



17th – 18th May 2022



Valencia (Spain)

Electromobility Technology Workshop:

Driving a Greener Value Chain

by  i-HeCoBatt

LIBERTY EU-Project: Goals and Key Innovations

ikerlan

MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE



TITLE: Dr. / Project Coordinator
SPEAKER: Egoitz Martinez-Laserna





LIBERTY Project Intro

- Overview
- Goals
- Mission
- Facts & Figures
- WP structure



Some of our key innovations

- Immersion Cooling
- Active Safety System
- BMS
- SOX algorithms
- Battery Passport



COLLABAT cluster

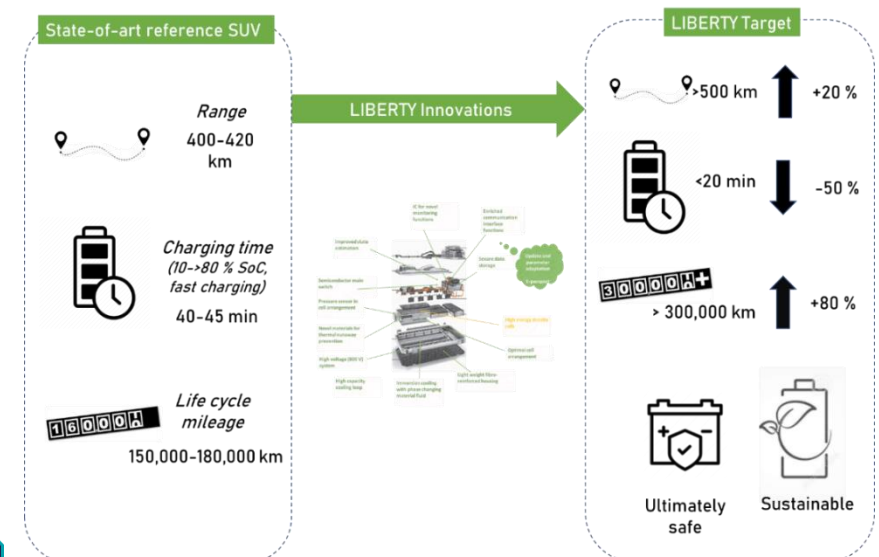
- Cluster Introduction

Project Overview

■ Lightweight Battery System for Extended Range at Improved Safety

- Objective 1: To achieve a range of 500 km on a fully charged battery pack
- Objective 2: To achieve a short charging time
- Objective 3: To achieve an ultimately safe battery system
- Objective 4: To achieve a long battery lifetime
- Objective 5: To achieve sustainability over the battery pack entire life cycle

Parameter	Benchmark: EQC 2019	Target: LIBERTY EQC
Battery system capacity [kWh]	80	96
Battery system weight based on 80 kWh battery capacity [kg]	650	520
Max. charging power [kW]	110	350
Charging window 10-80% SoC [min]	40	18
Range (WLTP) [km]	417	500
Battery life (no. of cycles to 80% DoD)	500	1000
Mileage [km]	160,000	>300,000



Project goals



LIBERTY project will develop a new battery system through smart combinations and implementation of innovations including:

- A compact and safe battery pack based on high energy density cells and lightweight materials housing which is crash resistant
- A versatile battery management system resulting in optimal performance and safety over the system's total lifetime (first and second life)
- High accuracy state estimators allowing fast charging, enhancing range and lifetime, and guaranteeing ultimate safety and diagnostics
- An innovative thermal management system ensuring safety and preventing battery degradation during fast charging
- Design a (semi) automated battery dismantling procedure thereby reducing costs for recycling and reuse
- Development of future-proof testing protocols for standardised EV safety as well as performance testing.

Lightweight Battery System for Extended Range at Improved Safety

<<upgrading battery performance, safety and lifetime from an overall lifecycle and sustainability point of view>>

<<LIBERTY's goal is to realise a step change in battery pack technology and to meet future user requirements.>>

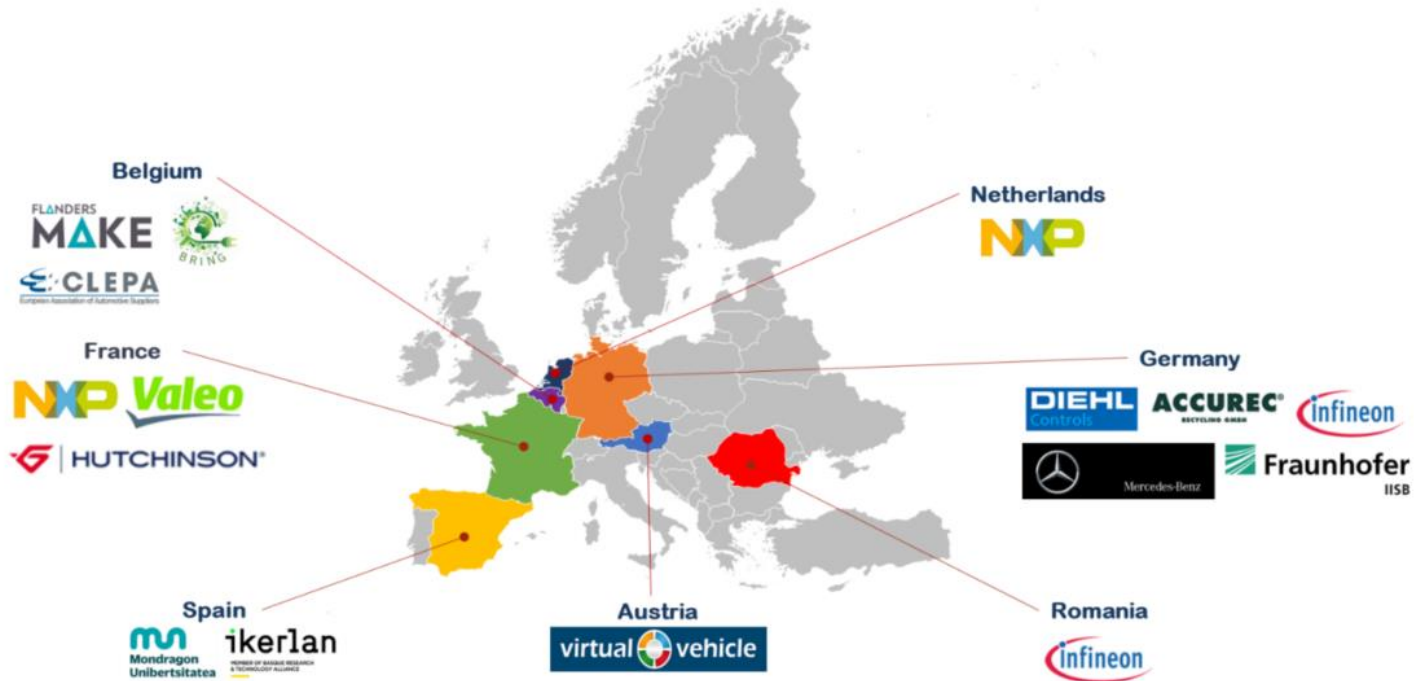
Technological solutions that meet all of these requirements still come with a higher price tag and usage limitations when compared to ICEs. The key lies in significantly upgrading battery performance, safety and lifetime from an overall lifecycle and sustainability point of view. This is the prime target of the LIBERTY project.



To build next-gen sustainable batteries, integrating cutting-edge technological innovation, from component- to Battery-pack level



Facts & Figures



- 16 Partners from 7 countries
- Coordinator: IKERLAN
- Start date: January 2021
- Duration: 42 months

WP Structure – V Design Methodology

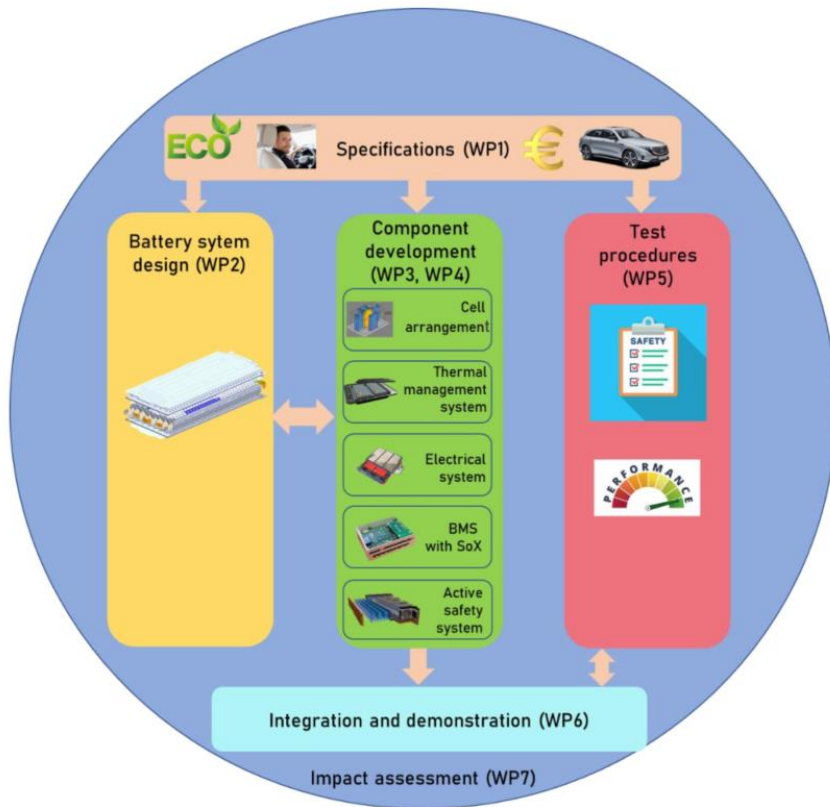
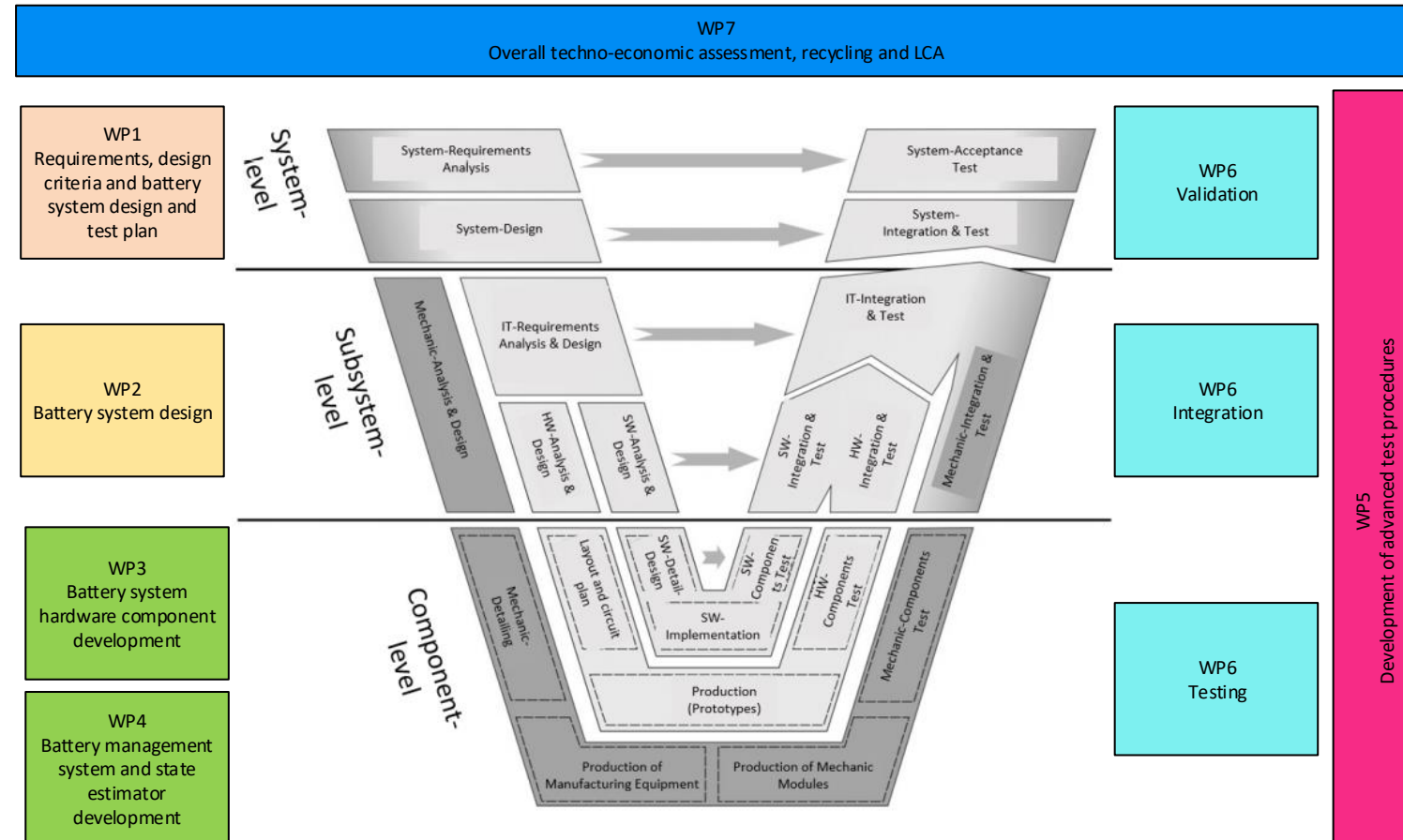


Figure 1-3 Overall approach and methodology of the work plan



V-model by Bender 2005, translated from Bender (2005) – "V-MODELS FOR INTERDISCIPLINARY SYSTEMS ENGINEERING", I. Graessler, J. Hentze and T. Bruckmann



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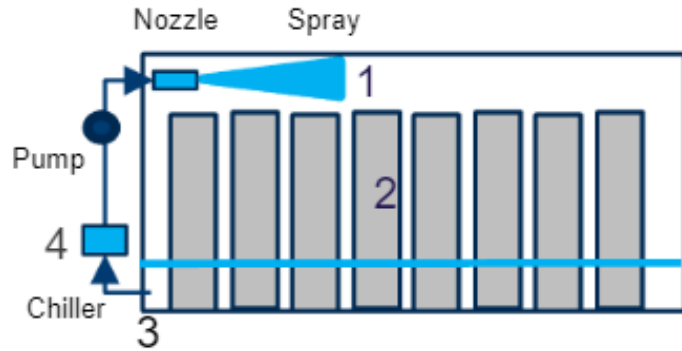
LIBERTY – Key Innovations

- O1: To achieve a range of 500 km on a fully charged battery pack
- O2: To achieve a short charging time
- O3: To achieve an ultimately safe battery system
- O4: To achieve a long battery lifetime
- O5: To achieve sustainability over the battery pack entire life cycle



Immersion Cooling based TMS

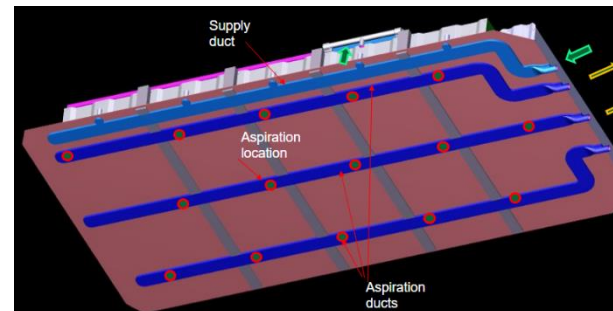
Conceptual Drawing



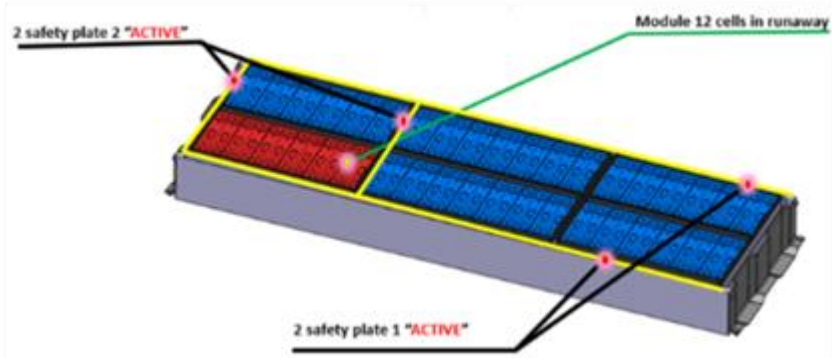
- 1- Dielectric liquid is sprayed on the battery surfaces
- 2- Liquid run off over the cells
- 3-The liquid is sucked by the pump
- 4-Liquid is cooled through a chiller to start a new cycle

- Monophasic partial immersion
- Nozzles in the upper part to be integrated with the casing
- Collection of the liquid in the down part to drive the fluid to pump and chiller
- Chiller will evacuate heat to vehicle system

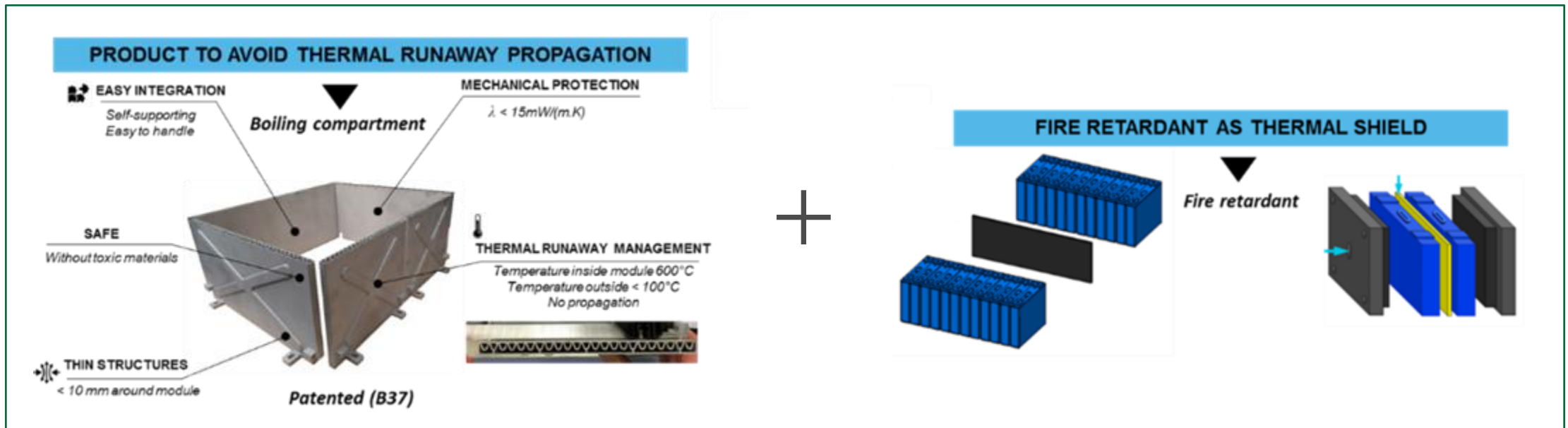
Testing and Integration



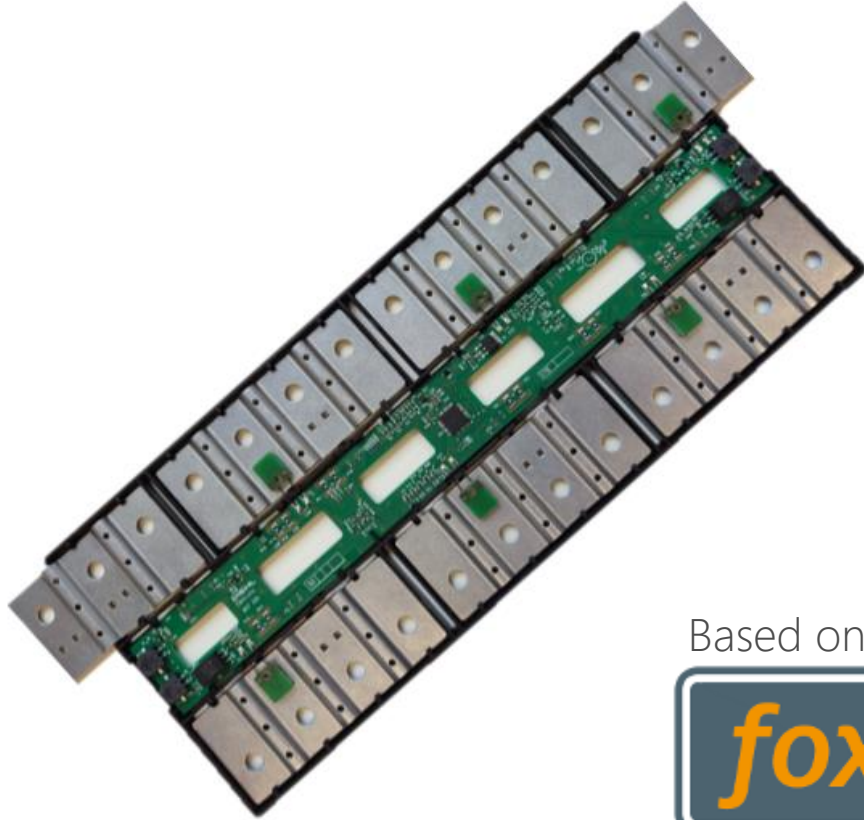
Active Safety System



- Encapsulation of group of cells to prevent TR propagation.
- Active: 2-phase fluid > boils in case of TR.
- Passive: Fire retardant material – minimize active use system



Battery Management System & HV electric system



- Bus bar design integrating BMS slaves.
- Impact of fluid for immersion cooling. Tailored solution
- Maximising energy density.
- Based on foxBMS2 open-source BMS.

Based on:



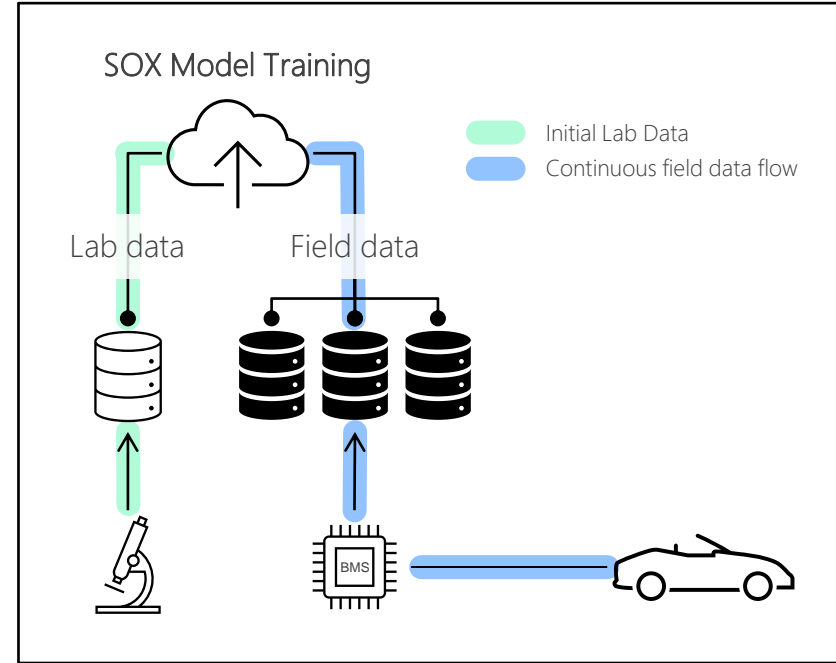
SOX Estimation Algorithms

Main Requirements:

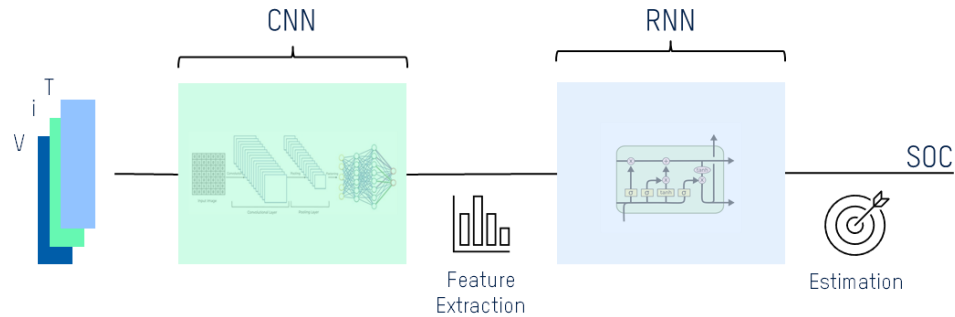
- Quick model development phase
- Reduced experimental burden

Our solution: Data-driven modelling techniques

- We take advantage of in-field operation data for SoX estimation modelling.



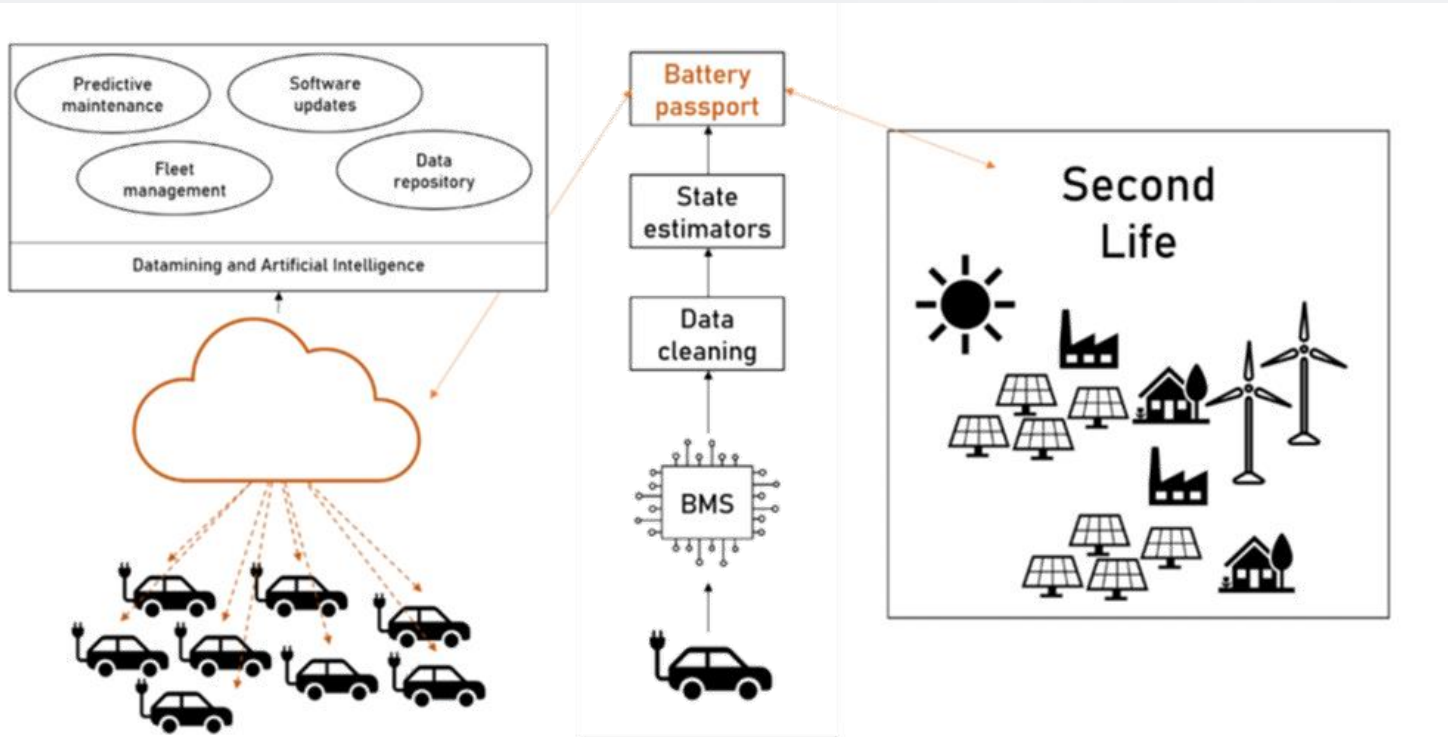
SOC estimation algorithm structure:



Outstanding Benefits:

- Increased accuracy and reliability as new data becomes available.
- Improved performance at unobserved conditions.
- Experimental burden can be significantly reduced.

Battery Passport Concept



- Real-Time battery data processed and stored
- Advanced services
- Enabling a simpler transition to 2nd Life.



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COLLABAT Cluster







■ LC-BAT-10-2020 projects joint Cluster: COLLABAT

- ALBATROSS
- LIBERTY
- HELIOS
- MARBEL



■ 4 main subclusters defined:

-  Sub – A: Sustainability
-  Sub – B: Testing
-  Sub – C: BMS
-  Sub – D: Modelling

- LinkedIn page published soon!
- Upcoming Events, workshops, whitepapers, etc.

Stay tuned!

Thank you very much!

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