D1.2: Requirements and metrics

D1.2

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1 Publishable Executive Summary

The aim of INCOBAT[1] is to provide innovative and cost efficient battery management systems for next generation HV-batteries. To that end, INCOBAT will propose a platform concept in order to achieve cost reduction, reduced complexity, increased reliability as well as flexibility and higher energy efficiency.

Targets of this deliverable are the following

(a) to explain the methods for requirement elicitation and requirement structuring deployed for the INCOBAT project
(b) to provide a structured list of requirements for next generation BMS
(c) to explain the method for gathering mission profiles (data gathered on rides with a real car on different tracks, time of the day and drivers).

Motivation and challenges for Requirement Engineering

The motivation for requirements engineering (RE) is to ability to describe the system's targets and to systematically break-down these targets into sub-targets for the sub-systems, elements and components building this system. This activity has a strong impact on the quality of the system to be developed.

Different challenges arise during the task of requirements engineering – and a large scope of methods exist in order to support the different activities and improve the quality of the system description. The main activities related to requirement engineering are:

- ***Requirement elicitation***: capability to clearly and fully identify and structure the main needs and system targets;
- ***Requirement specification***: capability to describe the identified requirements by means of requirement specification language
- ***Requirement analysis and validation***: capability to analysis the requirements with respect to different aspects such as lo wambiguity, correctness, completeness, consistency.
- ***System modeling***: This activity enables the formalization of the system architecture implementing the identified requirements – thus enabling cross check between an intended functionality and the capability to realize this functionality (resources required).
- ***Requirement management***: The requirements are evolving in the course of the project. Hence, the requirement status depends on the current stage of the project. Moreover, it is very likely that the system will change during the time frame of the project. The goal of requirement management is to structure the identified requirement and and maintain this structure over the project lifetime.

Results achieved for requirement engineering methods: Approach in INCOBAT

[1] INnovative COst efficient management system for next generation high voltage BATteries, www.incobat-project.eu

A major challenge by requirements engineering is to define the correct methods to apply in the project given the context (size of the project, RE skills of the team, expected maturity of the system). This definition is at the end a trade off between efforts in the project for RE and expected quality of the system. In the course of the INCOBAT project, we have focused on the following methods:

- ***Structure for requirement elicitation***: This first method aims at supporting the different domain experts to define a common language in order to provide their expertise and structure their information together. This method is supported by the definition of four views (operational, functional, logical and physical), which represent the system at a specific abstraction level. Further, for each of the view an Excel template is provided that describes the required attributes to fill for each requirements (e.g., ID, title, text, status, category)
- ***Requirement specification guideline***: Guideline how to write proper requirments. It includes general guidelines about the attributes of requirements as well as different boilerplates examples (proposed structures for requirement sentences)
- ***System modeling using SysML***: During the scope of this project, an architecture modeling using SysML is planned. This will be the content of the deliverable D1.3 System architecture specification. The architecture will be linked with the requirements identified in this document.
- ***Requirement management***: The last aspect deployed in the INCOBAT project is a method for requirement management. This method relies on commercial off-the-shelf tool PTC Integrity (available at AVL), on which specific enhancements such as document generation and graph generation have been integrated. These enhancements shall support a more efficient management of the requirements in INCOBAT.

Results achieved – technical requirements in INCOBAT

The requirement engineering framework presented in this section was important to develop a common detailed technical understanding of the system to develop. It was the possibility for each expert to contribute with his expertise in a common framework and language. This activity has been executed by means of regular (weekly) meetings during the first project year in order to structure the system description by technical topics in a systematic way.

Already in this research project, the number of requirements illustrates the complexity of the information and the efforts required for proper management of the requirements. Note that for industry projects this number is expected to be larger due to the following reasons:

- Higher accuracy on specific components and functionalities: specific aspects (e.g., central computing unit, battery estimation algorithms, intelligent sensing unit) are described in other deliverables and / or are background information from partners and thereore not described more in details in this context

- Higher accuracy for validation and dependability (e.g., safety, security) aspects: this aspect will be enhanced in the course of the projects (related to D1.4 “Safety and security concept” and D1.5 “Validation plan”

In the context of the INCOBAT projects, requirement elicitation and consolidation (specification, analysis and validation) as lead to a total of 368 requirements. The requirements are distributed as follows between the abstraction levels:

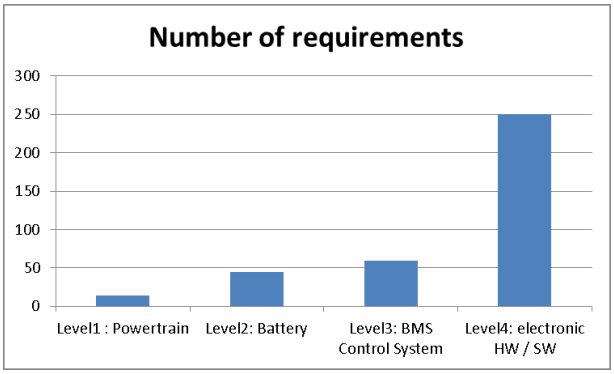

Figure 1: Distribution of requirements over the abstraction levels

Mission profiles

In the context of INCOBAT, following targets related to mission profiles have been identified:

1. Benchmark of overall INCOBAT technology: here we need something quite standardized, such that comparison to other external solutions is possible
2. Tailoring / Calibration of INCOBAT SoC algorithms (support WP2): here we need real and accurate information about the vehicle behavior and energy requirements
3. Robustness evaluation (Support WP5): here we need environment information (e.g. vibration, temperature, humidity etc.)

Based on these three targets and on the different test procedures existing (e.g., NEDC, FTP-75, WLTP), different approaches for mission profiles have been identified. The approaches proposed in this document represent a tailoring of the standardized test procedures according to the targets identified within INCOBAT.