EVA

EV BMS Analytics
leveraging Cloud & Digital Twins

Need for a Digital Twin (DT) for EV's BMS

Core BMS

- Monitor Current, Temp & Voltage limits
- Control of Current Flow (Charge/Discharge of the battery pack)
- Cell Balancing
- Calc SOH,SOC & OCV
- Detect fault codes

Core DT

- Estimation of Discharge Capacity, SOC,SOH
- Estimation of Cell Voltage and Temp
- Estimation of capacity and power fade
- Estimate internal resistance
- RUL prediction from running data

DT+

- RUL prediction(from forecasted/predicted data)
- Charging optimization
- Fault diagnosis
- Adaptive control of thermal management
- Evaluation of battery aging indicators

Market Gap for EV's BMS Analytics

Open Standards

➢ Our research shows the analytics modules available in the market for EV's or Utility grade battery performance (as part of battery management system) are proprietary in nature

➢ We are building SaaS & API based Digital Twin platform using open standards for EV/Utility BMS analytics in the areas of safety, reliability & performance

Flexibility

➢ There is a lack of flexibility in using analytical models and running in simulated scenarios on top of available battery management systems. In addition, the current models do not allow end users to see how prediction is happening on real-time data sets

➢ We are providing flexibility for end users to see the performance prediction by using multiple right-fit models and perform their very own "What-If" analysis

AI enabled Edge

➢ Most of these models are either running on a centralized cloud (and users can access the performance levels from their mobile/web browsers) or through a dedicated mobile app. There is a limitation of edge analytics to embed runtime models in (TensorRT/onnxRT) using docker images

➢ Our AI based DT platform supports the training/inference models to be embedded in different layers – be it at the edge, at the browser or at the mobile app level
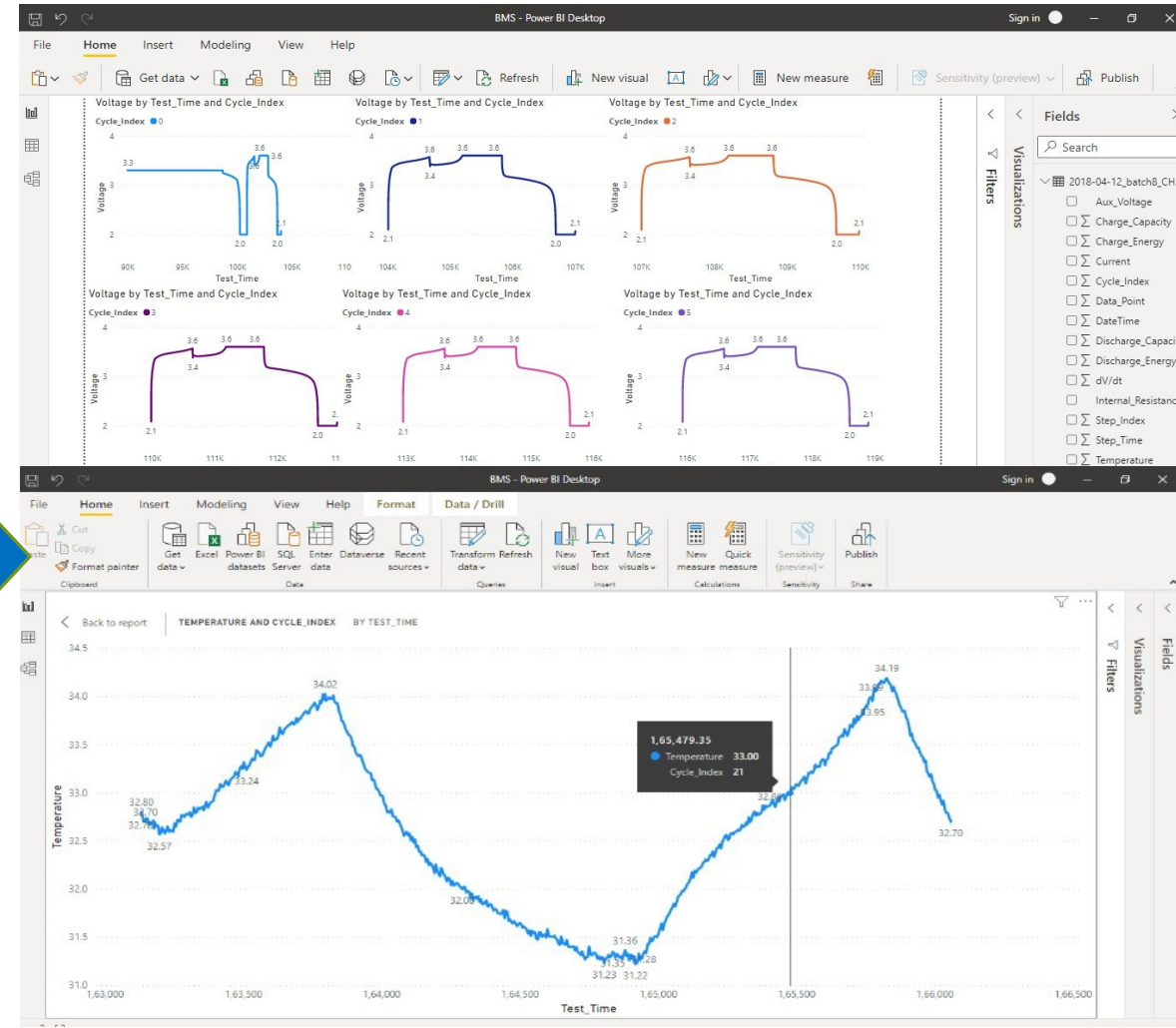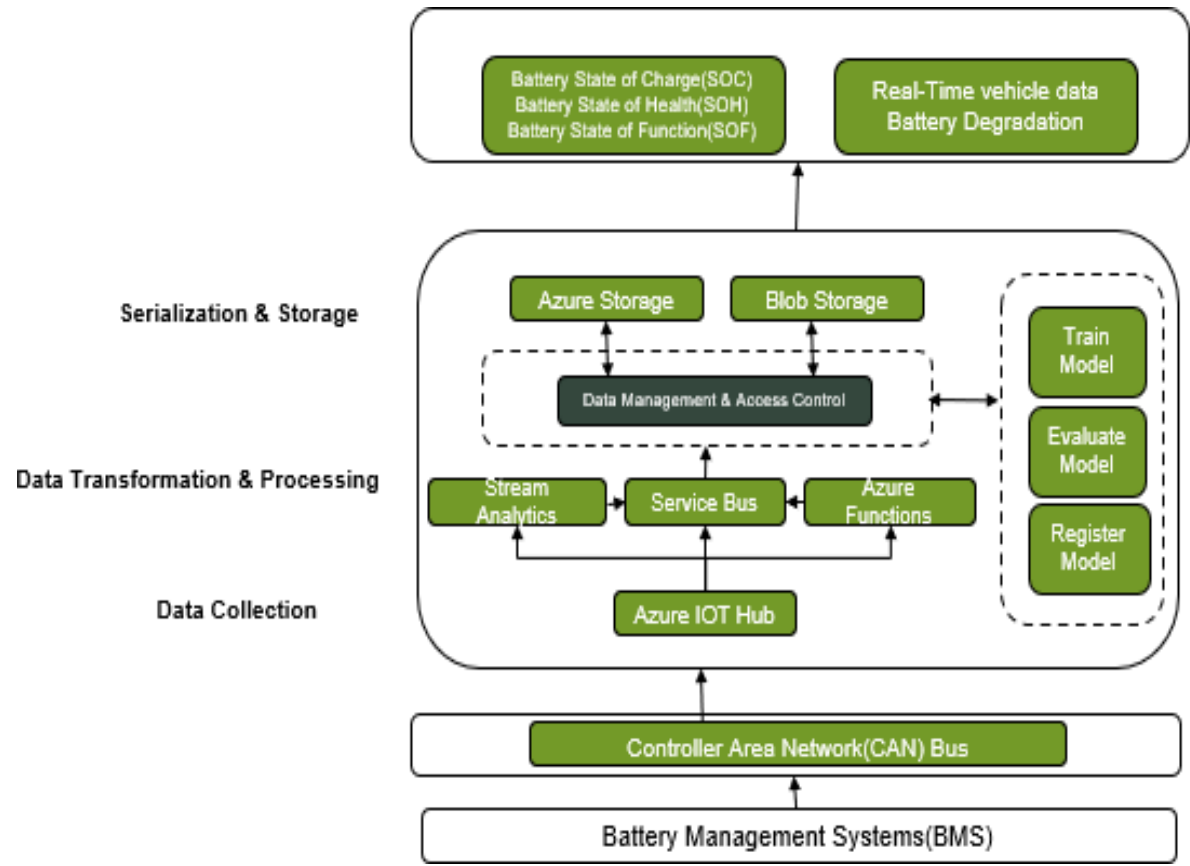
Putting the EV BMS into a DT Platform

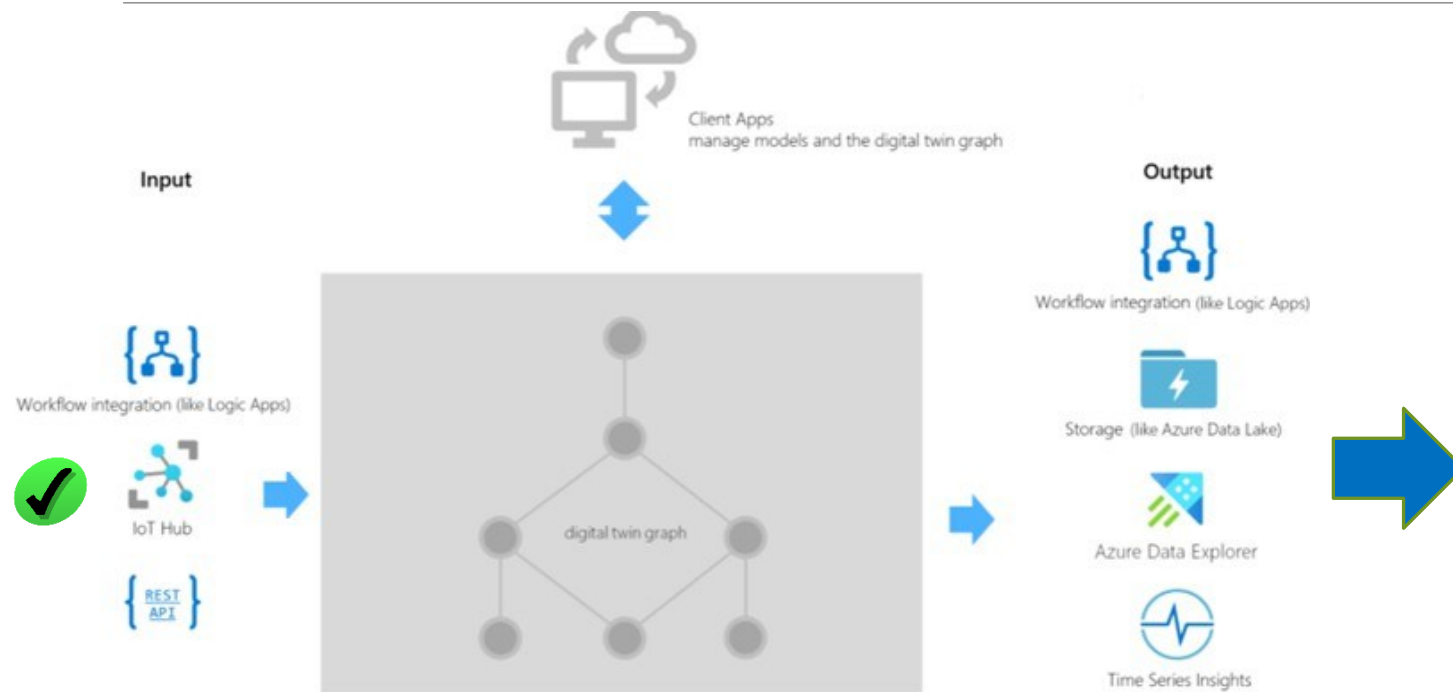*Planned EVA Release Cycles - 1, 2 and 3*

1 ✔ IoT Hub (Predictive)

2 DT Model (Prescriptive)

3 What-If Simulations (Forecasted FMEA)
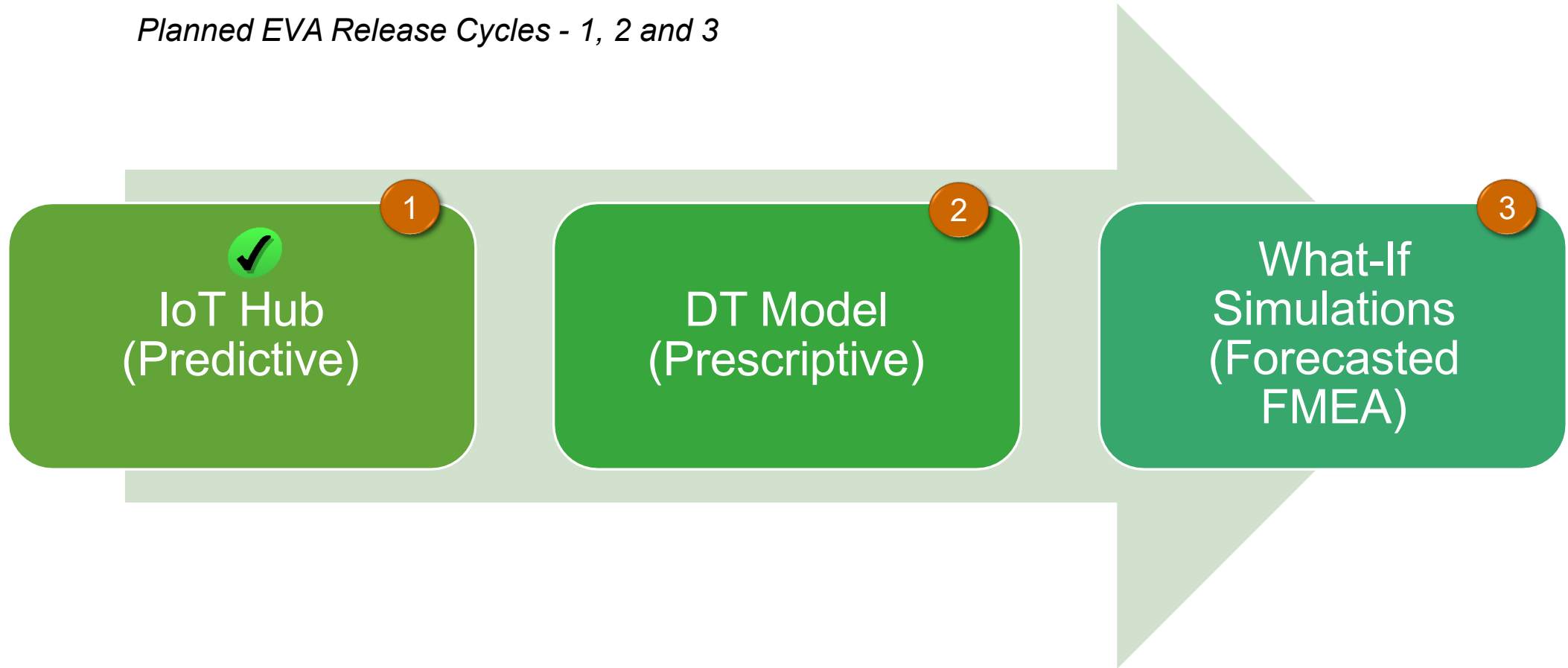
1st Release - Leveraging Azure IoT Hub

Demo Ready

Next Release - Moving to Azure DT Platform

Work in Progress

Capacity Estimation using V, I, T (Battery #6)
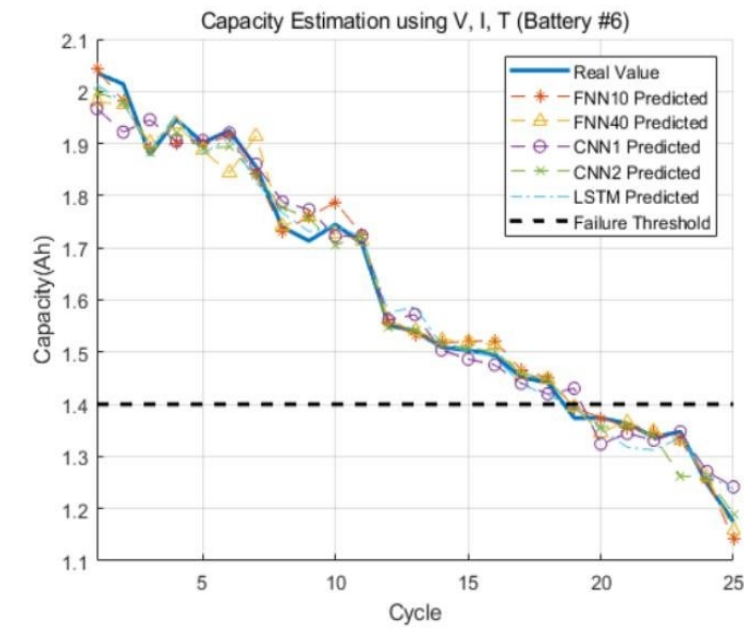
| SPC charts	Forecasting	Prediction for Overheating	CEP	What-If Analysis
• Compare with OEM Specs with Control Charts	• Leverage Time Series Data	• Apply right-fit prediction models on forecasted/ test data	• Run rules-based notification/ alerts engine	• Simulate operational scenarios for fault diagnosis

Going Forward - FMEA on EV's BMS Failures

BMS Failure Scope and Consequences
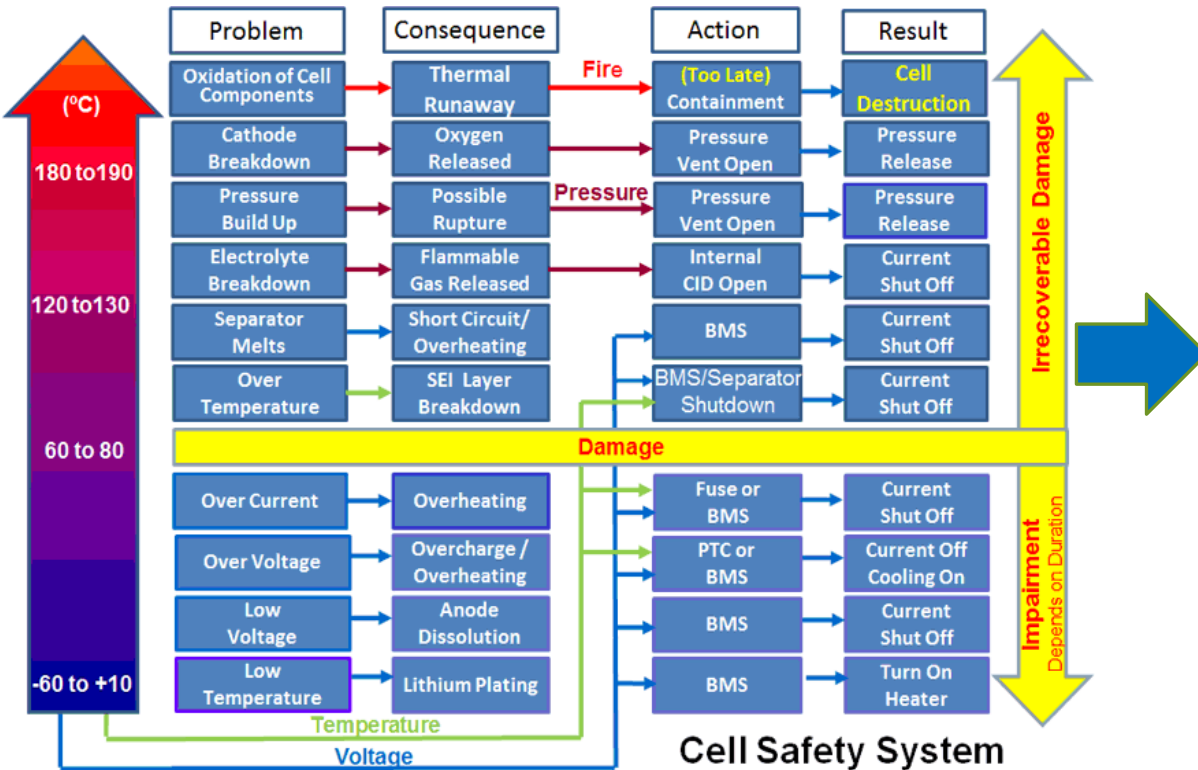
Enhancing FMEA (Failure Mode and Effects Analysis) using AI/ML for EV's BMS Failure Prediction
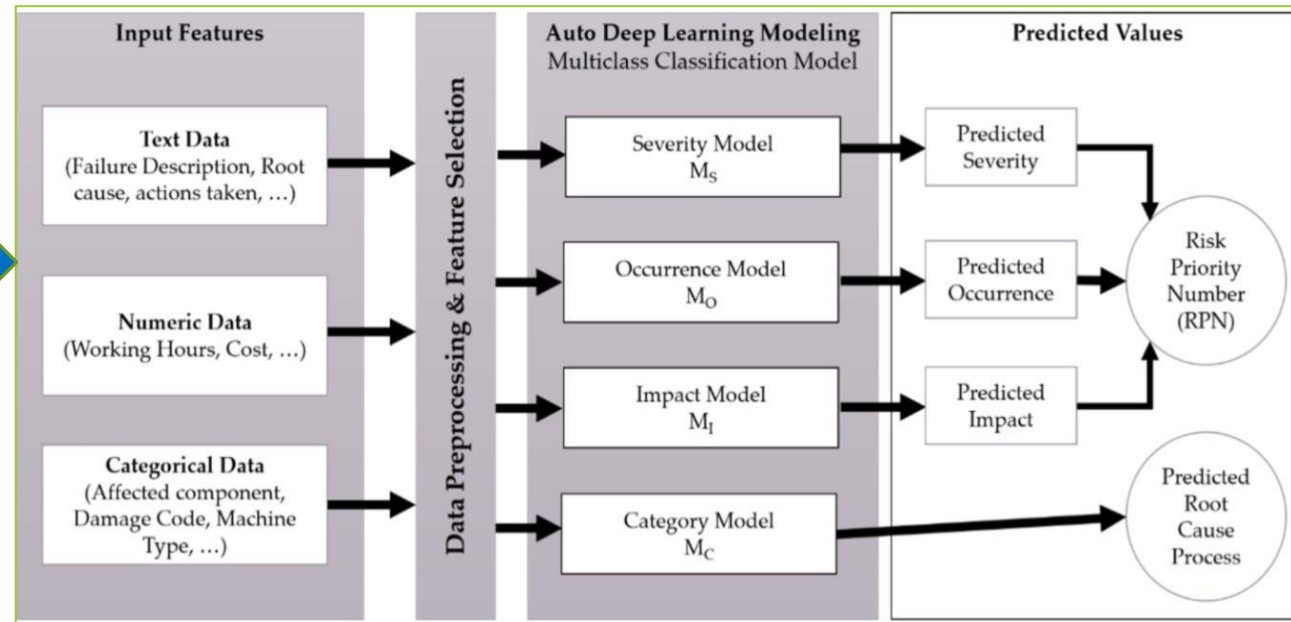
Our Value-Adds for EV BMS Analytics (EVA)

- Consulting in the field of battery systems and **failure analysis**

- POCs in the areas of **cybersecurity** and user management on BMS

- Partnership with Microsoft for data compliance, 24x7 delivery reliability and scaling requirements.

- Add-ons for modelling of battery cells (electric and thermal) for accurate state estimation algorithms (e.g., SOC, SOE, SOH, SOP)

- Prototyping of high-performance safer and reliable battery systems (e.g., for automotive, aviation and stationary applications)
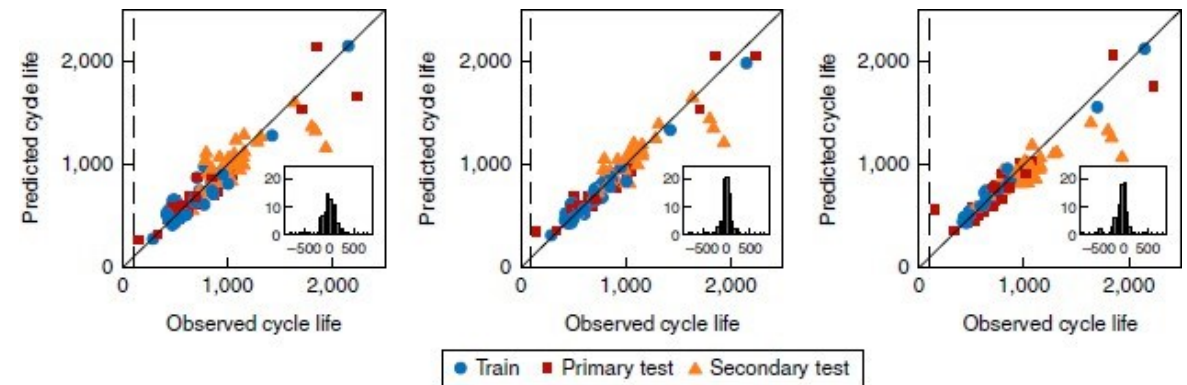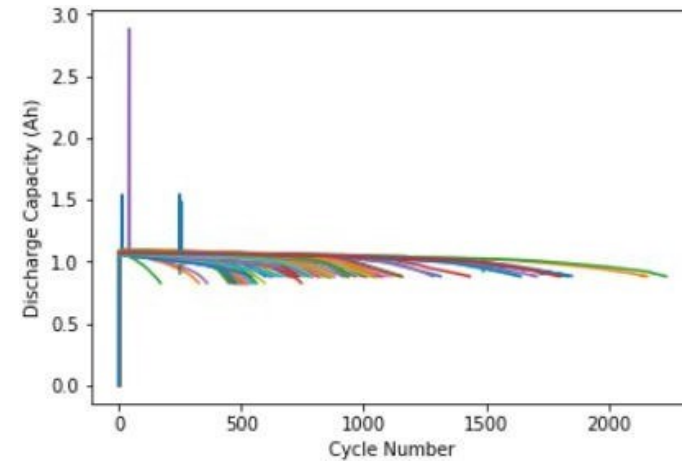
Applied Analytics for Digital Enterprises

Thank You

Greenojo provides Automation, Analytics and AI solutions to enterprise customers

For RFPs, Solutions and Sales/Partner
enquiries, connect us at - *sales@greenojo.com*