Verification and Validation

- **Validation:**
  - “Are we building the right system?”
  - Does our problem statement accurately capture the real problem?
  - Did we account for the needs of all the stakeholders?

- **Verification:**
  - “Are we building the system right?”
  - Does our design meet the spec?
  - Does our implementation meet the spec?
  - Does the delivered system do what we said it would do?
  - Are our requirements models consistent with one another?
Validation Goal

Check whether the **outputs** of activities fulfill defined quality criteria

Check whether the inputs of activities fulfill defined quality criteria

Check whether the **execution of activities** adheres to process definitions and activity guidelines

Content

Agreement

Documentation
Validating Created Requirements Artefacts

Validation with regard to

- **Content dimension**
  - Check whether all relevant requirements are known and understood to the required level of detail

- **Documentation dimension**
  - Check whether the requirements are documented according to the defined documentation and specification rules

- **Agreement dimension**
  - Check whether the stakeholders have reached agreement about the documented requirements
  - Check all known conflicts; if they have been resolved
  - Check whether there are conflicts that have not yet been identified
Validation of
Content

Quality of the information contained in the requirements artefacts

• **Completeness of artefact/document**
  – Does the requirement artefact / document **contain all relevant** information and requirements

• **Completeness of requirements**
  – Does each requirement **contain all the information**
    • that is needed according to the relevant reference model (e.g., template)
    • that is needed to perform subsequent development activities?

• **Consistency**
  – Can the **system meet all requirements** together
  – Are there requirements that **contradict** each other

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Validation of
Content

Quality of the information contained in the requirements artefacts

• **Correctness of requirements**
  – Does the content of each requirement correspond to the **actual stakeholder needs and wishes**
  – Are **all assumptions** about the system context made when defining the requirements correct?

• **Correctness of requirements classification**
  – Has each requirement
    • assigned to the right **requirement type**
      – goal, scenario, functional, quality, constraint, etc.
    • documented at the proper place
Validation of Documentation

- **Correct documentation format**
  - Does the requirements artefact have the prescribed documentation format

- **Comprehensibility**
  - Are the documented requirements comprehensible in the given context
    - *e.g.*, all terms that are used in the requirements artefacts clearly defined

- **Unambiguous documentation**
  - Does the documentation format of the requirements artefacts allows for an unambiguous interpretation of the requirements
  - Could ambiguities be avoided
    - by using a different, more appropriate documentation format

- **Compliance with documentation rules**
  - Does the requirements artefact adhere the documentation (or specification) rules and guidelines?
Validation of Agreement

- **Agreement**
  - Did the relevant stakeholders agree upon each requirement

- **Agreement after modification**
  - Has approval of the relevant stakeholders been obtained anew after
    - a requirements was modified
    - the content of the requirement changed

- **Check for conflicts**
  - Have the requirements been checked for potential conflicts caused
    - e.g., by conflicting goals?

- **Conflicts resolved**
  - Have all known conflicts been resolved for each requirement
Validation Goal

- Check whether the outputs of activities fulfill defined quality criteria
- Check whether the execution of activities adheres to process definitions and activity guidelines
- Check whether the inputs of activities fulfill defined quality criteria

Subject facet, Usage facet, IT system facet, Development facet

Context defects

- **Missing context information**
  - Important requirements have not been identified

- **Incorrect context information**
  - Requirements are defined on incorrect context information
    - E.g., wrong assumptions

- **Insufficiently considered context information**
  - Relevant context not adequately documented

- **Incomplete requirements sources**
  - Not all relevant requirements sources were considered
Subject Facet

• Have all relevant **objects** been identified and documented?

• Have all identified **objects** been captured completely and correctly?

• Have all **quality requirements** for the **representation of objects** been captured?

Subject Facet

• Have all relevant **legal requirements** (e.g., privacy regulations) for **representation of objects** in the system been considered?

• Have all relevant **requirements sources** been incorporated in the **identification** of the objects, their properties and relationships?
  – Stakeholders, documents and existing systems
Usage Facet

- Have the **desired interaction** with the environment been captured completely and correctly
  - stimuli the system must detect and
  - responses the system must produce

- Have the **quality requirements for interaction** with the environment been captured completely and correctly
  - desired performance
  - robustness against faulty operation and correct inputs
  - prevention of misuse

Usage Facet

- Have the **specifics of different user groups** been taken into account
  - e.g., specific requirements for different cultures and countries

- Have the **usage goals** of the relevant stakeholders and the relevant systems been elicited completely and correctly

- Have all **relevant requirements sources** for the usage facet been involved
  - e.g., expert for human-machine interfaces for the corresponding type of system
IT System Facet

- Have the relevant properties of the **hardware and software components** with which the system interacts or that belong to underlying hardware and software platform of the system been captured completely and correctly.

- Have all required **system interfaces** and the **relevant protocols** at each interface been documented completely and correctly.

IT System Facet

- Have all **relevant IT strategies** been considered appropriately
  - *e.g.*, with regard to the use of upcoming or future technology

- Have all **relevant IT policies** been considered and documented
  - installation, update and backup policies

- Have all **relevant requirement sources** of the IT system facet been involved in the requirements elicitation activities
Development Facet

- Have all requirements pertaining to the languages and development tools to be used been captured completely and correctly
  - Specification languages, programming languages, etc.

- Have the requirements for the development process and development standards been captured completely and correctly
  - including the development rules and guidelines with which the project must comply

Development Facet

- Have all development artefacts to be provided or exchanged been identified
  - e.g., between the client and the contractor

- Have the targeted project duration and cost been checked for feasibility after all (essential) requirements been agreed on

- Have all relevant requirements sources of the development facet been considered
Validation Goal

- Check whether the outputs of activities fulfill defined quality criteria
- Check whether the inputs of activities fulfill defined quality criteria
- Check whether the execution of activities adheres to process definitions and activity guidelines

Validation of Execution of Activities

- Has the execution of the activities been documented in the prescribed way?
- Have all activities that are required according to the process definition been performed
- Have all inputs defined in each activity description been considered for the respected activity
Validation of Execution of Activities

- Does the **execution of each activity** correspond to the **rules and guidelines** defined in the activity description

- Have all **outputs** defined in each activity description been created

- Have all **stakeholders** who are relevant for performing the respective activity been involved in the execution of the activity