

SWE 215: Software Requirements Engineering

Requirements Negotiation

1

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Objectives

- Conflicts in Requirements Engineering
- Requirements negotiation
- Conflicts Resolution
- Negotiation technique: Win-Win

Goal of Requirements Negotiation

- Rarely are the stakeholders' needs and wishes **free of conflicts**.
- **Example:** the maintenance staff of an email system might demand that the **incoming and outgoing messages** are **recorded in a log file** in order to **support fault analysis** and, hence, system **maintenance**. In contrast, the users of the email system might demand **high confidentiality** of the exchanged messages and hence **disapprove the logging of messages**.
- The **requirements engineers** must hence **check whether all stakeholders agree with the documented requirements**.
- **Negotiation** in requirements engineering aims to **achieve agreement among all stakeholders about the requirements** and hence has to deal with **conflicts about requirements**.

Conflicts (in Requirements Engineering)

- **Definition:** A conflict in requirements engineering exists, if the needs and wishes of different stakeholders (or groups of stakeholders) regarding the system **contradict each other**, or if some **needs** and wishes **cannot be taken into account**.

Simple examples of conflicts about requirements:

- **Ex1:** A group of stakeholders demands the use of **radar sensors for distance measurement**. Another group of stakeholders asks, instead, for **ultrasound sensors**.
- **Ex2:** A stakeholder demands that **safety-relevant information** for the **driver** be displayed on **a head-up display**. Other stakeholders think this would **distract the driver** and hence reject this requirement.

Conflicts (in Requirements Engineering)

- Unresolved conflicts **compromise the acceptance** of the system by the stakeholders. As a result some stakeholders may **no longer support the development** of the system, or **the conflicts may even cause a failure of the development project**.
- Conflicts should not be regarded negatively in requirements engineering. **They can serve as a source of new ideas and the development of innovative requirements**.
- **Requirements negotiation** is one **core activity** of requirements engineering. The goal of requirements negotiation is to **achieve progress in the agreement dimension by identifying, analyzing, and resolving the conflicts**.

Requirements Negotiation (Conflict Management)

The goal of the negotiation activity is to:

1. Identify conflicts
2. Analyze the cause of each conflict
3. Resolve the conflicts by means of appropriate strategies
4. Document the conflict resolution and the rationale

Sub-activity 1: Identifying Conflicts

- Examples: **Identifying conflicts in the different requirements engineering activities:**
- During the elicitation of requirements in a workshop, two stakeholders state requirements that contradict each other and hence cannot be realized together.
- When documenting requirements that have been elicited during interviews, the stakeholders detect a conflict between two requirements that originate from different interviews.
- In requirements management, a conflict occurs during the prioritization of requirements. Two stakeholders have different opinions regarding the priority of a requirement.
- During requirements validation, a conflict occurs while the stakeholders check the specified requirements for correctness. One stakeholder considers a requirement to be correct, while another stakeholder objects to this requirement.
- During conflict resolution, a new conflict is identified.

Sub-activity 1: Identifying Conflicts

8

- Conflicts do not always become obvious: **A stakeholder may not express his disapproval of a requirement immediately.**
- Requirements engineers should pay special attention during all requirements engineering activities to detect and document (possibly latent) conflicts.
- Requirements engineers need to actively search for conflicts that have remained undetected during the other requirements engineering activities.

Sub-activity 2: Analyzing Conflicts

9

Determine the type of conflict:

- **Data conflict:** A data conflict is caused by a lack of information, by misinformation, or by different interpretations of an issue.
- **Interest conflict:** An interest conflict is caused by subjectively or objectively different interests or goals of stakeholders.
- **Value Conflict:** A value conflict is caused by different criteria which stakeholders apply when evaluating an issue (e.g. cultural differences).
- **Relationship conflict:** A relationship conflict is caused by negative interpersonal behavior among stakeholders (e.g. disrespect, insulting).
- **Structural conflict:** A structural conflict is caused by an unequal balance of power between stakeholders.

Data Conflict

10

- A **data conflict** about a requirement exists if stakeholders are **wrongly or incompletely informed** about the requirement or if stakeholders **interpret the meaning of the requirement differently**.
- **Example**: Requirement for a car entertainment system
 - **R4**: The DVD player shall be able to handle re-writeable CDs (CD-RW) and DVDs (DVD-RW).
 - A stakeholder disagrees with the requirement. In his opinion it does not make sense for a DVD player in the car to be able to write data onto CDs or DVDs.
- The stakeholder **interprets the requirement concerning the handling of rewritable CDs and DVDs such that the DVD player shall be able to write data on these media**. **To resolve the conflict, the stakeholders need to clarify that writing on these media is not part of the requirements for the DVD player.**

Interest Conflict

11

- An **interest** conflict about the requirements for the system to be developed exists if **the stakeholders' interests or goals** with regard to the system **contradict each other**.
- Example:
 - A stakeholder wants the car entertainment system to be equipped with MP3 functionality, an optional hard disk, and a USB interface in order to attract technology-oriented customers.
 - Another stakeholder wants the system to be equipped merely with standard CD player functionality and a radio. His goal is to reduce the costs in order to attract price-conscious customers.

Value Conflict

12

- A **value** conflict exists if different stakeholders **evaluate** a requirement **differently** or each stakeholder considers the **importance** of the requirement **differently**.
- The evaluation of facts is affected by a number of factors such as experience, profession, education, training, personal ideals, culture, and religion.
- **Example:**
 - A stakeholder demands that the DVD player of the car entertainment system shall support the OGG* format in addition to the MP3 format.
 - Another stakeholder objects to this requirement since he thinks that supporting the OGG* format is unimportant.

* The OGG format is a file compression format for audio data

Heuristics for Conflict Analysis

13

1. Checking for a data conflict:

- Let the stakeholders explain the conflicting requirements,
- Does one of the explanations deviate from the actual requirement? If so, a data conflict exists.

2. Asking for the stakeholders' interests:

- Ask the stakeholders for their goals with regard to the conflicting requirements.
- Check the resulting goals for contradictions. If there is a contradiction, an interest conflict exists.

3. Clarifying the stakeholders' evaluation backgrounds:

- Ask the stakeholder why he/she evaluates the conflicting requirements in the way he/she does.
- Check the evaluation backgrounds of the different stakeholders for differences that may cause the detected conflict. If there is such a difference, a value conflict exists.

Sub-activity 3: Resolving Conflicts

14

To resolve a conflict, one of the following **three basic strategies** can be applied:

- **Negotiation:** The conflicting parties agree on a solution by means of negotiation.
- **Creative solution:** The original viewpoints of the conflicting parties are discarded and a new, creative solution is developed that harmonizes the viewpoints of all conflicting parties.
- **Decision:** A higher authority makes a decision in favor of one conflicting party.

Sub-activity 3: Resolving Conflicts

15

Example of conflict about requirements:

- The car safety system shall be equipped with radar technology in order to be able to monitor the traffic ahead of the car. There is a conflict among two groups of stakeholders regarding the distance up to which the radar sensor shall monitor the traffic in front of the car. One group demands 1,000 m; the other one demands 500 m.

Conflict Resolution through Negotiation

- Exchanging information, arguments, and opinions.
- The conflict is resolved if **either the viewpoint of one of the conflicting parties is accepted by the other parties or the parties find a solution that ranges between the different viewpoints and is accepted by all parties as a compromise.**
- **Advantage**: the viewpoints of all conflicting parties are considered and a win-win situation is created.
- **Disadvantage**: Can be a very time-consuming process. In addition, the compromise may not be the best solution from an objective viewpoint.

Example:

- The stakeholders resolve the conflict using the negotiation strategy by agreeing on a detection range of 750 m.

Conflict Resolution through a Creative Solution

- ***Discarding the old solutions:*** The conflicting parties **abandon** their **viewpoints** in favor of a **newly developed viewpoint** that is acceptable to all conflicting parties.
- Creativity techniques such as brainstorming are used.
- **Advantage:** All conflicting parties come off as winners, since a solution is found that is acceptable to all parties.
- **Disadvantage:** Can be time consuming and impact on other requirements that are influenced by the solution.

Example: Creative, novel solution

- The stakeholders resolve the conflict by proposing a novel solution. By equipping the car with **a laser sensor instead of a radar sensor** the detection range is increased to 1,000 m **without causing additional costs.**

Conflict Resolution through Decision

18

- Reaching an agreement among the stakeholders may be too **costly in terms of required time and effort**. In addition, there are also conflicts for which **agreement can never be reached**.
- The conflict is resolved by **a decision-maker**, i.e. a person or group who **has the required decision-making authority**, e.g. a project leader or a representative of the client.
- **Advantage**: Quick resolution without consuming too many resources
- **Disadvantage**: A conflict can only be resolved by a higher authority (if exists). when a decision is made in favor of one viewpoint, the other viewpoint is ignored. This can negatively influence the motivation of the ignored, conflicting party.
- Another possibility to bring about a decision is **to vote on the viewpoints** of all involved stakeholders.
- **Example**: The client is involved as a higher authority. The client decides that the detection range shall be 500 m.

Resolving Data Conflicts

19

- A data conflict is based on the **misinformation** of stakeholders or on misinterpretation.
- Should be resolved through **negotiation**. During negotiation, information exchange between the involved, conflicting parties takes place. **The conflicting parties may be provided with additional, relevant information.**
- The use of **creative solution** is **not suited** for **data conflicts** because it **would be based on incomplete or incorrect information.**
- **Decision-making** in favor of one conflicting party **is not suited**. Decision could be **made in favor of the wrong viewpoint due to missing information or a misunderstanding.**

Resolving Interest Conflicts

20

- Based on the common interests, the parties should first try to resolve the conflict through **negotiation**.
- If an agreement is reached, **each conflicting party should benefit from the resolution of the conflict.**
- **A decision-maker is recommended for:**
 - Conflicts that cannot be resolved by means of negotiation
 - The conflicting parties **are not willing to find a compromise at all.**
- **The creative solution strategy is only conditionally suited** because the main problem is the difference of goals or interests, which have to be **harmonized or substituted by new goals interests before a creative solution can be found that is accepted to all parties.**

Resolving Value Conflicts

21

- **Negotiation** is only **conditionally suitable** as a strategy for resolving value conflicts, since **values are often deeply rooted in the stakeholders' personality**. These values **cannot be easily changed or abandoned during a negotiation** about the conflict.
- Requirements engineers should **strive for a creative solution**. One example of a creative solution for a value conflict is to realize different variants of the system so that each stakeholder finds his or her values respected by some system variant.
- However, it should only be considered if the value conflict is of **significant importance** for the system and **there are sufficient resources** for implementing the solution.
- If the values of the conflicting parties are irreconcilable, **the conflict should be resolved through a decision**.

Evaluation of the Conflict Resolution Strategies

	Negotiation	Creative Solution	Decision
Data Conflict	Suitable	Not Suitable	Not Suitable
Interest Conflict	Suitable	Conditionally Suitable	Suitable
Value Conflict	Conditionally Suitable	Suitable	Conditionally Suitable

Sub-activity 4: Documenting Conflicts Resolutions

- Documentation of **achieved conflict resolutions** together with the **viewpoints** of the conflicting parties and the **pros** and **cons** of each viewpoint is recommended.
- If conflict resolutions are **not documented**, the achieved solutions **may be forgotten** and conflicts that have already been resolved **may recur**.
 - For instance, some stakeholder might ask for a requirement that is in conflict with another requirement and has therefore been **discarded earlier during conflict resolution**.

Negotiation Techniques: Win-Win Approach

- The goal of the Win-Win [Boehm and Ross 1989] approach is to make all stakeholders become winners.
- The Win-Win approach differentiates three basic situations:
 - Win-Lose,
 - Lose-Lose,
 - Win-Win.

Win-Lose Situation

- **Win-lose:** If some stakeholders achieve their goals in a conflict **at the expense of other stakeholders**. Some stakeholders are the **winners**, other stakeholders are the **losers** of the conflict.

Example:

- For the car safety system, stakeholder A proposes the function "monitoring the temperature of the brake discs". To realize this function, the stakeholders must abandon other functions of the car safety system, as the available resources are limited. **Stakeholder A is the winner**, since his function is realized. Other stakeholders whose functions are not realized as a consequence of realizing this function are the **losers**.

Lose-Lose Situation

- **Lose-Lose:** If **no conflicting party achieves its goals** in a conflict, this situation is referred to as a lose-lose situation. In this case, all involved parties are losers.

Example:

- Stakeholder A tries to put through some function for the product to be developed against the resistance of another stakeholder B. In turn, stakeholder A rejects a function that stakeholder B wants to be implemented in the system. In the end, neither of the two functions is implemented, since the stakeholders are not able to resolve the conflict in time. Both stakeholders are losers.

Win-Win Situation

- **Win-Win:** If all conflicting parties achieve their goals completely or partially in a conflict, the situation is referred to as a win-win situation, since all parties are winners. **During conflict resolution, the stakeholders should always strive for a win-win situation.**

Example:

- Two stakeholders ask for system functions that exclude each other. During the negotiation about this conflict, the parties agree that two versions of the system shall be realized, each implementing one of the two sets of mutually exclusive functions. Both stakeholders are winners regarding this conflict.

Achieving a Win-Win Situation

- **Understand how stakeholders want to win:** the requirements engineers must know **what each stakeholder considers as a benefit for himself.**
- **Raise adequate expectations:** Unrealistic expectations for the system to be developed hinder achievement of a win-win situation.
 - For instance, a stakeholder who does not have a software engineering background may misjudge the difficulties related to realizing the functionality that he asks for. Likewise, developers may misjudge the difficulties that stakeholders are confronted with during their everyday work with the system.

Win-Win Approach and Conflict Resolution Strategies

29

- Resolution of a conflict by creating a win-win situation provides **confidence among the stakeholders** and also **increases their willingness to make a compromise**.
- If a conflict is resolved through negotiation or through a creative solution, all stakeholders should benefit from the resolution of the conflict.
- Resolving a conflict through a decision generally leads to a win-lose situation since the decision is typically made in favor of a single viewpoint and hence privileges one party.