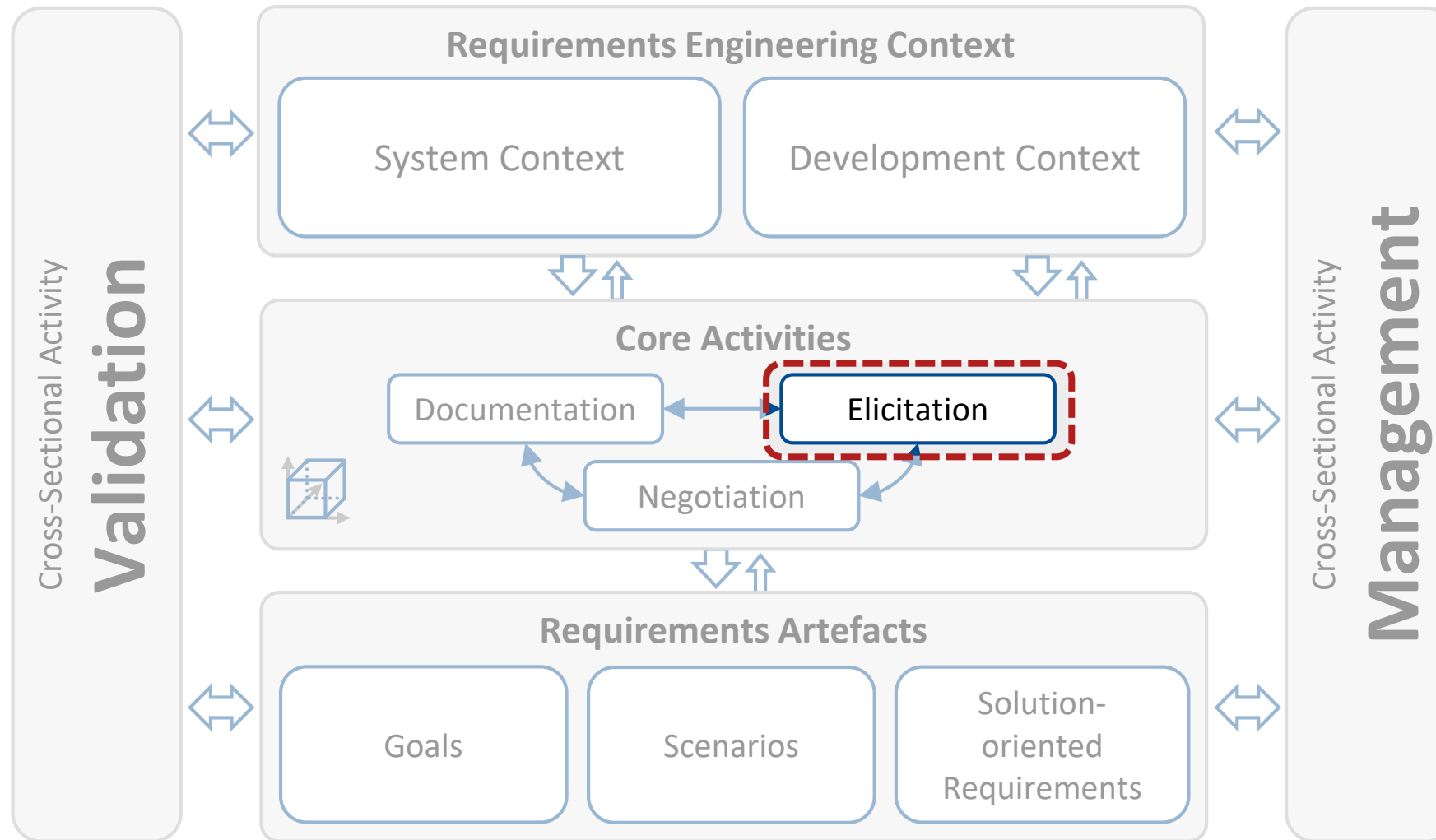


Requirements Engineering & Management

Core Activities – Elicitation I

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Requirements Engineering Framework



Agenda

1. Introduction to Requirements Elicitation
2. Requirements Sources
3. Identification of Requirements Sources
4. Eliciting Existing Requirements vs. Creating Innovative Requirements
5. Use of Goals and Scenarios



1. Introduction to Requirements Elicitation

Goal of Requirements Elicitation

- D** Requirements elicitation is a core requirements engineering activity. The goal of requirements elicitation is threefold:
- (1) **Identify** relevant **requirements sources**.
 - (2) Elicit **existing requirements** from the identified sources.
 - (3) Develop **new and innovative requirements**.

2. Requirements Sources

Importance

- Some requirements sources might be obvious or might have already been identified.
- Nevertheless, many requirement sources are typically unknown (at the beginning of requirements engineering).
- Not identifying or not considering relevant requirement sources typically leads to
 - incomplete requirements (e.g. requirements are overlooked).
 - insufficient agreement or unrecognized conflicts about requirements.
 - Both lead to change requests during system operation (and higher costs)!
- Identifying (all) relevant requirements sources is thus essential!

Three Types of Requirements Sources

Documents



Existing
Systems



Stakeholders

All icons from [1]

D A stakeholder is either a person or an organization with potential interest in the desired system.
Each stakeholder typically has specific goals and requirements for the desired system.
A person can represent the interest of different stakeholders.

Documents (1)

Existing documents contain relevant information about:

- requirements for the desired system
- the requirements engineering context

We differentiate between three types of documents:


1. General binding documents: Defined by standardization bodies, governments, special interest groups, trade organizations or professional organizations, ...




Examples: laws and standards

Documents (2)

2. Organization-specific documents: Defined by an organization

-  Examples: development guidelines, product strategies, HCI guidelines, IT-strategies, security guidelines, business process documentation or market analysis reports

3. Product-/System-specific documents: Describe any kind of development artefact (e.g., requirements, code, architecture, test cases, use cases, experience, errors) of a predecessor system or similar system

-  Examples: Change requests documents, error reports, user manuals, system architecture documents, requirements specifications, maintenance documents, test documentation and marketing material

Existing Systems (1)

We differentiate between three types of systems:

1. Predecessor systems:

- Predecessor (legacy) systems typically have a similar purpose. They are still in use within an organization (or have been used) and are (partially) replaced by the new system.

2. Systems of competitors:

- Analysing systems competing with the system to be developed is essential to avoid overlooking important requirements, and to identify some differentiating features of the new system.

3. Systems from other domains:

- Systems developed for another domain might offer properties, use innovative technology, offer unique features and the like, which might be relevant for the desired system – i.e. they can be a valuable sources for innovative requirements.

Existing Systems (2)

Predecessor and competitor systems provide an excellent source for uncovering existing requirements:

- Requirements realized by a predecessor system might still be relevant for the new system.
- Existing systems should be analysed
 - to elicit their properties
 - to identify required enhancements
 - to identify known deficiencies, which should be avoided in the future.
 - to identify previous errors already fixed, and thus to avoid making the same errors in the development of the desired system.
- Stakeholders using or involved in the development or operation of existing systems are potential valuable requirements sources.

3. Identification of Requirements Sources

Two-Step Procedure

Requirements Engineering Context

Step 1

Identification of potentially relevant requirements sources



Step 2

Selection of requirements sources to be considered



All icons from [1]

Step 1 – Potentially Relevant Requirements Sources

Goal: Identify a large set of potential relevant requirements sources.

Activities:

- 1.1 Use already known requirements sources and/or suitable checklists to identify additional, potential requirement sources.
- 1.2 Record newly identified, potential relevant requirement sources.
- 1.3 For each newly identified requirement source, perform activity 1.1 again.

Iterate until the set of identified sources becomes (more or less) stable.

Step 1

Step 1 – Hints

- Consider all perspectives on the requirements engineering context for identifying potential requirement sources.
- Consider all three types of requirement sources (stakeholders, documents and existing systems).
- Analyse available context information:
 - Identify relevant context objects potentially having requirements for the system to be developed.
 - Identify further requirements sources potentially having knowledge about those context objects.
- Use domain and system-specific checklists to support the identification of context objects and requirement sources.

Step 1

Step 1 – Checklist for Requirements Sources

E Checklist for a car safety system

Stakeholders	Documents	Systems
<ul style="list-style-type: none">• car driver• professional driver• accident assessor• physicist• car technician• automotive engineer• maintenance staff• sensor expert• engineer• control unit display• safety experts• regulatory agencies• lawyers	<ul style="list-style-type: none">• car manual• user interface descriptions• documents of the engine control• specification of analogue systems• AUTOSAR standard	<ul style="list-style-type: none">• previous safety system• safety systems of competitors• sensors systems• HCI systems• systems interacting with safety system• flight safety systems• train safety systems• metro safety systems

Step 1

Step 2 – Selecting Requirements Sources

Goal: Select the most relevant requirements sources

Execute the so called **100 Dollar Test** in a group meeting:

- In a 100-dollar test **each stakeholders metaphorically spends 100 dollars** on the items (requirements sources) to be assessed.
- Each stakeholder individually **distributes the money** to the **requirements sources** she/he thinks are **relevant**.
- The **amount of money** a specific requirements source receives **defines the relative weighting** of this source.
- The group **selects** the **highest weighted requirements sources to be considered first**.

Remaining sources might be considered later.

Step 2

Step 2 – Hints for Selecting Most Relevant Sources

- The cut-off point for considering identified requirement sources depends on the project setting, e.g. on the time available, the budget available and the availability of the requirements sources.
- Check if selected sources cover all relevant parts of the RE context.
- You might use the 100-dollar test to select the requirements source separately for each perspective on the requirements engineering context.
- When selecting the stakeholders for the assessment, ensure an adequate representation of the RE context.

Step 2

4. Eliciting Existing Requirements vs. Creating Innovative Requirements

Two Important Kinds of Requirements

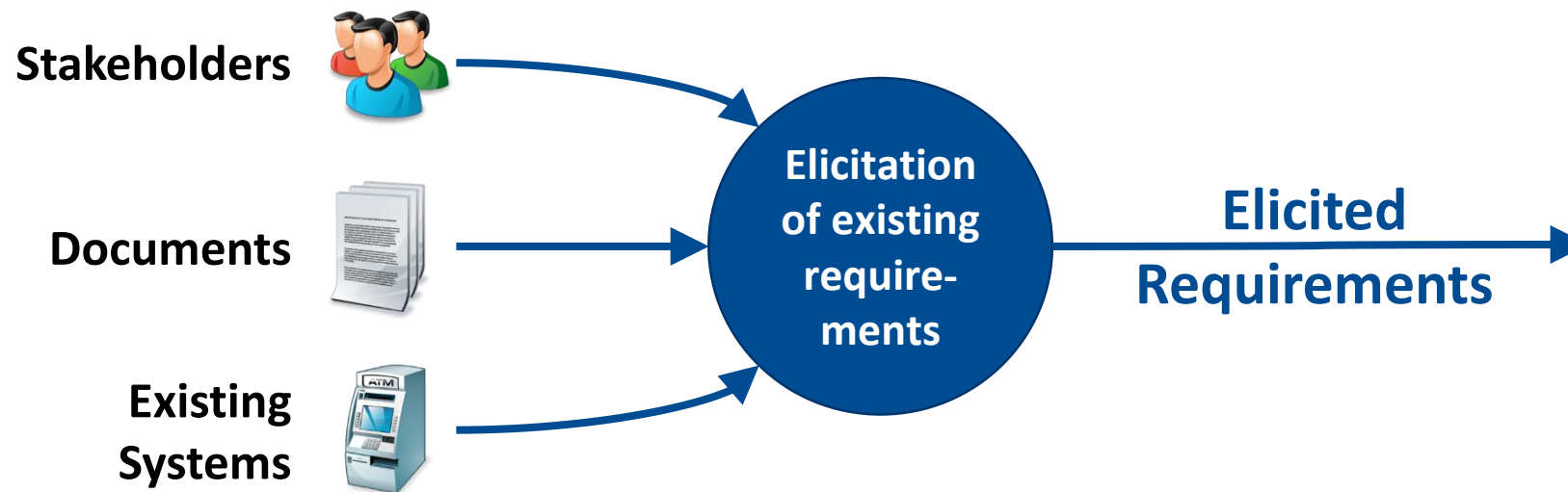
Besides identifying requirements sources, the goal of requirements elicitation is twofold:

- (1) Elicit existing requirements from relevant requirements sources
- (2) Create and develop innovative (new) requirements.

Both kinds are equally important
for system success!

Eliciting Existing Requirements

Requirements engineers can elicit requirements from the three types of requirements sources:



All icons from [1]

Elicitation Existing Requirements from Stakeholders

E Stakeholders express their requirements guided by a questionnaire:

Question 12: How can the safety of a car during winter be improved?

Answer: The car should display a warning when the outside temperature is below 3°C to indicate a high probability of icy roads.

Question 13: In your opinion, how can the risk of rear-end collisions be decreased?

Answer: The safety system should warn the driver if the distance to the vehicle in front gets critically low – and even might initiate an emergency braking if required.

Elicitation Existing Requirements from Documents (1)



Regulation 2010/156/EC

[...] All electronic systems in a vehicle that directly or indirectly influence the occupants' safety or the safety of other traffic participants must be designed in such a way that failure of the electronic system has no negative effects on safety. [...]

The law (regulation 2010/156/EC) must be considered for the safety system of the car.

Based on the law the following goals might be defined:

G1: The driver shall be able to override the system actions at any time.

G2: The system must not disturb any other system even in the case of a system failure.

Elicitation Existing Requirements from Documents (2)



Error FA-2003-1-10-F3: The motor heat emission heats the sensor responsible for measuring the outside temperature. Therefore, the displayed outside temperature is incorrect (too high), especially when driving at low speed.

Error Correction: The sensor was put in a new position which protects the temperature sensor from the engines heat emission (see Correction Report K-B-2003-4-12-k5).

Based on the error report, the stakeholder might derive the following requirement:

Req-15: Protect the temperature sensor from the heat emission of the engine.

Elicitation Existing Requirements from Existing Systems (1)

E To elicited requirements from existing systems, typically the following two steps are executed:

- (1) The incarnation of the existing system is elicited and defined resulting in an incarnation model of the predecessor system.
- (2) Based on the modelled incarnation of the system an essential model is created by abstracting from the incarnation.

Detailed methodology and guidelines
available: Essential Systems Analysis

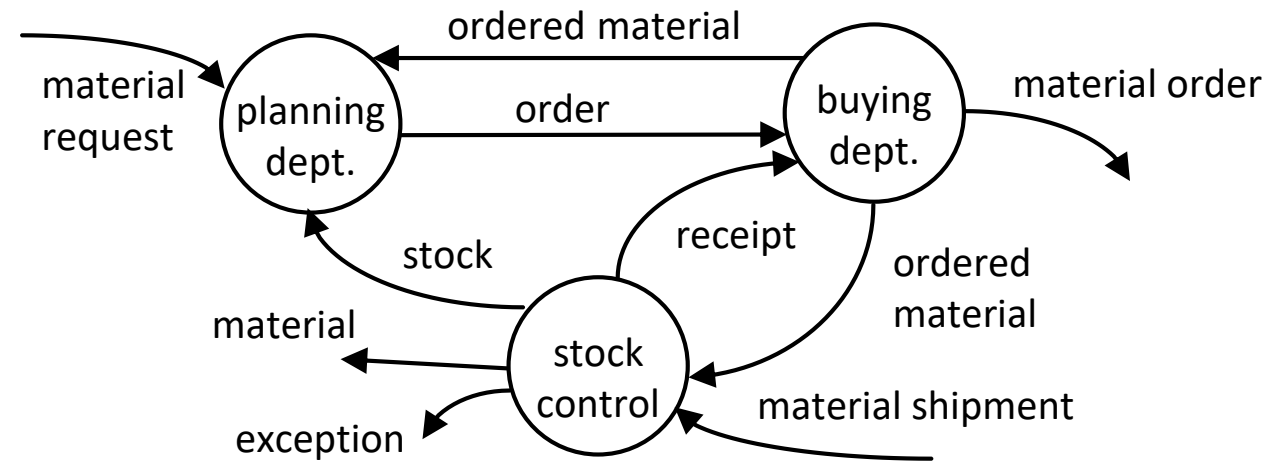
Elicitation Existing Requirements from Existing Systems (2)

Excerpt

E

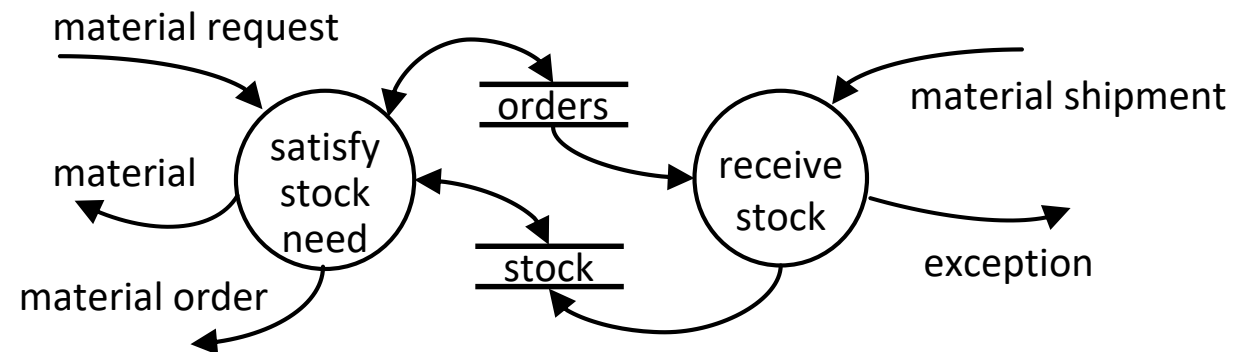
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Incarnation
of the
predecessor
ERP system



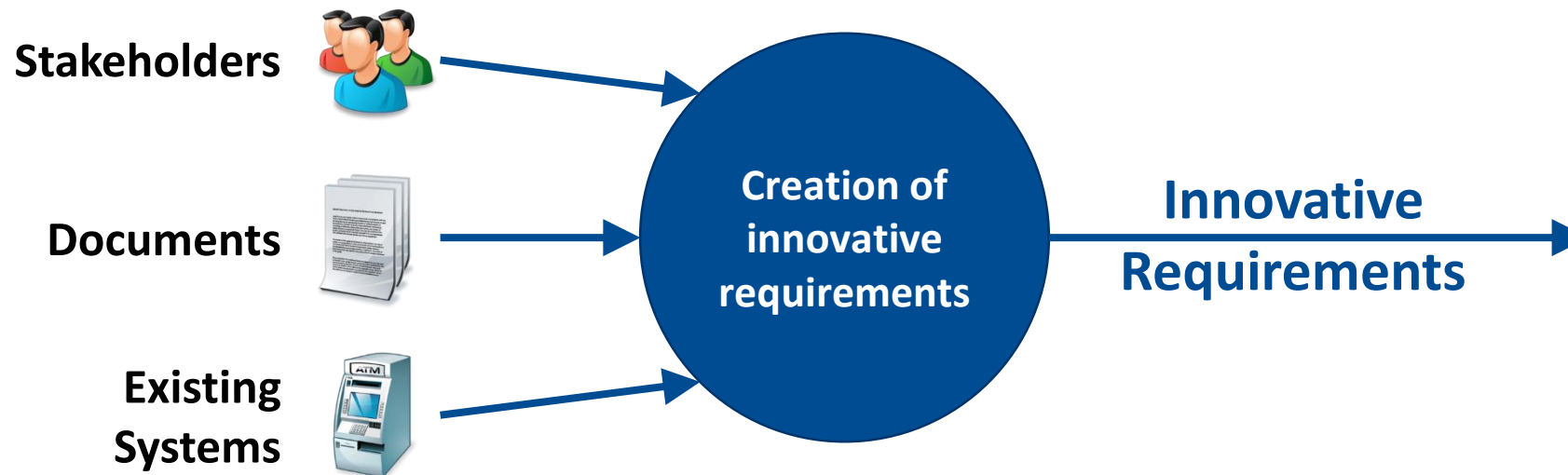
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Essence
of the
predecessor
ERP system



Creation of Innovative Requirements (1)

- Innovative (new) requirements **cannot** be elicited from requirements sources in the same way as existing requirements!
- Innovative requirements have to be created in **creative processes** using creativity techniques such as brainstorming.



Creation of Innovative Requirements (2)

Creativity is

“the ability to produce work that is both novel (i.e. original unexpected) and appropriate (i.e. useful, adapted to a task constraints)” [Sternber and Lubart 1999]

Three Categories of Creativity:

- Exploratory creativity
 - Search space of partial and complete possibilities.
- Combinational creativity
 - Make unfamiliar connections between familiar possibilities in the search space.
- Transformational creativity
 - Challenge the constraints on the search space.
 - Enlarge space of possible ideas to explore.

Creation of Innovative Requirements with Stakeholders

- E** • During brainstorming for “What to display in the next generation of head up display for a car”, the following ideas have been collected:
 - Traffic signs
 - Circumnavigate traffic jam
 - Navigation instructions
 - Proactive traffic light monitoring
 - Current speed
 - Slippery road warning
- The idea to monitor the traffic light status based on a proactive traffic light monitoring is innovative and considered in the next system release.

Creation of Innovative Requirements using Existing Documentation

- E** The overall vision is to build a smart refrigerator which knows the products stored and offers innovative functions based on this knowledge.
- To identify some possible innovative requirements for the fridge, the requirements engineer analyses the specification of a food trader's ERP system.
 - He identifies the functionality to monitor the “best before” dates as potential innovative requirements for the fridge.
 - Similar as the ERP system, the fridge should control the “best before” dates and provide the information to the user – to ensure food is used before it spoils.

Creation of Innovative Requirements using Existing Systems

E To identify some potentially innovative requirements for a smart refrigerator the stakeholder decide to participate in a demonstration of smart televisions.

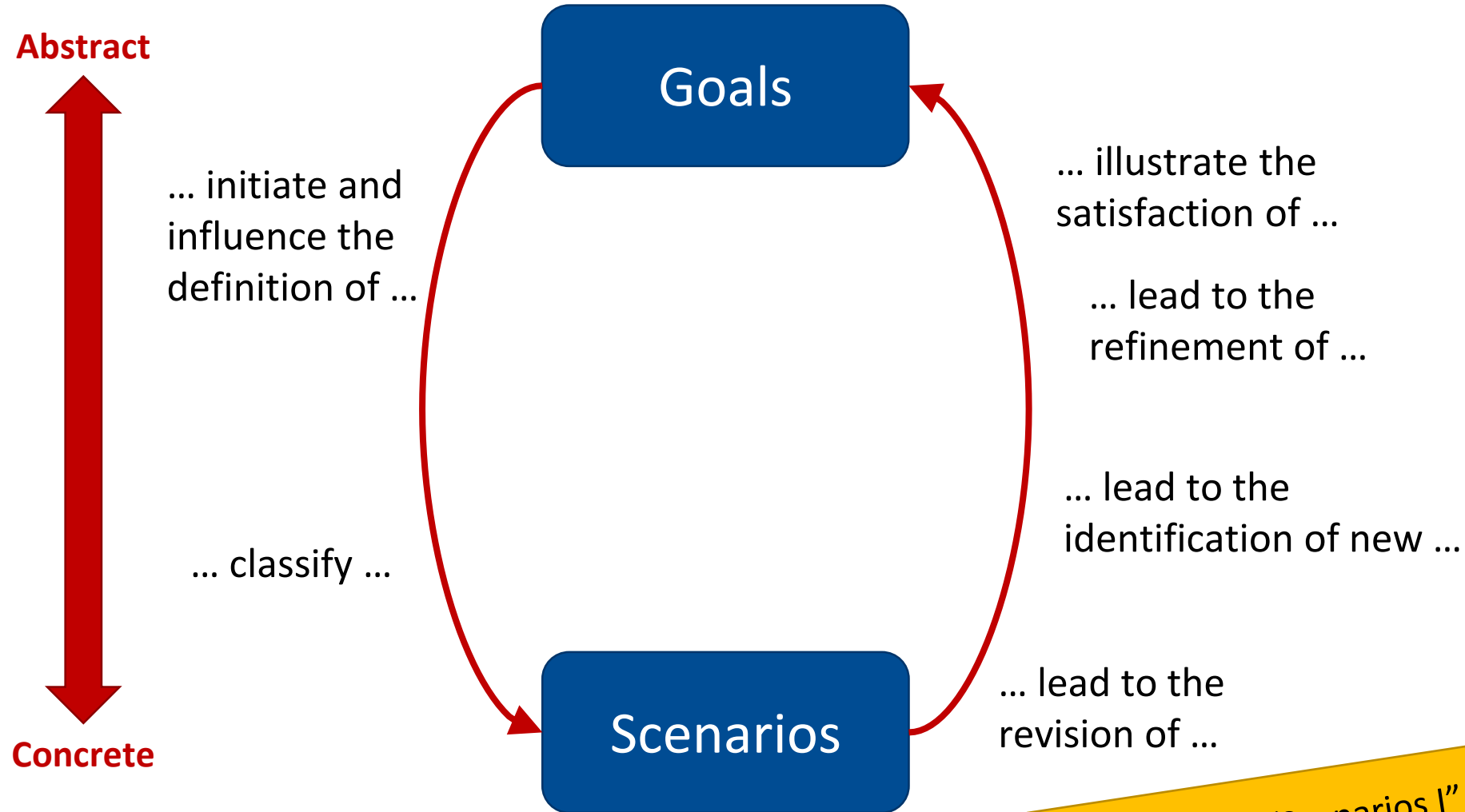
During the demonstration and by talking to the television experts the stakeholder identify features realized in the smart television system potentially useful and innovative for the smart refrigerator. The refrigerator shall interact with the smart phones of the consumers in order to suggest recipes corresponding to their diet and the available food. Furthermore, the refrigerator shall create a shopping list according to the available products and send them fully autonomous to the smart phones.

5. Use of Goals and Scenarios

Significant Improvement of Elicitation

- Using goals and scenarios can significantly improve the elicitation of existing requirements as well as the development of new/innovative requirements.
 1. Elicit a set of goals first.
 2. Define scenarios for these goals to better understand the goals by documenting concrete examples of goal satisfaction and dissatisfaction.
 3. Check scenarios for new or refined goals and solution-oriented requirements.
 - When eliciting existing requirements, the scenarios might be already concrete enough and suited to defined solution-oriented requirements.

Interplay between Goals and Scenarios



See Lecture "Scenarios I" for details!

Summary

- The goal of requirements elicitation is to identify relevant requirements sources, elicit existing requirements from the identified sources and develop innovative (new) requirements.
- There are three types of requirement sources: documents, existing systems, and stakeholders.
- Two-step process of identifying requirement sources:
 1. Identification of potentially relevant requirements sources;
 2. Selection of the sources to be considered.
- Missing requirement sources leads to incomplete specifications and low quality systems.
- The creation of innovative requirements differs from the elicitation of existing requirements.
- Use of goal and scenarios can significantly improve the elicitation of existing as well as the creation of innovative requirements.

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Image References

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Legend

 Definition

 Example

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Vielen Dank für Ihre Aufmerksamkeit