HORIZON EUROPE PROGRAMME
TOPIC HORIZON-CL5-2023-D2-05-01

GA No. 101137975

Situationally Aware Innovative Battery Management System for Next Generation Vehicles

InnoBMS - Deliverable report

D2.1 - Data collection protocol

Funded by the European Union

Deliverable No.	D2.1	
Related WP	WP2	
Deliverable Title	Data collection protocol	
Deliverable Date	2024-10-31	
Deliverable Type	REPORT	
Dissemination level	Public (PU)	
Author(s)	Bernhard Stanje (AVL)	2024/11/01
Checked by	Bernhard Stanje (AVL)	2024/11/01
Reviewed by	Sajib Chakraborty (VUB)	2024/10/29
	Christophe Rebreyend (UNR)	2024/10/29
Coordinator	Prof. dr. ir. Omar Hegazy (VUB)	Yyyy/mm/dd

Document History

Version	Date	Editing done by	Remarks
V0.1	2024/04/16	Bernhard Stanje	
V0.9	2024/25/10	Bernhard Stanje	Review version of the document (some information of partners missing)
V1.0	2024/11/01	Bernhard Stanje	Version for submission final edit
V1.1 FINAL	2024/11/01		Submitted

Project summary

The core objective of InnoBMS is to develop and demonstrate (TRL6) a future-ready best-in-class BMS hard- and software solution that maximizes battery utilization and performance for the user without negatively affecting battery life, even in extreme conditions, whilst continuously maintaining safety. Concretely, the InnoBMS proposal will deliver a 12% higher effective battery pack volumetric density, a 33% longer battery lifetime and a demonstrated lifetime of 15 years. The results will be demonstrated using novel testing methods that give a 36% reduction in the testing time of a BMS. The results will be demonstrated in two use cases, one light commercial vehicle (Fiat Doblo Electric) and one medium-duty van (IVECO eDaily). The key outcomes will enable a cost reduction of 12% and 9.7% for passenger cars and light-duty vehicles, respectively. The core objective will be achieved through five technical objectives. 1) advanced hybrid physical and data-driven models and algorithms to enable a flexible and modular BMS suitable for a wide range of batteries. 2) Software for a fully connected and fully wireless BMS that acts as a communication server inside the vehicle E/E-architecture, the center of connection, on-board diagnostics and decision-taking for all battery-related information. 3) A scalable, fully wireless and self-tested BMS hardware that enables using different battery sizes at different operating voltage levels, and smart sensor integration. 4) Better battery utilization and exploitation using cloud-informed strategies and procedure. 5) A heterogeneous simulation toolchain and automated test methods.

Publishable summary

Today's world is becoming more and more data-centric and the importance of a data collection protocol cannot be overstated. A data collection protocol/plan (DCP) describes the data flow (incl. how the data is generated and processed) within a research project, in other words such a protocol serves as a guiding framework for gathering and managing data, ensuring that all necessary information is collected, transferred/shared and stored in a consistent and reliable manner. It is essential for facilitating meaningful interactions between different data sources, helping to create a cohesive understanding of the data flow within the project.

Specifically, the data collection plan (DCP) protocol will define the type of data to be collected for the edge- and cloud-based algorithms (physical-chemical and data-driven), data for testing and validation, collection frequencies as well as sampling rates of the sensors, transfer of the data (when and how), and the communication protocol (security level, encryption, interfaces) for the cloud-based software platform as well as for the wireless BMS. The data collection protocol will comply with the upcoming EU passport regulation. Encryption requirements will be defined when needed. The reported results include the lab test data, operational and other data to be collected from each use case. The DCP is not a fixed document but evolves during the lifespan of the project. This first version of the DMP includes an overview of all datasets and their specific attributes that will be reused or generated within InnoBMS project.

In the project's progress, the DCP might updated to reflect significant changes such as dataset updates, new collected or generated data, and updates on public repositories.

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Abbreviations & Definitions

Abbreviation	Description
BMS	Battery Management System
CAN	Controller Area Network
CMB	Cell Monitoring Board
DCP	Data Collection Protocol/Plan
DMP	Data Management Protocol
EIS	Electrical Impedance Spectroscopy
GB	Gigabyte
HiL	Hardware in the Loop
HW	Hardware
Hz	Hertz
I	Current
IVT	Current, Voltage, Temperature
kHz	Kilo Hertz
MB	Megabyte
RuL	Remaining Useful Life
SBMS	Battery Control Unit
SoC	State of Charge
SoH	State of Health
SoP	State of Power
SoS	State of Safety
SoX	State of X
SW	Software
T	Temperature
THCC	Typhoon HIL Control Center software
V	Voltage
V2G	Vehicle to grid
V2x	Vehicle to everything
VCU	Vehicle Control Unit

1 Introduction

The purpose of the present document is to outline the strategy for the management of the data generated within the framework of InnoBMS project activities. Procedures for the management of research data (processed or generated data), models and scientific publication data will be addressed. The management policy will be defined fully in compliance with the open access principles adopted by the European Commission and enforced through the Grant Agreement.

The project recognizes the value of regulating research data management issues. A data management plan (DMP) assists in the organization and control of data whereas the data collection plan defines the way how the data is collected and handled within the project. The expected types of research data that will be re-used or generated in the InnoBMS project will be discussed per project partner.

Accordingly, in line with the rules laid down in the Model Grant Agreement, the beneficiaries will deposit the underlying research data needed to validate the results presented in the deposited scientific publications clearly and transparently.

The data management plan (DCP) protocol will define the type of data to be collected for the edge- and cloud-based algorithms (physical-chemical and data-driven), collection frequencies as well as sampling rates of the sensors, transfer of the data (when and how), and the communication protocol (security level, encryption, interfaces) for the cloud-based software platform as well as for the wireless BMS. The reported results include the operational and other data to be collected from each demo case. The DCP is not a fixed document but evolves during the lifespan of the project. This first version of the DMP includes an overview of all datasets and their specific attributes that will be reused or generated within InnoBMS project.

In the project's progress, the DCP might updated to reflect significant changes such as dataset updates, new collected or generated data, and updates on public repositories.

2 Data Collection Plan

2.1 Data Summary

The data generated during the InnoBMS project will be experimental data from characterization, validation tests and modelling data. Besides testing data, the project also incorporates operational data, that will be provided individually for each use-case vehicles, these might be different for each individual use-case depending on the requirements. For smooth collaboration, a password-protected SharePoint was set up by Uniresearch, where all project-related files which can be shared among the partners and can be stored and organized in different folders. All involved partners have access to the project SharePoint to upload, download, and edit working documents. In addition, partners can also choose to store and manage their data by themselves and share with involved partners if necessary. Moreover, FMF will provide a cloud service to execute detailed physics-based models and data-driven models. In addition, specific and selected operational data from vehicle-edge telematics will be pushed to the InnoBMS cloud. InnoBMS aims to make as much generated data as possible publicly available to maximize the impact of the results. This means that InnoBMS tries to make all data not subject to IP rights or classified as protected in the consortium agreement or in NDAs publicly available in online repositories if possible.

Table 1. General information regarding data in this project

What is the purpose of data generation or re-use and its relation to the objectives of the project?	The purpose of data generation is to develop a best-in-class BMS hard- and software solution that maximizes battery performance for the user without negatively affecting battery life while ensuring battery safety.
What types and formats of data will the project generate or re-use?	See detailed tables below.
Will you re-use any existing data?	Yes, some data will be re-used from partners projects (list can be found in the submitted proposal document)
What is the origin/provenance of the data?	Measured/generated data (see tables below)
What is the expected size of the data?	100 – 1000 GB
To whom might the data be useful ('data utility') outside the project?	The results of the project and parts of the underlying data are interesting for - the European automotive industry in general - Battery developers and testing solution providers and their customers - Battery cell producers, BMS producers, and Academic institutions engaged in the research of batteries - Vehicle and powertrain manufacturers/developers
Data Storage during project	- Project SharePoint (for all data that can be shared among all partners without restriction) - Servers of partners - Commercial cloud data storage of partners

For the InnoBMS project, data collection is a critical component, since most innovations and control mechanisms of the BMS require extensive data input in form of operational data, model data or sensor data. To ensure consistency and completeness, we have created a set master table specifically for each project partner. This master table is designed to capture all necessary information required for the project's success. Each partner is responsible for filling out their designated master table with the relevant data. This approach helps in maintaining organized and standardized data across all partners, facilitating efficient analysis and reporting. By filling out these master tables, partners contribute to a comprehensive data set that will be instrumental in achieving our project goals. These tables than can also be used to identify potential data gaps which can be applied for early risk mitigation.

Table 2. Master table template for datasets

Dataset	NAME of the Dataset
Description/Purpose	Short Description what it does – also refers to what is being generated f.e. Models for the estimation of capacity fade and remaining useful life to be running on the BMS
Origin	How will it be generated? Experimental, Models, Simulation etc
Format	What will the format of the data be? *.csv, etc
Frequency	How often will the data be collected/generated? Hz, 1/10Hz?
Required Input	Is there an input of another dataset/partner work required if so please state it f.e. experimental cell data of XY is required
Interaction	How will this data set be used in the Project? f.e. will be used as input for TX.Y
Expected size	If possible, state the expected data size. f.e. MB range or GB range
Transfer of data	How will the data be collected? f.e. CAN bus, wireless?
Access	How will the data be shared within the project? Will everyone have access or only specific partners?

2.2 Datasets relating to the InnoBMS project per partner

The following section will include an overview on each InnoBMS partner contribution regarding data sets. In the project, there will be various datasets with different roles and varying levels of interaction. Some datasets, such as operational data and modelling data, will be actively and frequently updated. These datasets are crucial for ongoing monitoring, model development, and supporting real-time decision-making processes. They will undergo continuous interaction to reflect the latest information and insights.

On the other hand, certain datasets, like testing data (e.g. cybersecurity testing, HiL testing of the BMS etc.), will be generated during specific testing phases and will not have any further interaction. This data is essential for validating models and systems, ensuring they perform correctly under different conditions. While testing data is critical during its specific phases, it remains static once generated, serving a validation purpose of individual features.

By clearly differentiating between these types of datasets, we can manage them more efficiently, ensuring that each dataset is utilized effectively to contribute to the project's overall success.

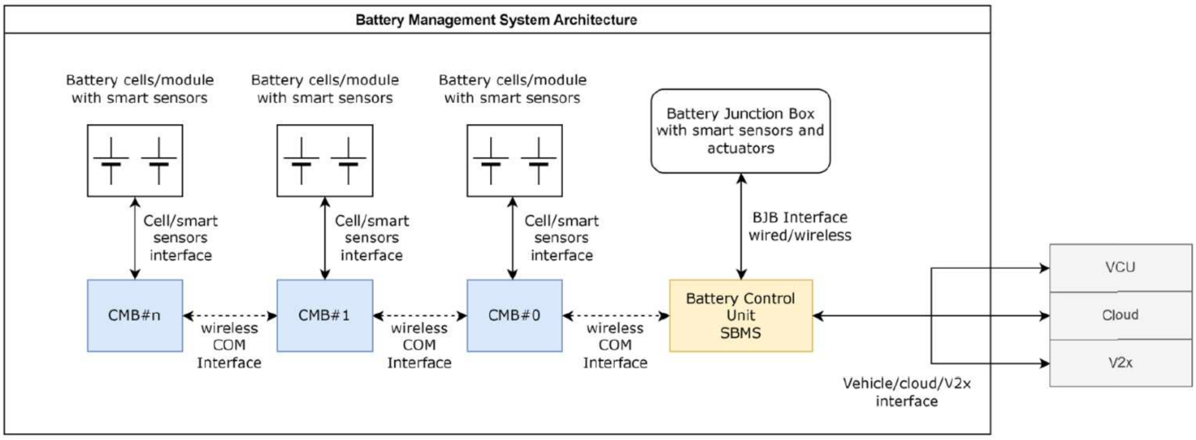

Figure 1. schematic view of the BMS architecture

Figures 1 is a schematic view of how data will be distributed within the BMS in the project. Here, the interaction of the BMS architecture is drawn - all operational data will be collected via the cell monitoring board (CMB) and transferred to the central battery control unit (SBMS). The SBMS will act as a gateway to transfer the operational data (sensors, IVT and thermal management) to the respective user (cloud, models, VCU, edge etc) of the corresponding dataset. The datasets will be shared wirelessly as indicated in the figure and the transfer to the cloud will be done either by 4G/5G or a local wireless network.

AVL

Table 3. Dataset of AVL

Dataset	Ageing model and RUL prediction function	Security Test Data	Test Plan	Generated System model for Security Analysis
Description/Purpose	To estimate the capacity fade and in turn determine the remaining useful life.	Result data from in-vehicle test execution	Plan for the tests as defined	Automated security analysis; communication standard conformance checks, input for fuzz testing
Origin	Data generated from data driven algorithm - ageing model.	Data generated by the in-vehicle measurement system	Created out of ISO26262 risk assessment and additional tests specific to the new BMS architecture	Active automata learning queries of the system's communication interfaces (prob. also an internal API, if applicable)
Format	Matlab files	ASAM MDF4	Tbd	GraphViz DOT files, semi-formalized security test outputs
Frequency	Hz range (100ms – 1s)	Tbd		N/A
Required Input	Cell datasheet, Capacity of the cell at different temperature, Ageing test specification and test datasets, Drive cycle profiles, Load cycles data with different C-rates, Sensor data – current (t), cell voltage(t), temperature(t) SOC data from cell testing, Predefined EOL Capacity parameter	ISO Standards Risk Assessment Documents	Alignment with HiL test set up and all partners involved in testing BMS hardware	Communication Interface descriptions, Input alphabets, ideally traces of standard-conform system interactions
Interaction	BMS SW, control mechanism	BMS HW, T5.1, SoS - algorithm	T5.1, SoS testing	Data will be used to generate security-related tests.

Expected size	GB range	several 10 GBytes (depending on vehicle and test count)	MB range	Generated models are in KB range, Learning Traces are up to a few hundred MBs
Transfer of data	To the relevant partner via SharePoint	To the relevant partner via SharePoint	To the relevant partner via SharePoint	Not immediately needed
Access	The algorithm will be delivered as a usable black box model that can be integrated on the Edge BMS.	Results of the SoS testing will be shared as a report withing the project partners	The test plan will be shared as report within the project partners	Data will be shared project internally, restrictions are defined and limited by the CA.

VUB

Table 4. Dataset of VUB

Dataset	Data for Enhanced G2V and V2G	Data for pre-conditioning	Data from OVPP tests	Data from real vehicle test
Description/Purpose	Data from Simulation model and tests	Data from Simulation model and tests	Data from physical powertrain platform	Data from real vehicle's edge device
Origin	Generated data from MATLAB Simulink model and vehicle test	Generated data from MATLAB Simulink model and vehicle test	Testbench data	Related data from edge: Battery pre-conditioning and enhanced V2G
Format	.mat/.txt	.mat/.txt	.mat	.txt/json
Frequency	Hz range, etc.	Hz range, etc.	10 msec to Hz range	Hz range, etc.
Required Input	Data from model	Data from model	Data from OVPP edge	Data from edge
Interaction	Data will be used for T2.2	Data will be used for T2.2	Data will use for T2.3	Data will use for T3.3
Expected size	MB range or GB range	MB range or GB range	GB range	MB or GB range
Transfer of data	CAN wireless etc.	CAN wireless etc.	LAN	CAN wireless etc.
Access	Data will be shared project internally, restrictions are defined and limited by the CA.	Data will be shared project internally, restrictions are defined and limited by the CA.	Data will be provided upon request	Data will be shared project internally, restrictions are defined and limited by the CA

TOFAS

Table 5. Dataset of TOFAS

Dataset	Operational data	BMS Performance Data	Cell data
Description/Purpose	Data from the vehicle (Pack Current, Pack Voltage, Temperature (min/max cell temp), min/max cell voltage, cooling / heating loop temp (tbd), SoC, SoH, Allowed Charge / Discharge Current, Water Pump Duty Cycle etc.)	Dataset for testing and validating the performance of the advanced BMS. Pack Current, Pack Voltage, Cell Temperature (min/max cell temp), min/max cell voltage, SoC, SoH, etc.)	Cell datasheet, Cell performance measurements (tbd),
Origin	The data originates from prototype vehicles provided by TOFAS.	The data originates from prototype vehicles provided by TOFAS.	The data will be provided by cell supplier
Format	*.csv, *.xlsx documents	*.csv, *.xlsx documents	*.pdf, *.xlsx documents
Frequency	Hz range (100ms)	tbd	
Required Input	Data from BMS (SoC, SoH, etc.)	Data from BMS (SoC, SoH, etc.)	
Interaction	WP2, WP3, WP4	WP2, WP3	WP2, WP3
Expected size	GB range	GB range	MB range
Transfer of data	CAN	CAN	
Access	Data will be provided upon request.	Data will be provided upon request.	Data will be provided upon request. Data will be shared project internally, restrictions are defined and limited by the CA.

BOSCH

Table 6. Dataset of BOSCH

Dataset	Data from test report	Data from edge testing
Description/Purpose	Data from Simulation model and tests	Data from Simulation model and tests
Origin	Generated data from test reports	Generated data from edge testing
Format	.mat/.txt/.xls/.xlsx	.mat/.txt/.xls/.xlsx
Frequency	Hz range, etc.	Hz range, etc.
Required Input	Data from model	Data from model
Interaction	Data will be used for T2.2	Data will be used for T2.2
Expected size	MB range or GB range / To be determined	MB range or GB range / To be determined
Transfer of data	CAN wireless etc.	CAN wireless etc.
Access	Data will be shared project internally, restrictions are defined and limited by the CA.	Data will be shared project internally, restrictions are defined and limited by the CA.

AVL-SFR

Table 7. Dataset of AVL-SFR

Dataset	HW Security Requirements	HW Design of CMB
Description/ Purpose	Requirements for Secure Encrypted Communication (L1 and L2)	Architecture of CMB
Origin	Experience from former projects	Experience from former projects
Format	Excel Document	Visio Document
Frequency	n.a.	n.a.
Required Input	System Requirements	System Requirements Hardware Requirements
Interaction	These are requirements. They shall be implemented in the overall HW Requirements document for the BMS	Alignment with SBMS
Expected size	L1 Requirements: 5 L2 Requirements: 22 Excel document < 100 kB	n.a.
Transfer of data	To the relevant partner via SharePoint	To the relevant partner via SharePoint
Access	Data will be shared project internally	Information might be shared upon request.

Dataset	HW Design of CMB	HW Design of CMB
Description/ Purpose	Schematic Design of CMB	Layout Design of CMB
Origin	Experience from former projects Part suppliers and AVL library	Experience from former projects Part suppliers and AVL library
Format	Altium Designer File Schematic as pdf	Altium Designer File Layout, Gerber Files
Frequency	n.a.	n.a.
Required Input	Architecture of CMB Hardware Requirements	Architecture of CMB Hardware Requirements Design Rules
Interaction	Alignment with SBMS	Alignment with SBMS
Expected size	tbd	tbd
Transfer of data	To the relevant partner via SharePoint	To the relevant partner via SharePoint
Access	Information might be shared upon request.	Information might be shared upon request.

IDIADA

Table 8. Dataset of IDIADA

Dataset	SoC Algorithm	SoH Algorithm	SoP Algorithm
Description/ Purpose	State of Charge estimation Algorithm	State of Health estimation Algorithm	State of Power estimation Algorithm
Origin	Algorithm is based on calculations using existing models. Experimental data will be used for development and validation of the algorithm.	Algorithm is based on calculations using existing models. Experimental data will be used for development and validation of the algorithm.	Algorithm is based on calculations using existing models. Experimental data will be used for development and validation of the algorithm.
Format	- Algorithm: Simulink black-box with Matlab code - Validation results from simulation (execution of the algorithm in Matlab): .mat file and/or report	- Algorithm: Simulink black-box with Matlab code - Validation results from simulation (execution of the algorithm in Matlab): .mat file and/or report	- Algorithm: Simulink black-box with Matlab code - Validation results from simulation (execution of the algorithm in Matlab): .mat file and/or report
Frequency	Hz range	Hz range	Hz range
Required Input	- Experimental data (Voltage, current and temperature measurements and SOC reference) from usage profiles as they would be available in the edge BMS to validate the algorithm - Parameters of Electric Equivalent Circuit models (derived by UL from Electrochemical/Physical models) and parameters from characterization. (The model provides voltage estimation from current and temperature data) Specifically: Capacity (T), OCV(SOC,T,hyst), R_{int}(SOC,T), R_i(SOC,T), C_i(SOC,T)	- Experimental data (Voltage, current and temperature measurements) from usage profiles as they would be available in the edge BMS to validate the algorithm. Capacity measurements during battery lifetime. - Parameters of Electric Equivalent Circuit models (derived by UL from Electrochemical/Physical models) and parameters from characterization. (The model provides voltage estimation from current and temperature data) Specifically: Capacity (T), OCV(SOC,T,hyst), R_{int}(SOC,T), R_i(SOC,T), C_i(SOC,T)	- Experimental data (Voltage, current and temperature measurements) from usage profiles as they would be available in the edge BMS to validate the algorithm. Resistance measurements during battery lifetime. - Parameters of Electric Equivalent Circuit models (derived by UL from Electrochemical/Physical models) and parameters from characterization. (The model provides voltage estimation from current and temperature data) Specifically: Capacity (T), OCV(SOC,T,hyst), R_{int}(SOC,T), R_i(SOC,T), C_i(SOC,T)
Interaction	This algorithm will be used for SoC estimation after implementation by the	This algorithm will be used for SoH estimation after implementation by the	This algorithm will be used for SoP estimation after implementation by the

	software developer of the Edge BMS	software developer of the Edge BMS	software developer of the Edge BMS
Expected size	Algorithm: MB range or less Simulation results: GB range	Algorithm: MB range or less Simulation results: GB range	Algorithm: MB range or less Simulation results: GB range
Transfer of data	Input data shall be provided in csv or .mat format for offline validation	Input data shall be provided in csv or .mat format for offline validation	Input data shall be provided in csv or .mat format for offline validation
Access	Data will be provided upon request Data will be shared project internally, restrictions are defined and limited by the CA Data will only be shared to some partners Summary of normalized results could be shared but not all in detail. Specific results will be shared internally in the project.	Data will be provided upon request Data will be shared project internally, restrictions are defined and limited by the CA Data will only be shared to some partners Summary of normalized results could be shared but not all in detail. Specific results will be shared internally in the project.	Data will be provided upon request Data will be shared project internally, restrictions are defined and limited by the CA Data will only be shared to some partners Summary of normalized results could be shared but not all in detail. Specific results will be shared internally in the project.

CID

Table 9. Dataset of CID

Dataset	AAT data	Lithium plating detection	BTMS data
Description/Purpose	Experimental data from Accelerated Aging Tests. These data will be used for D2.2 and D2.3	Algorithm generated based on EIS measurements. EIS data will be collected from test done in T2.2 and used for D2.2 and D2.3	BTMS operation data will be collected for developing control strategies. These data will be used for D2.2 and D2.3
Origin	Experimental data	Experimental data	Modelling data
Format	.csv	.csv or .mat	.csv or .mat
Frequency	Hz range, etc.	Hz range	Hz range, etc.
Required Input	-Cell datasheet -Cell EIS measurements -Operational data (I, V, T) -Estimated real time SOC	-Cell datasheet -Cell EIS measurements -Operational data (I, V, T) -Estimated real time SOC	-Compressor speed -Heating level -Pump speed -radiator fan speed -Inlet coolant temperature -System pressure drop vs flow rate -In-cabin temperature
Interaction	T5.5	T2.2	T3.2 and T3.3
Expected size	Order of GB, 10 GB aprox	Order of GB, 1 GB aprox	Order of Mb
Transfer of data	CAN wireless etc.	CAN wireless etc.	CAN wireless etc.
Access	Data will be shared project internally, restrictions are defined and limited by the CA	Data will be shared project internally, restrictions are defined and limited by the CA	Data will be shared project internally, restrictions are defined and limited by the CA

Table 10. Dataset of CID

Dataset	BTMS MPC strategy	TRA tests
Description/Purpose	Model and simulation data used for developing control strategies. These data will be used for D2.2 and D2.3	Cell data generated from abusive TRA tests will be generated and used for D2.2 and D2.3
Origin	Control strategies	Experimental data
Format	.mat	.mat
Frequency	Hz range, etc.	Hz range, etc.
Required Input	BTMS data listed: -Compressor speed -Heating level -Pump speed -Radiator fan speed -Inlet coolant temperature -System pressure drop vs flow rate -In-Cabin temperature	-Cell datasheet -Cell EIS measurements -Operating Data (I, V, T) -Estimated real-time SOC
Interaction	T3.2 and T3.3	T2.2
Expected size	Order of GB, 20 GB approximately	Order of GB, 1 GB approximately
Transfer of data	CAN wireless etc.	CAN wireless etc.
Access	Data will be shared project internally, restrictions are defined and limited by the CA	Data will be shared project internally, restrictions are defined and limited by the CA

UL

Table 11. Dataset of UL

Dataset	Data from ROM model	Data from Cloud model
Description/Purpose	Data from running reduced order model (ROM) of the battery	Data from running Cloud model of the battery
Origin	Generated data from ROM	Generated data from the cloud model
Format	.txt or any human readable format, e.g., .dat, .csv	.txt or any human readable format, e.g., .dat, .csv
Frequency	Depending on the type of simulation (from kHz to Hz range).	Depending on the type of simulation (from kHz to Hz range).
Required Input	Cell characterisation (datasheet, electrode and separator thickness, electrode material determination, porosity estimation, volume fractions of active material, binder and carbon black, particle size distribution) Electrochemical characterisation (GITT, OCV, EIS) Performance characterisation (charge/discharge curves at different C-rates) Ageing characterisation (capacity retention/loss, EIS) Input: Drive cycle profiles, Load cycles data with different C-rates, Sensor data – current (t), cell voltage(t), temperature(t)	Cell characterisation (datasheet, electrode and separator thickness, electrode material determination, porosity estimation, volume fractions of active material, binder and carbon black, particle size distribution) Electrochemical characterisation (GITT, OCV, EIS) Performance characterisation (charge/discharge curves at different C-rates) Ageing characterisation (capacity retention/loss, EIS) Input: Drive cycle profiles, Load cycles data with different C-rates, Sensor data – current (t), cell voltage(t), temperature(t)
Interaction	Data will be used for T2.3 and T3.2	Data will be used for T2.3 and T3.2
Expected size	From tens of MB up to one GB range.	From tens of MB up to one GB range.
Transfer of data	CAN	CAN
Access	Data will be provided upon request and shared with all partners.	Data will be provided upon request and shared with all partners.

THIL

Table 12. Dataset of THIL

Dataset	Battery/System models in THCC	Real-time HIL data streams (virtual tests)	Real-time HIL test results (virtual tests)
Description/Purpose	Real-time models for use in the remote HIL testbed in Novi Sad	Real-time battery model response to model stimulation for the BMS considering the test case scenario deployed.	Modeling output from tests run via cloud interface
Origin	Modelling data	Model response	Experimental Modelling data
Format	.tpkg, .tse, .cus	Analog/Digital signals, Modbus, CAN messages	.mat, .h5, .mf4, .csv; .pdf, Allure
Frequency	10 kHz to 5 MHz	10 kHz to 5 MHz	10 kHz to 5 MHz
Required Input	ROM Battery Model (UL), Test scripts for model stimulation (in Python or via Modbus, CAN, UDP, etc) derived from Test Case Specifications in T5.1.	Remote connection to HiL testbed in Novi Sad, properly parameterized and connected interface with the BMS card, Test script execution. Optionally, real-time model stimulation can be implemented using the HIL SCADA software in THCC	Battery/System models in THCC, Input control signals (Analog/Digital from BMS controller).
Interaction	Data will be used for T2.3, T5.2, T5.3	Data will be sent to the interfaced controller hardware and THCC connected computer	Data used in T5.3, T5.5
Expected size	1 –10 MB	< 1 kb / 100 us	Order of Mb
Transfer of data	Modbus, CAN, CAN FD, UDP.	AO/DO, Modbus, CAN, CAN FD, UDP.	UDP, TEAMS.
Access	Data will be provided upon request and shared with all partners.	Data will be available to any device properly interfaced with the HIL testbed during test runs.	Data will be provided upon request and shared with all partners.

FMF

Table 13. Dataset of FMF

Dataset	Measurement Data for BMS HW	Integration Interface Test data	Design Data
Description/Purpose	BMS HW test data	BMS interface test data from HIL, vHIL and battery test chamber	BMS HW design and Integration concept documents.
Origin	Generated data from BMS HW and Integration with advanced sensors	Logged data from testing	Created by the design and integration team
Format	.docx, .pptx, .xlsx, .pdf, a2l, hex, .dbc, .ldf, .mat, .csv,	csv, .mat, .blf, .mf4	.xlsx, Polarion, .MAT, .pdf
Frequency	Hz range, etc.	Hz range, etc.	N.A
Interaction	Data will be use for T2.X, T3.X, T4.X, T5.X	Data will be use for T2.X, T3.X, T4.X, T5.X	Data will be use for T2.X, T3.X, T4.X, T5.X
Expected size	MB range or GB range	MB range or GB range	MB range or GB range
Transfer of data	Can logs and oscilloscope measurement for pins Digital, PWM, Analogue, Resistive, etc.	CAN logs and instrumentation	Internal Server
Access	Data will be provided upon request Data will be shared project internally, restrictions are defined and limited by the CA Data will only be shared to some partners Summary of normalized results could be shared but not all in detail. Specific results will be shared internally in the project.	Data will be provided upon request Data will be shared project internally, restrictions are defined and limited by the CA Data will only be shared to some partners Summary of normalized results could be shared but not all in detail. Specific results will be shared internally in the project.	No Access will be granted to project partners. Information might be shared upon request.

PTE

Table 14. Dataset of PTE

Dataset	Data for SoX algorithms	Test data	Design Data
Description/Purpose	Data from testing protocols	Data from HIL, vHIL and battery test chamber	Software code and design blocks, concept documents, ISO26262 and cyber security documentation
Origin	Generated data from parameterization experiments	Logged data from testing	Created by design team
Format	.docx, .pptx, .xlsx, .pdf	.xlsx, Polarion, .MAT, .pdf	.xlsx, Polarion, .MAT, .pdf
Interaction	Data will be used for T2, T3	Data will be used for T3, T4, T5	Data will be used for T3
Expected size	GB range	10s GB	10MB to 1GB
Transfer of data	CAN wireless etc.	CAN and instrumentation	Internal Server
Access	Data will be provided upon request Data will be shared project internally, restrictions are defined and limited by the CA Data will only be shared to some partners Summary of normalized results could be shared but not all in detail. Specific results will be shared internally in the project.	Data will be provided upon request Data will be shared project internally, restrictions are defined and limited by the CA Data will only be shared to some partners Summary of normalized results could be shared but not all in detail. Specific results will be shared internally in the project.	No Access will be granted to project partners. Information might be shared upon request.

Table 15. Dataset of PTE

Dataset	Operation data
Description/Purpose	Data from testing protocols I, V, T, pressure, EIS (tbd)
Origin	Generated data from parameterization experiments
Format	.docx, .pptx, .pdf, .json, .csv / .xlsx, sql database, .hd5,.parquet, .blf
Interaction	Data will be used for T2, T3
Expected size	GB range
Transfer of data	CAN wireless etc.
Access	Data will be provided upon request. Data will be shared project internally, restrictions are defined and limited by the CA Data will only be shared to some designated partners. Summary of normalized results could be shared but not all in detail. Specific results will be shared internally in the project.

3 FAIR data

In the InnoBMS project the central point for data storage is the password protected project SharePoint server, to where all partners have access. Furthermore, public data (public deliverables, scientific publications) will made available on the InnoBMS website. All generated raw data underlying scientific publications produced by the InnoBMS project will have open access via a public repository. Generated data which are subject to IP protection or other limitations according to the Consortium Agreement will not be made public. This will be covered by the deliverables D7.2 Initial Data Management Plan Description data generated, standards/method used, data exploited and/or shared and D7.3 Final Data Management Plan to make data findable, accessible, interoperable, reusable.

4 Risks and interconnections

4.1 Risks/problems encountered

If applicable (consider using table below to report risks – and solutions ! – encountered for the activities/tasks related to this deliverable)

Risk No.	What is the risk	Probability of risk occurrence[1]	Effect of risk[1]	Solutions to overcome the risk
WP2-1	Missing dataset for BMS feature	2	1	Early set up of the DCP and through this deliverable D2.1 helped to intentify possible dataset gaps – aligment on responsibilities and dataset owner was immediatly initiated
WP2-2	Unsufficient dataset for BMS feature	2	1	See above

1) Probability risk will occur: 1 = high, 2 = medium, 3 = Low

5 Deviations from Annex 1

Report/summarise any deviations from the original plan have to be made, in case no deviations: state no deviations.

No Deviations.

6 Acknowledgement

6.1 The consortium

The author(s) would like to thank the partners in the project for their valuable comments on previous drafts and for performing the review.

Project partners:

#	Partner short name	Partner Full Name
1	VUB	Vrije Universiteit Brussel
2	TOFAS	TOFAS Turk Otomobil Fabrikasi Anonim Sirketi
3	BOSCH	Robert Bosch GmbH
4	AVL	AVL List GmbH
5	AVL-SFR	AVL Software and Functions Gmbh
6	IDIADA	Idiada Automotive Technology SA
7	CID	Fundacion Cidetec
8	UL	Univerza v Ljubljani
9	THIL	Tajfun Hil Društvo sa Ograničenom Odgovornošću za Istraživanje, Proizvodnju, Rgovinu i Usluge Novi Sad
10	UNR	Uniresearch BV
11	FMF	FPT Motorenforschung AG
12	PTE	Potenza Technology Limited

6.2 Disclaimer/ Acknowledgment

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101137975. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

7 Appendix A - Quality Assurance Review Form

The following questions should be answered by all reviewers (WP Leader, reviewer, Project Coordinator) as part of the Quality Assurance procedure. Questions answered with NO should be motivated. The deliverable author will update the draft based on the comments. When all reviewers have answered all questions with YES, only then can the Deliverable be submitted to the EC.

NOTE: This Quality Assurance form will be removed from Deliverables with dissemination level “Public” before publication.

Question	WP Leader	Reviewer	Project Coordinator
	Bernhard Stanje (AVL)	Sajib Chakraborty (VUB)	NAME (Organisation)
1. Do you accept this Deliverable as it is?	Yes	Yes	Yes / No (elaborate)
2. Is the Deliverable complete? - All required chapters? - Use of relevant templates?	Yes	Yes	Yes / No (elaborate)
3. Does the Deliverable correspond to the DoA? - All relevant actions preformed and reported?	Yes	Yes	Yes / No (elaborate)
4. Is the Deliverable in line with the InnoBMS objectives? - WP objectives - Task Objectives	Yes	Yes	Yes / No (elaborate)
5. Is the technical quality sufficient? - Inputs and assumptions correct/clear? - Data, calculations, and motivations correct/clear? - Outputs and conclusions correct/clear?	Yes	Yes	Yes / No (elaborate)
6. Is created and potential IP identified and are protection measures in place?	Yes	Yes	Yes / No (elaborate)
7. Is the Risk Procedure followed and reported?	Yes	Yes	Yes / No (elaborate)
8. Is the reporting quality sufficient? - Clear language - Clear argumentation - Consistency - Structure	Yes	Yes	Yes / No (elaborate)