be used
- **Development facet**
 - Aspects concerning the development process of the system
 - E.g., process guidelines, development tools

Excerpt from the book „Requirements Engineering - Fundamentals, Principles, and Techniques“ by Springer-Verlag, 2010
(c) Prof. Dr. Klaus Pohl

Requirements Elicitation

Sources

- **Subject facet:** Requirement Sources
 - Domain experts, relevant stakeholders (e.g. data privacy officers)
 - Models of the subject domain, textbooks (e.g. laws)
 - Existing systems
- **Usage facet:** Requirement Sources
 - Direct users, indirect users, experts for user interfaces
 - Standards, laws and regulations for user interfaces, domain models in the usage domain
 - Existing systems used in the same or a similar way
- **IT system facet:** Requirement Sources
 - Persons who deal with planning design and operation of the IT system environment, technology consultants, suppliers
 - IT infrastructure documents, reference architecture
 - Analysis of existing system designs
- **Development facet:** Requirements Sources
 - Process stakeholders, like process engineers, process managers and process executors (e.g. requirements engineers, architects)
 - Guidelines for the development process

Requirements Elicitation

SMART

- **S**pecific
- **M**easurable
- **A**chievable / **A**ppropriate
- **R**ealistic / **R**elevant
- **T**imely / **T**ime bound
- Watch:

<https://www.youtube.com/watch?v=hXIUA2SdIAU>

Task 1

Team Work (~20 min)

- Elicit a set of SMART requirements for the P-project:
 - Make sure you cover every type of requirements (8 types, as in slide 14) and every possible facet (4 facets, as in slide 17).
 - For each requirement, explicitly state its type and the facet it corresponds to.
 - You should use the P-project description in Workshop 1 to devise some of the requirements.
 - Interact with other groups of students to extract at least two requirements from stakeholders outside your development team! Indicate in the assignment sheet which are the requirements you identified at this step.
 - Write down the elicited requirements using Rupp's format. Make your requirements traceable by numbering them.

Multiplayer Game

Together with your partner, you have been hired to develop a platform for a client-server multiplayer game. Your customer has not decided on the game yet; at this point they are exploring the idea of a simple game with unambiguous rules.

The client-server architecture requires you to deliver two products: a client and a server. The server controls the game, and the client serves as one player of the game. Of course, the client and the server will need to be able to communicate with each other. Furthermore, your customer is very enthusiastic about the possibility of your client and server to communicate with the client and server of competitor companies. An opportunity for competition would be so much more fun! Last, but not least, you should not only be able to play the game as a human, your client should also be able to play by itself! This means your client needs to have a computer player.

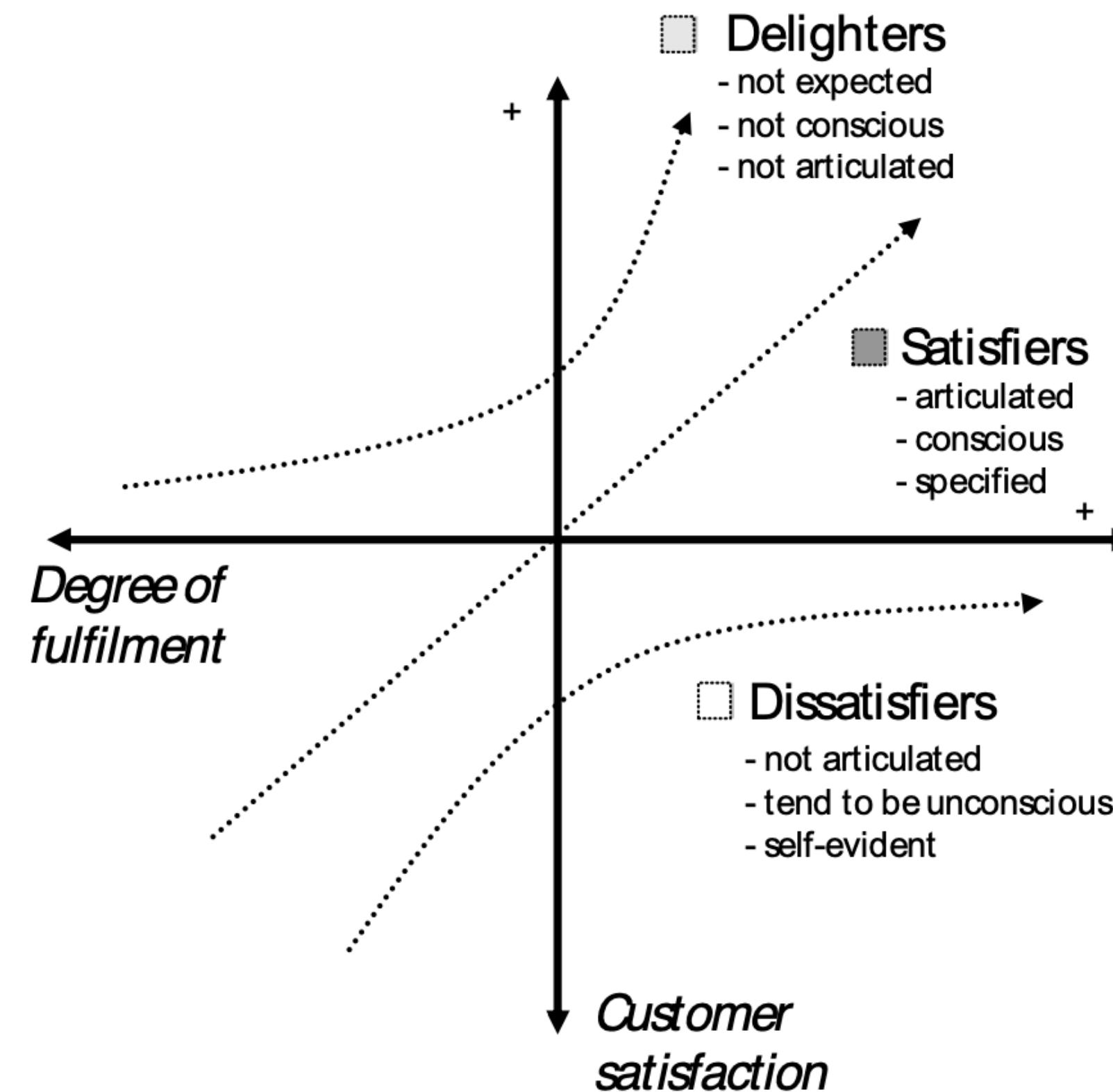
The contract with your customer stipulates a fully functional client-server game implementation, that adheres to best coding standards and good practices. Your customer expects you deliver a preliminary design at the start of the project, together with a good documentation and a complete (design) report at the end. Finally, your customer demands for an extensively tested product.

A detailed description of the client and server functionality can be found in the M2 manual, starting on page 17.

You will have one day (in workshop 2) to meet your customer and understand her preliminary requirements. The actual implementation of the project (possibly addressing sudden changes in your customer's requirements) can take maximum four weeks; your budget runs out after that.

Requirements Prioritisation

Stakeholders Satisfaction



Task 2

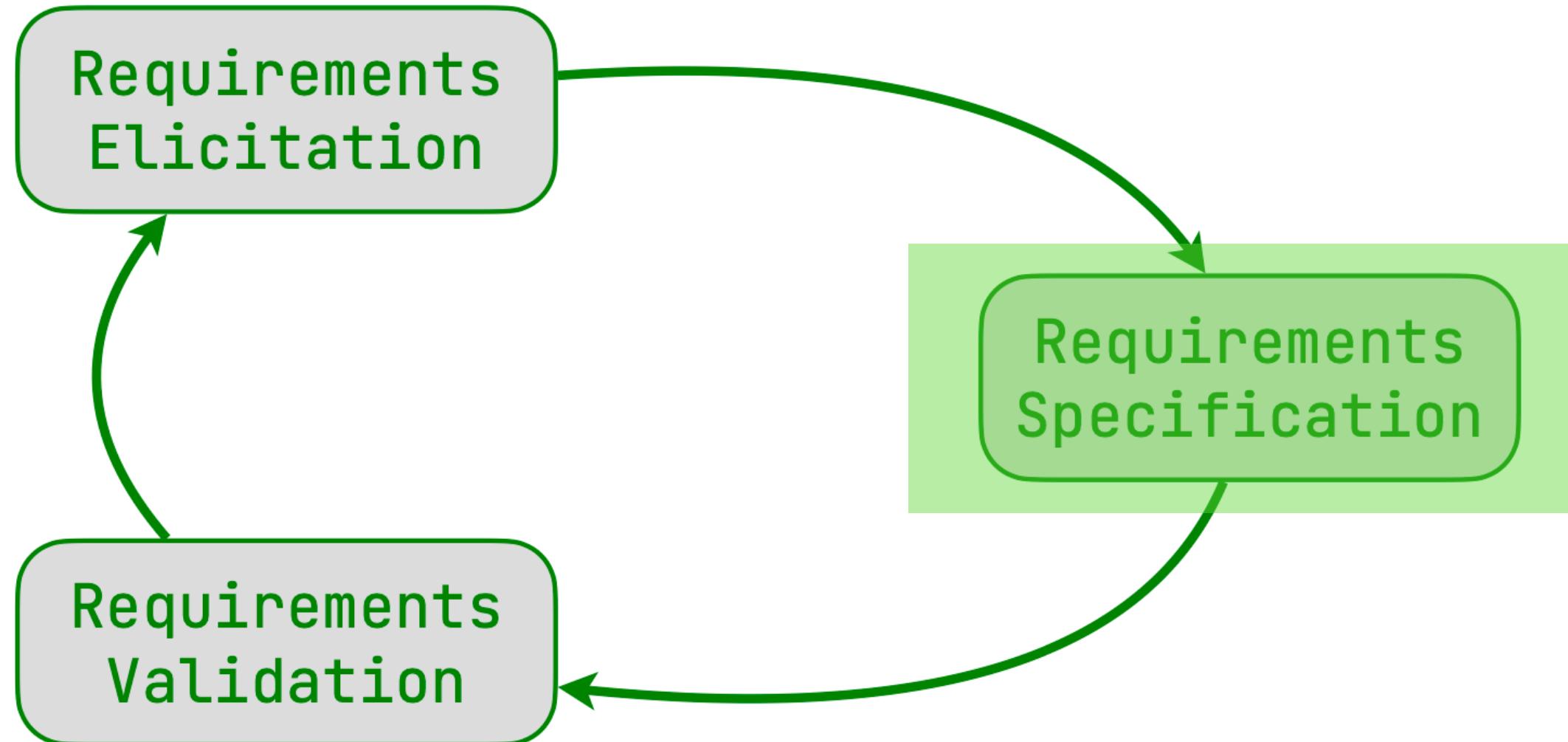
Team Work (~10 min)

- Locate in the stakeholders' satisfaction coordinate system the requirements in Task 1 (use the associated requirements numbers), and briefly motivate your choice.

Requirements Overview

- **Importance**
- **Definition, Formats & Types**
- **Elicitation**
- **Specification / Documentation**
- **Validation**

Requirements Engineering

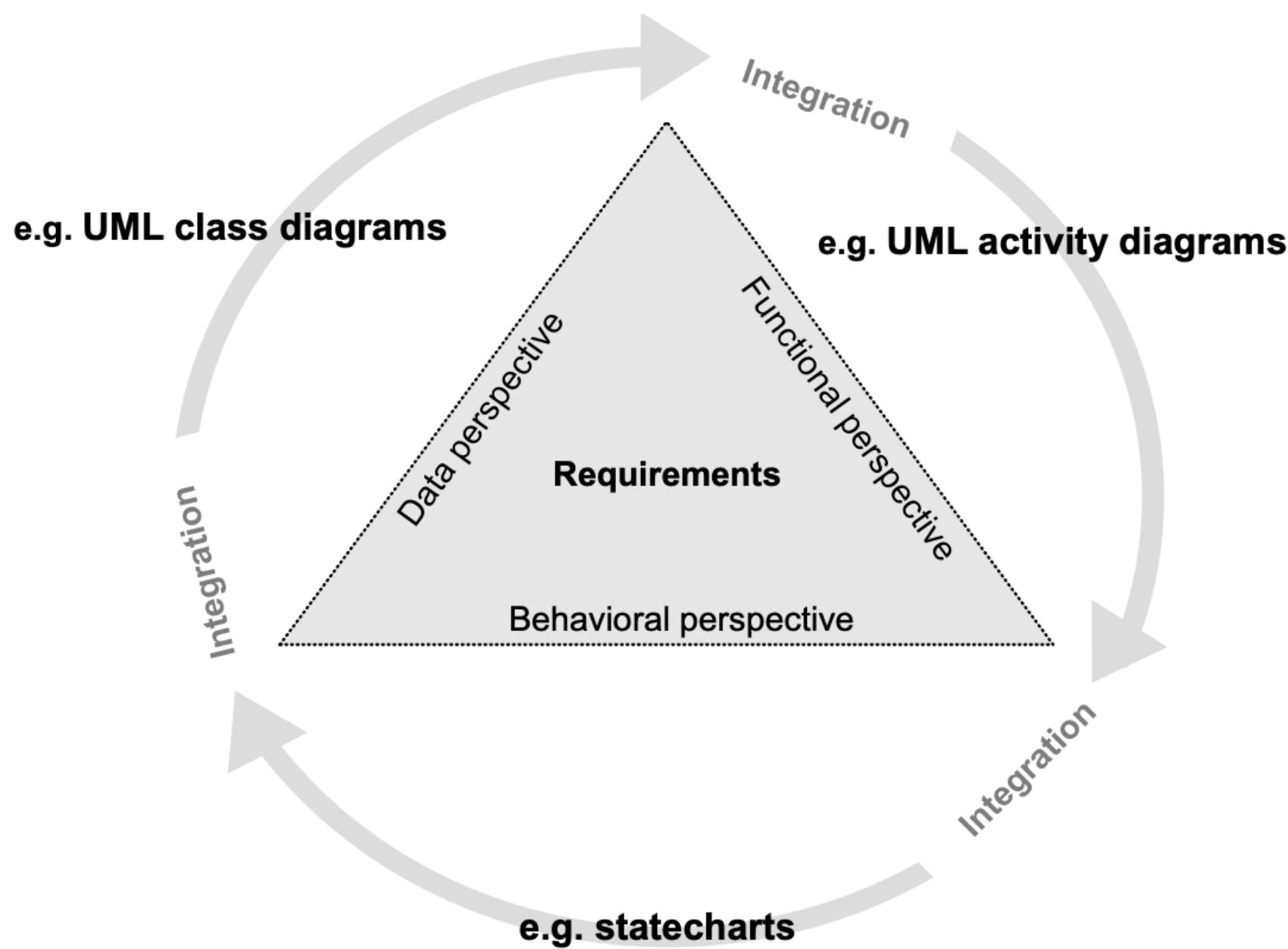


Omar Elgabry, [Requirements Engineering – Introduction](#) (2013)

- **Elicitation:** During requirements elicitation, different techniques are used to **obtain requirements from stakeholders** and other sources and to refine the requirements in greater detail.
- **Specification:** During documentation, the **elicited requirements are described adequately**. Different techniques are used to document the requirements by using natural language or conceptual models
- **Validation:** In order to guarantee that the predefined quality criteria are met, **documented requirements must be validated** and negotiated early on.

Requirements Specification / Documentation

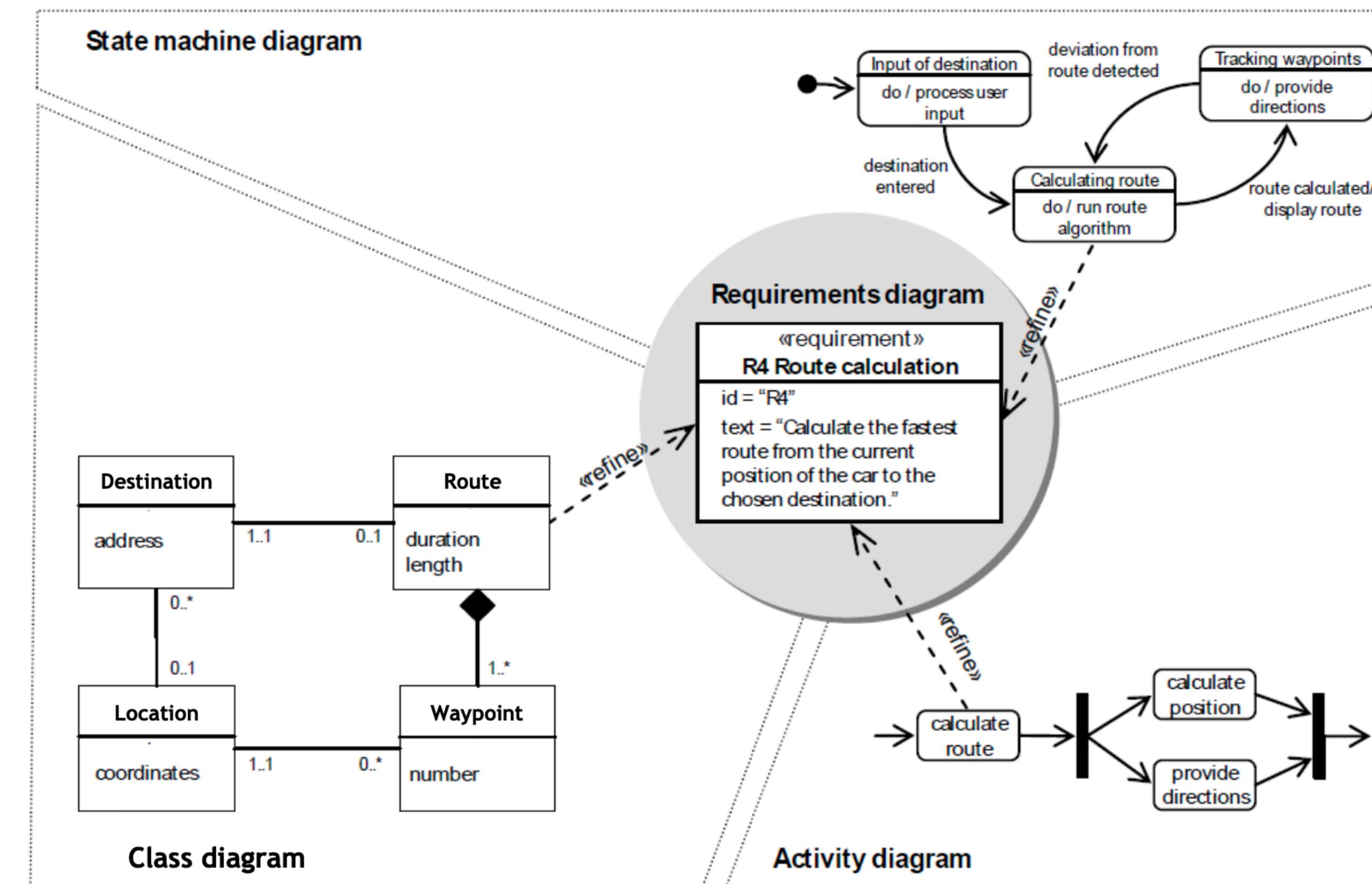
Functional - Behavioural - Data Perspectives



- **Functional perspective:** This perspective documents which information of the system context is being manipulated by the system to be developed and which data is being transmitted to the system context by the system.
- **Behavioural perspective:** The embedding of the system in the system context is documented on the basis of states in this perspective. This is done, for instance, by documenting the reaction of the system to events within the system context, documenting the conditions that trigger a state change, or documenting the effects that the system has on its environment.
- **Data perspective:** In this perspective, the structures of input and output data as well as static-structural aspects of the usage and dependency relationships of the system in the system context are documented.

Requirements Specification / Documentation

Functional - Behavioural - Data Perspectives



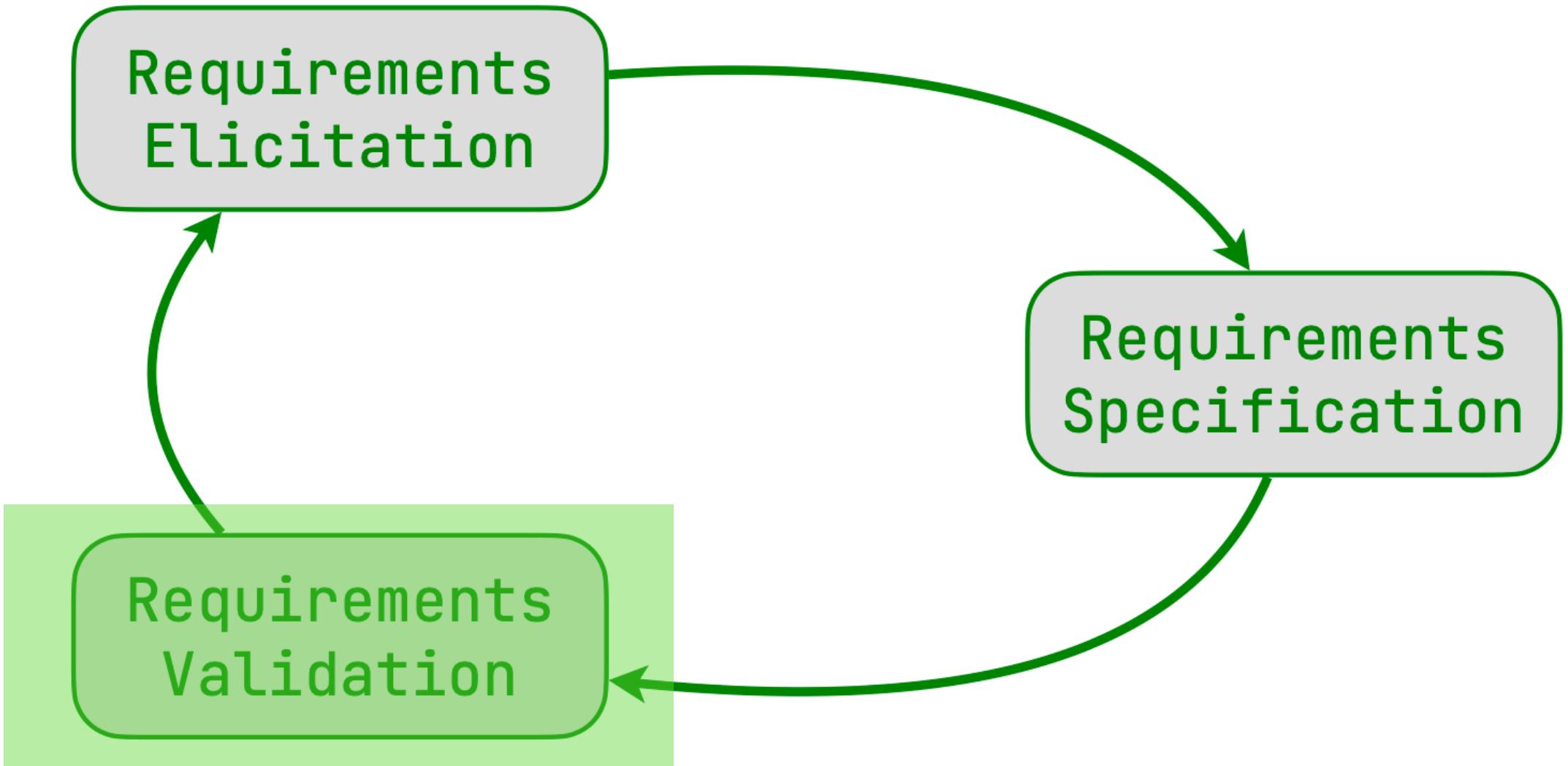
Task 3 (~15 min)

- Document one of the requirements in Task 1 from the functional, behavioural and data perspective. If documenting is not possible for some of the perspectives, then explain why.

Requirements Overview

- **Importance**
- **Definition, Formats & Types**
- **Elicitation**
- **Specification / Documentation**
- **Validation**

Requirements Engineering



Omar Elgabry, [Requirements Engineering – Introduction](#) (2013)

- **Elicitation:** During requirements elicitation, different techniques are used to **obtain requirements from stakeholders** and other sources and to refine the requirements in greater detail.
- **Specification:** During documentation, the **elicited requirements are described adequately**. Different techniques are used to document the requirements by using natural language or conceptual models
- **Validation:** In order to guarantee that the predefined quality criteria are met, **documented requirements must be validated** and negotiated early on.

Requirements Validation

Goals

- Activity that must be performed (to a varying degree of intensity) throughout the entirety of requirements engineering.
- Goals:
 - **Content:** Have all relevant requirements been elicited and documented with the appropriate level of detail?
 - **Documentation:** Are all requirements documented with respect to the predetermined guidelines for documentation and specification?
 - **Agreement:** Do all stakeholders concur with the documented requirements and have all known conflicts been resolved?

Requirements Validation

Principles

- Principle 1: Involvement of the correct stakeholders
- Principle 2: Separating the identification and the correction of errors
- Principle 3: Validation from different views
- Principle 4: Adequate change of documentation type
- Principle 5: Construction of development artefacts
- Principle 6: Repeated validation

Requirements Validation Techniques

- **Walk-through**
- **Roles:**
 - Staffed: reviewer, author, minute-taker, and potentially the moderator
- **Goals:**
 - Identify quality flaws within requirements by means of a shared process
 - Gain a shared understanding of the requirements between all the people involved
- **Preparation:**
 - The requirements to be validated are handed out to all participants and inspected
 - The participants discuss the requirements to be validated step-by-step, under guidance of the moderator/reader
 - Usually, the author of a requirement is the one who introduces the requirement to all other participants
 - The authors have the opportunity to give additional information to the group along with the actual requirement (e.g., alternative requirements, decisions, and rationale for decisions)
 - A minute-taker documents the flaws in quality that have been identified during the session

Your Assignment

- Submit your answers to Tasks 1, 2 and 3 as a pair, in one PDF document, today, before 23:59h! A valid PDF explicitly states the names of all team members!

Good luck!