

AVL



AVL List GmbH (Headquarters)



E-Library : A Plug & Play Approach to E-Testing

How Supporting a **Purpose** goes beyond Supporting a **Product**

2019

Henry Joswa

Your Goals. Our Service Solution.



Electrification Services Approach



Experience

SUPPORT THE CUSTOMER PURPOSE.

And Not Only Our Product .



Added Value

The Electrification Industry Scenario

Electrification Broke The Equilibrium Of Automotive Testing & Development ...

TECHNOLOGY & METHDOLOGY CHANGED



COMPETENCY REQUIRED CHANGED



PEOPLE & WORKFORCE CHANGED



... All At a Rapid Pace.

Hurdles To The Finish Line

3 Pivotal Drivers for Our Customers

Fast Time To Market

Building Competence & Skill

Manpower & Resource Limitations



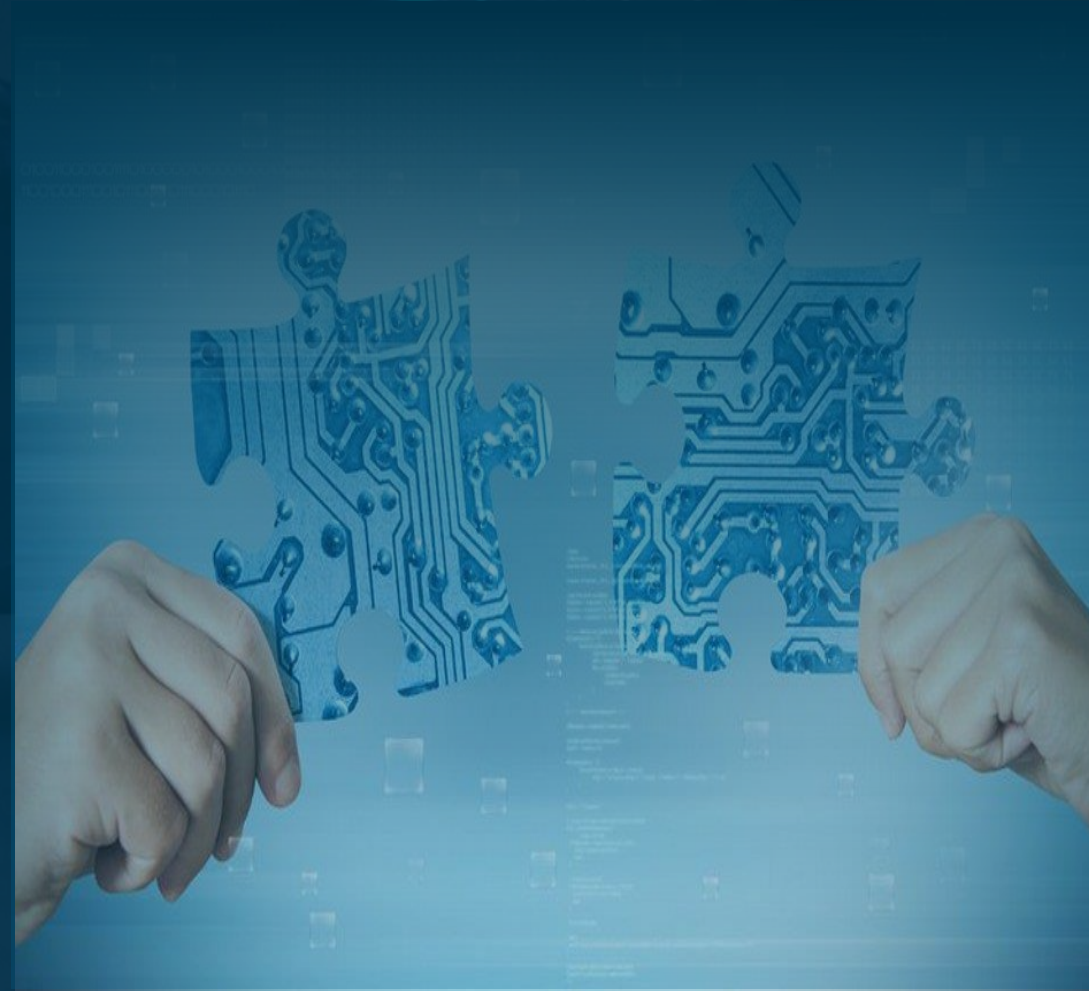
Bringing Down The Hurdles

E-Library is a package of ...

Flexible Ready To Use Tests with Minimal Parametrization

+ Automated Data Analysis & Intelligent Reporting

+ Competence builder based on Global Test Standards.



Why A Test System Is Required ?

WHY A CUSTOMER NEEDS A TEST SYSTEM ?

 Chief Engineer & Team

Power, Performance, Design, Packaging, Safety, etc.



Mobility Market Demand



System Requirements & Design

Sub-System Requirements & Design

Component Requirements & Design

Implementation

Iterative Validation & Verification

Design & Validation Plan (DVP) - What Test To Do When

System Integration & Testing

Sub-System Integration & Testing

Component Testing

Battery

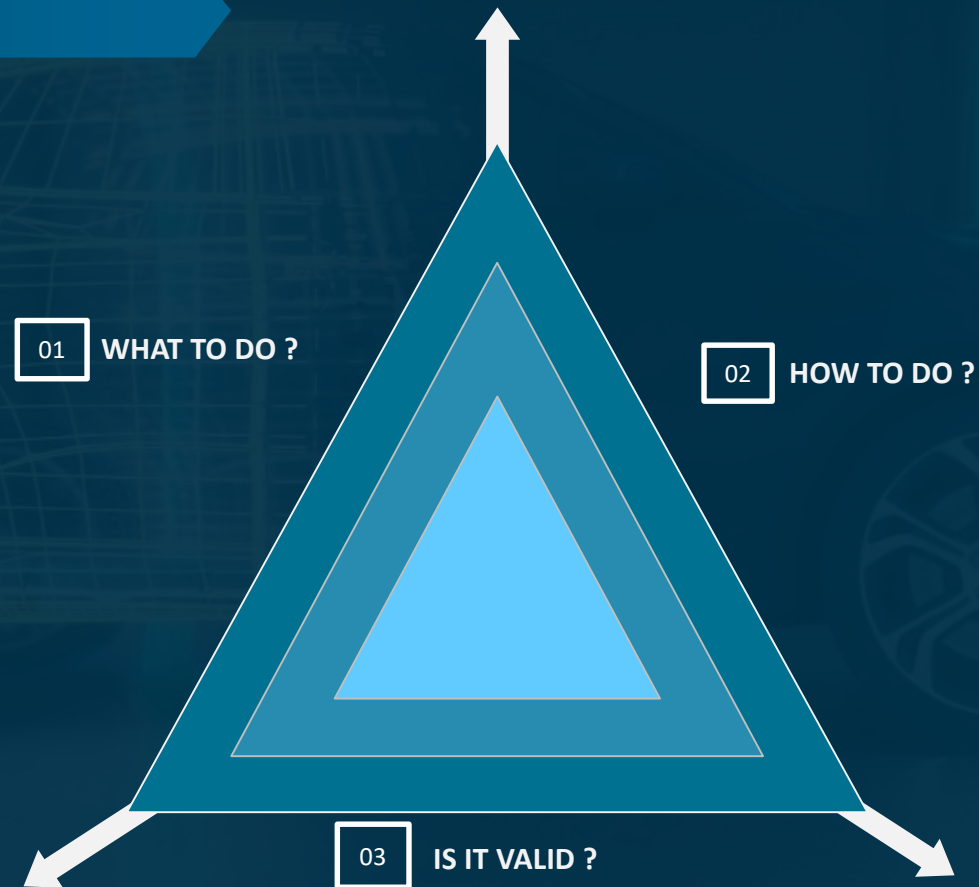
Battery + E Drive

Battery + E Axle + Controls ..then full vehicle integration.



The E-Testing Challenge

ELECTRIFICATION TESTING CHALLENGE ...

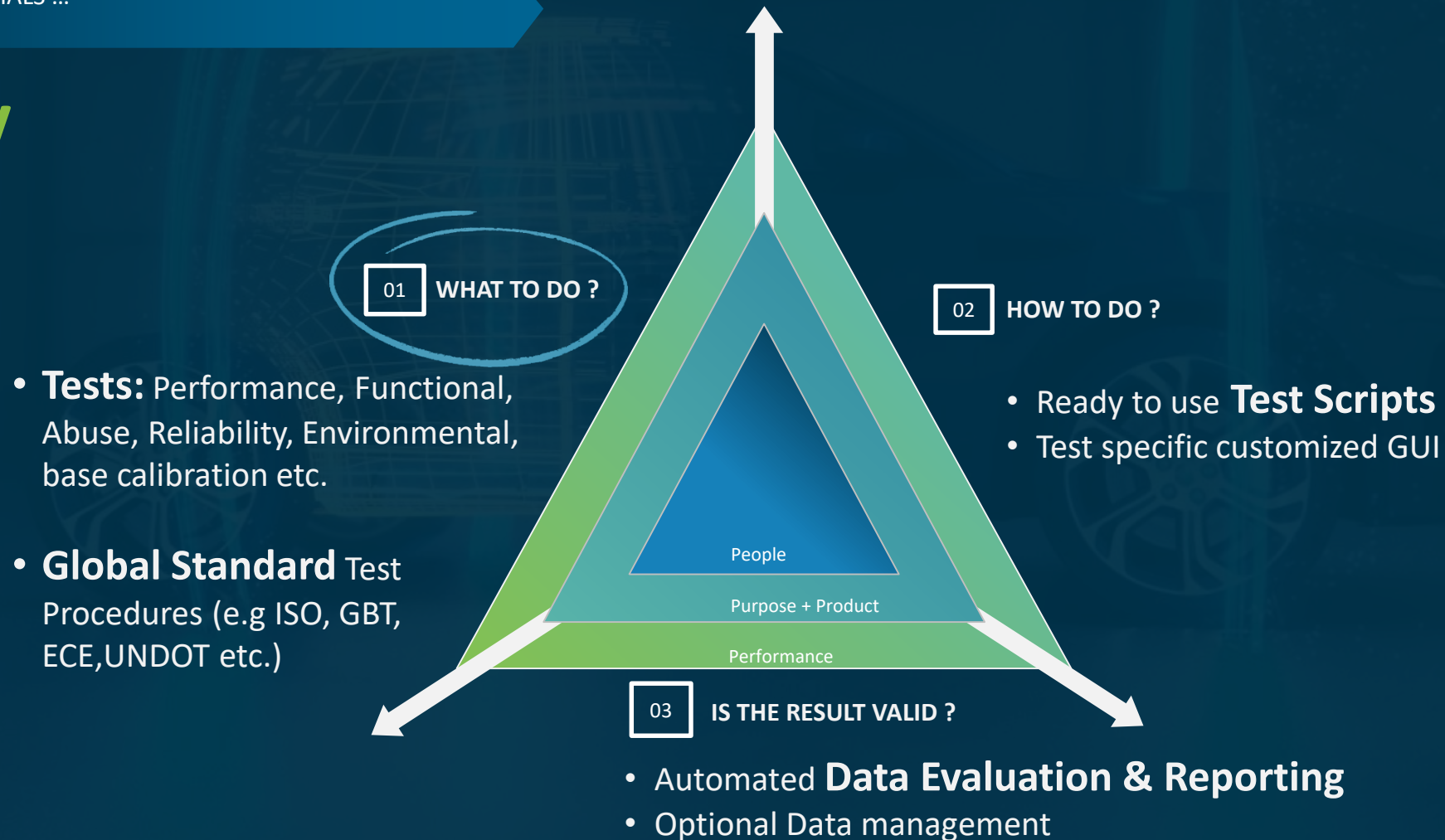


The Know & The How

E-Library: A "Plug & Play" Approach to E Testing & Development

E-LIBRARY CRACKS THE ESSENTIALS ...

E-Library



ISO 12405-4 Test Procedures.

Performance Tests

Energy and capacity at room temperature

Energy and capacity at different temperatures and discharge rates

Power and internal resistance

No-load SOC loss

SOC loss at storage

Cranking power at low temperature

Cranking power at high temperature

Energy efficiency (High Power)

Energy efficiency (Fast Charging)

Cycle life

Reliability Tests

Dewing – Temperature change

Thermal shock cycling

Vibration *

Mechanical shock *

Abuse Tests

Short circuit protection *

Over charge protection

Over discharge protection

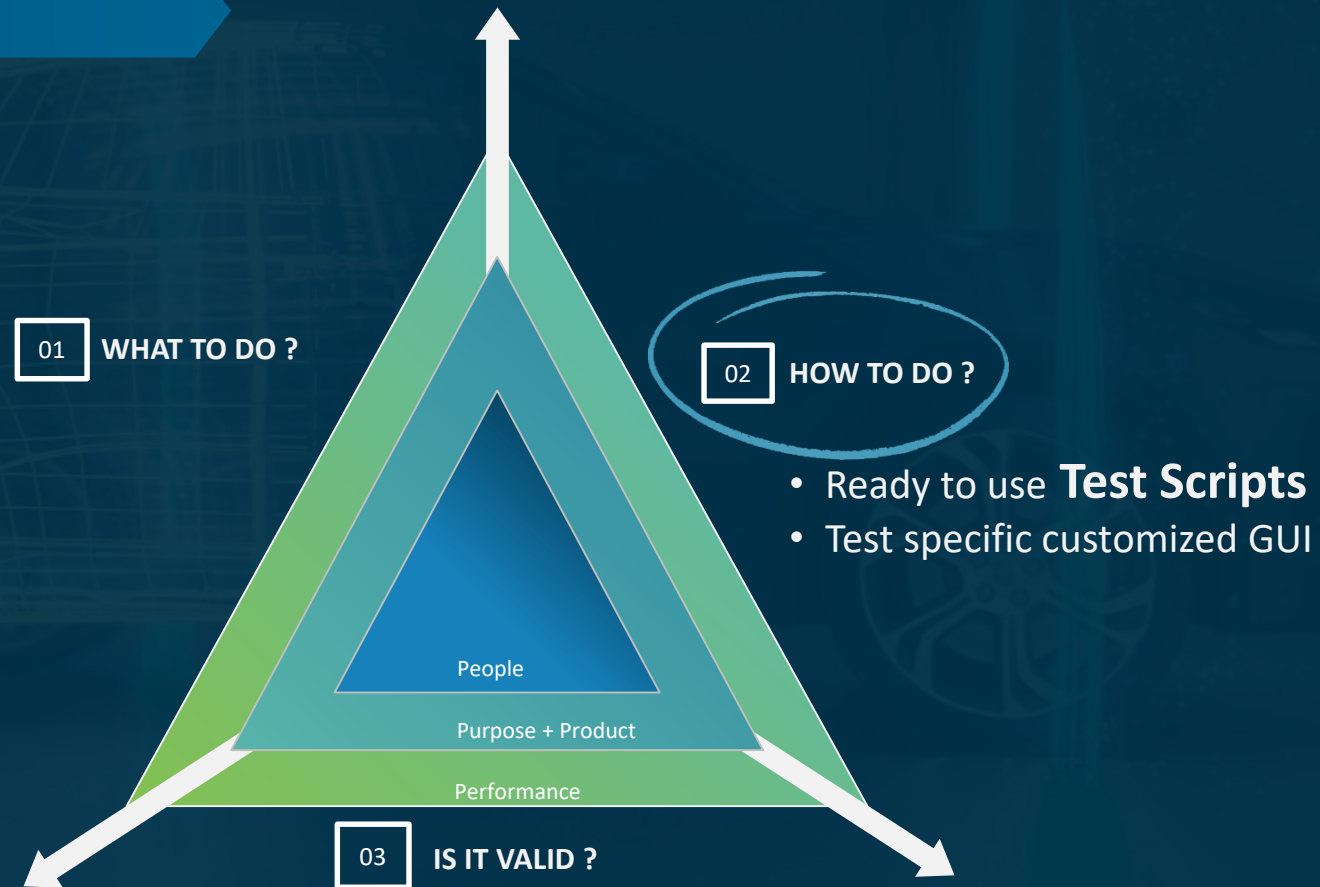
* Non AVL Equipment integration involved. Driver development may be required.
To Be evaluated

The Know & The How

E-Libraries: A "Plug & Play" Approach to E Testing & Development

E-LIBRARY CRACK THE ESSENTIALS ...

E-Library



What is the "How To Do?"

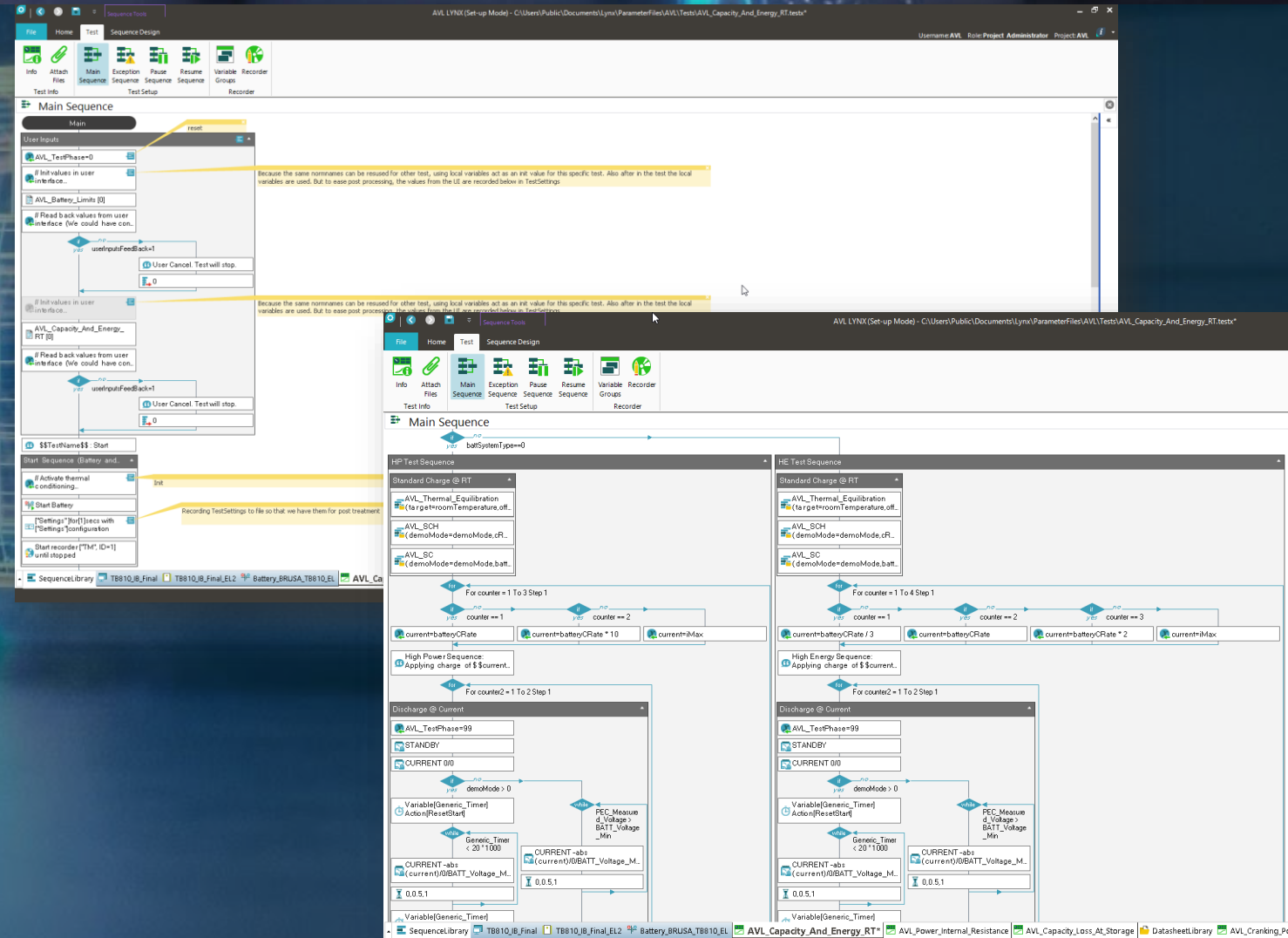
Pre Built Validated Test Scripts



GENERAL STEPS INVOLVED

1. Automation System Preparation / Set Up
2. Test Sequence Scripting
3. Verification and Debugging in simulator and/or testbed
4. Test Execution

* A Commissioned Test Bed and functional UUT are prerequisites



E Libraries did it for you !!

Flexible & Customizable Pre Built Validated Test Scripts



UUT Specific Parametrization

Datasheet[1] - AVL_Battery_Limits

Battery

SETTINGS

BATTERY SYSTEM: High-Power (HP) ▾

BATTERY C RATE (Ah): 35.0000 ▾

C MULTIPLIER: 1.0000 ▾ (ISO : 1C for HP and C/3 for HE)

CUT OFF C RATE: 0.1000 ▾ (C RATE Multiplier for stopping CV Phase)

LIMITS

VOLTAGE (V)	Lower	330 ▾	Upper	420 ▾
CURRENT (A)	Lower	-400 ▾	Upper	400 ▾
POWER (kW)	Lower	-160 ▾	Upper	160 ▾
TEMPERATURE (°C)	Lower	-50 ▾	Upper	0 ▾
SOC (%)	Lower	0 ▾	Upper	100 ▾
CELL VOLTAGE (mV)	Lower	3000 ▾	Upper	4500 ▾

* Cancelling will stop the test

ISO 12405-4:2018

OK Cancel

Test Specific Parametrization Examples

1

Datasheet[1] - AVL_Capacity_And_Energy_RT

Capacity And Energy RT

DISCHARGE I MAX (A): 200 ▾

ROOM TEMPERATURE (°C): 25 ▾ (ISO : 25)

* Cancelling will stop the test

ISO 12405-4:2018

OK Cancel

2

Datasheet[1] - AVL_Cranking_Power

Cranking Power (Low/High Temperature)

ROOM TEMPERATURE (°C): 25 ▾ (ISO : 25 degree C)

TEMPERATURE LEVEL: Low Tempel ▾

High Temperature (HT) Test

HIGHEST TEMPERATURE (°C): 40 ▾ (ISO :50 degree C)

Low Temperature (LT) Test

LOWEST TEMPERATURE (°C): -40 ▾ (ISO : -18 degree C)

Perform the test with the additional low temperature in continuation

OPTIONAL TEMPERATURE (°C): -30 ▾ (ISO : -30 degree C)

* Cancelling will stop the test

* This test applies to high-power battery systems only *

ISO 12405-4:2018

OK Cancel

+ Open test
scripts for
editing.

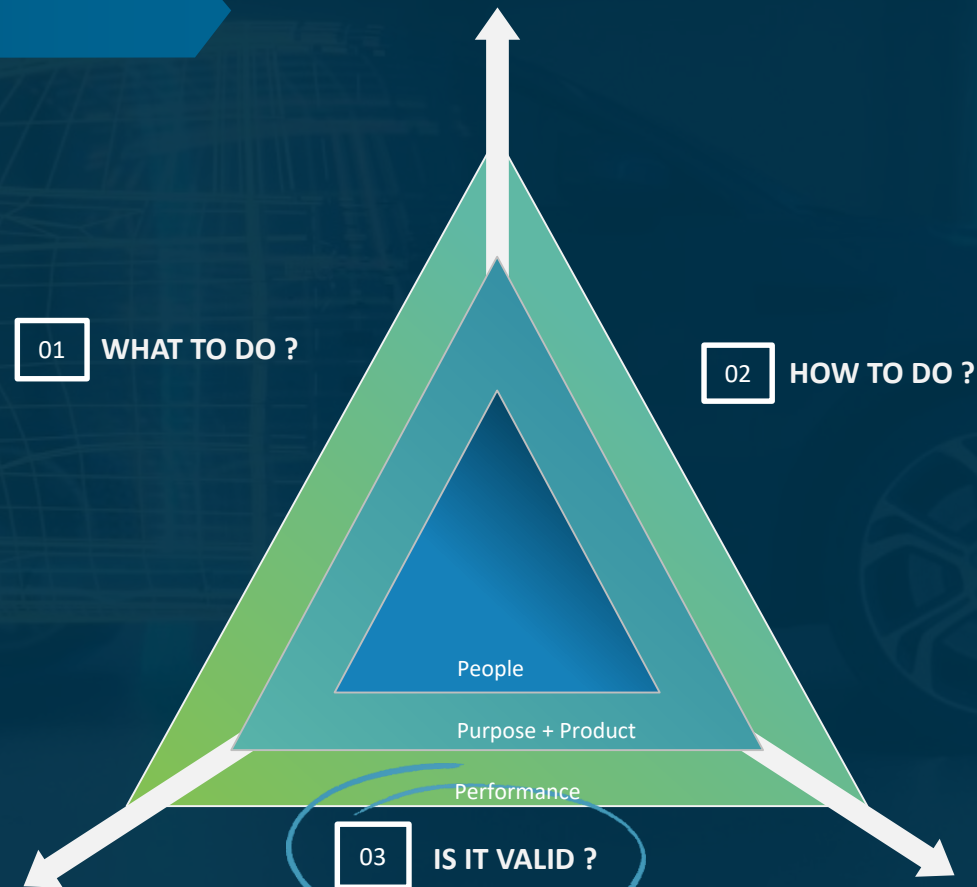
AVL Customer Service Solution

E-Libraries: A “Plug & Play” Approach to E Testing & Development



E-LIBRARY CRACK THE ESSENTIALS ...

E-Library



- Automated **Data Evaluation & Reporting**
- Optional Data management

The Ultimate Reason For A Test Run: Data !!

Automated Data Analysis & Intelligent Reporting



GENERAL STEPS INVOLVED

1. Data file(s) handling & set up in CONCERTO (Data Processor)
2. Data Analysis & Data Interpretation
3. Graph / Plot Layout set Up
4. Plot / Report Generation
5. Documentation (.docx, pptx, PDF)
6. Automated E mail reports

E Libraries does it for you !!

Efficiency Trend

Date : 2019/11/21 Time: 11:29:21

Discharge Resistance (First vs Last @RT)

R1 [mOhm]

R2 [mOhm]

Power and Resistance 68% 25°C

Curves and Calculation points

Discharge Resistance		
R1	10,072	mOhm
R2	24,850	mOhm
R3	87,072	mOhm
R4	149,29	mOhm
R5	9,2867	mOhm

Charge Resistance		
R6	10,057	mOhm
R7	24,834	mOhm
R8	87,056	mOhm
R9	9,2320	mOhm

Open Circuit Voltage		
U0	254,6848	V

Date : 2019/09/18 Time: 15:15:58

E Libraries : A Speedy Pull Ahead.



E-Library

Estimated 16 X Faster Time to Productive Testing

Test System Investment

Test System Installation

Testing & Operational Ramp Up

Productive Testing Phase

1 "Ready To Use" Test

1 Learn

2 Customize

Conventional Approach

Test System Investment

Test System Installation

Testing & Operational Ramp Up

Productive Testing Phase

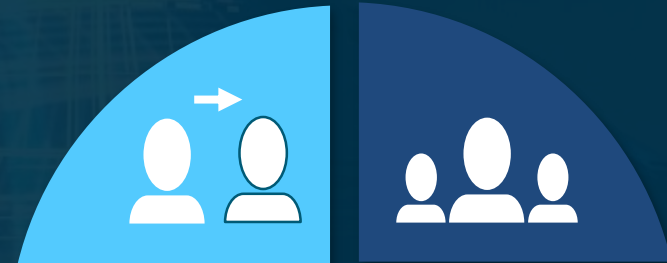
1 Learn

2 Implement

3 Test

E-Library

01 Knowledge Transfer



Application Support **04**

02 Access to Commented Test Script



Documentation **05**

03 Built In "Safe Limit" Handling



Access to EDP* Training **06**

Workflow: The Easy 1 ...2...3

Simple. Flexible. Consistent



One Time Set Up & Integration

Estimated Installation time : 40 min

*Included in packaged Application Support

Open Test

Y	Name	Modified	Size
1	AVL_Capacity_And_Energy_All	18/07/2019 11:54:46	6.98 KB
2	AVL_Capacity_And_Energy_RT	18/07/2019 11:54:47	7.21 KB
3	AVL_Capacity_Loss_At_Storage	18/07/2019 11:49:45	5.44 KB
4	AVL_No_Load_SOC_Loss	18/07/2019 11:49:53	6.40 KB
5	AVL_Power_Internal_Resistance	18/07/2019 11:54:47	7.03 KB

Capacity Loss at Storage

Battery Info

BAT_Limit_Voltage_CHG: 420 BAT_Limit_Voltage_DCH: 50

BAT_Limit_Current_CHG: 200 BAT_Limit_Current_DCH: 200

BAT_Limit_Power_CHG: 84 BAT_Limit_Power_DCH: 64

BAT_Limit_Temp_Upper: 40 BAT_Limit_Temp_Lower: 10

BAT_SOC_Limit_CHG: 96 BAT_SOC_Limit_DCH: 0

Hydrex: 10 BAT_C_Rate: 1

Target Battery

Target Discharge SOC: 50 Target Charge SOC: 50

ISO 12405-4:2018

1 Test Selection & Parametrization

Power Electronics Controller - Setpoint

Cannot manually execute setpoints while a test is running.

Current [A] Voltage [V] Power [W]

Active Control Mode: []

Active: 253.5021 0.0000 0.0000

Demand Value: 287.5516 0.0000 0.0000

Standby: [] Ramp Time [s]: 0.0 Apply

Phase: Off Ramp Rate [V/s]: 10.0

Graph: PEC_Measured_Current [A] [I], PEC_Measured_Voltage [V] [I], BAT_Measured_Cell_Temperature [C] [I]

2 Test Run

Power and Resistance 20% 25 °C

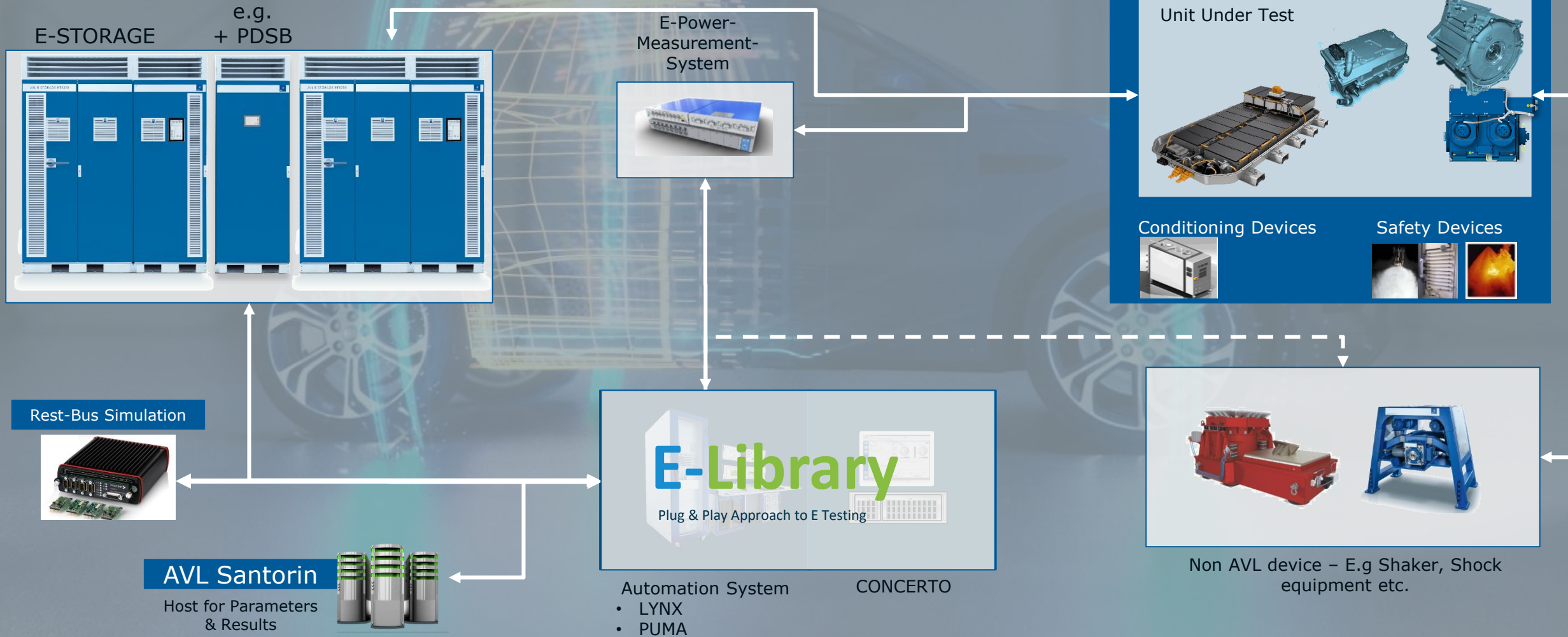
Curves and Calculation points

Current [A] Voltage [V]

RecordingTime [s]

3 Data Analysis & Reporting

Interoperable & Optimized Toolchain



E-Library: The Summary Round Up

E-Libraries is a “Plug & Play” package offering ...

COMFORT

COMPETENCE

CONFIDENCE

Much Needed SPEED

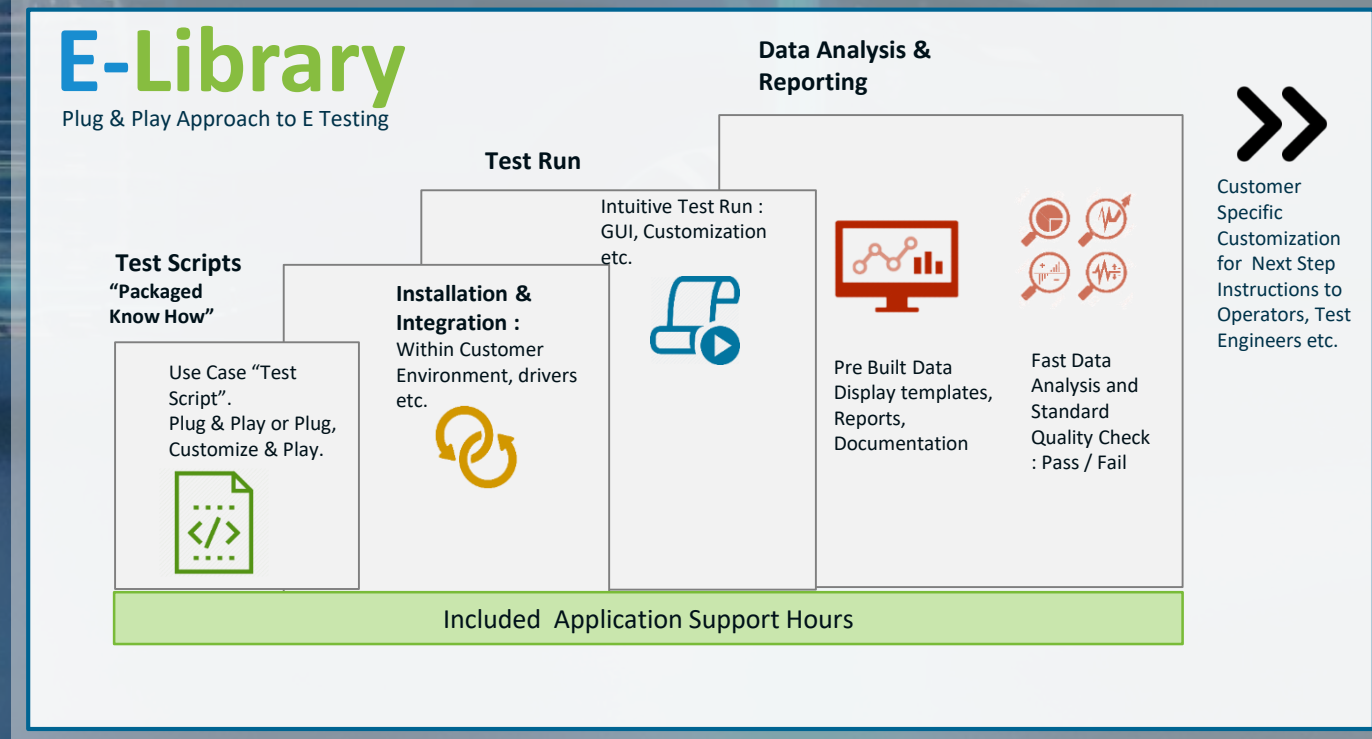
E-Libraries Is a Package Of...

“OUT OF THE BOX” TESTS. EASILY CUSTOMIZABLE.

AUTOMATED DATA ANALYSIS & INTELLIGENT REPORTING

BUILT-IN KNOWLEDGE TRANSFER

APPLICATION SUPPORT



AVL Customer Service Solution

E-Libraries: A “Plug & Play” Approach to E Testing & Development



E-Library USP & VALUE DELIVERED



FAST TIME TO PRODUCTIVITY .

- Ready to use tests.
- Automated data analysis & reporting



BUILD ELECTRIFICATION COMPETENCY

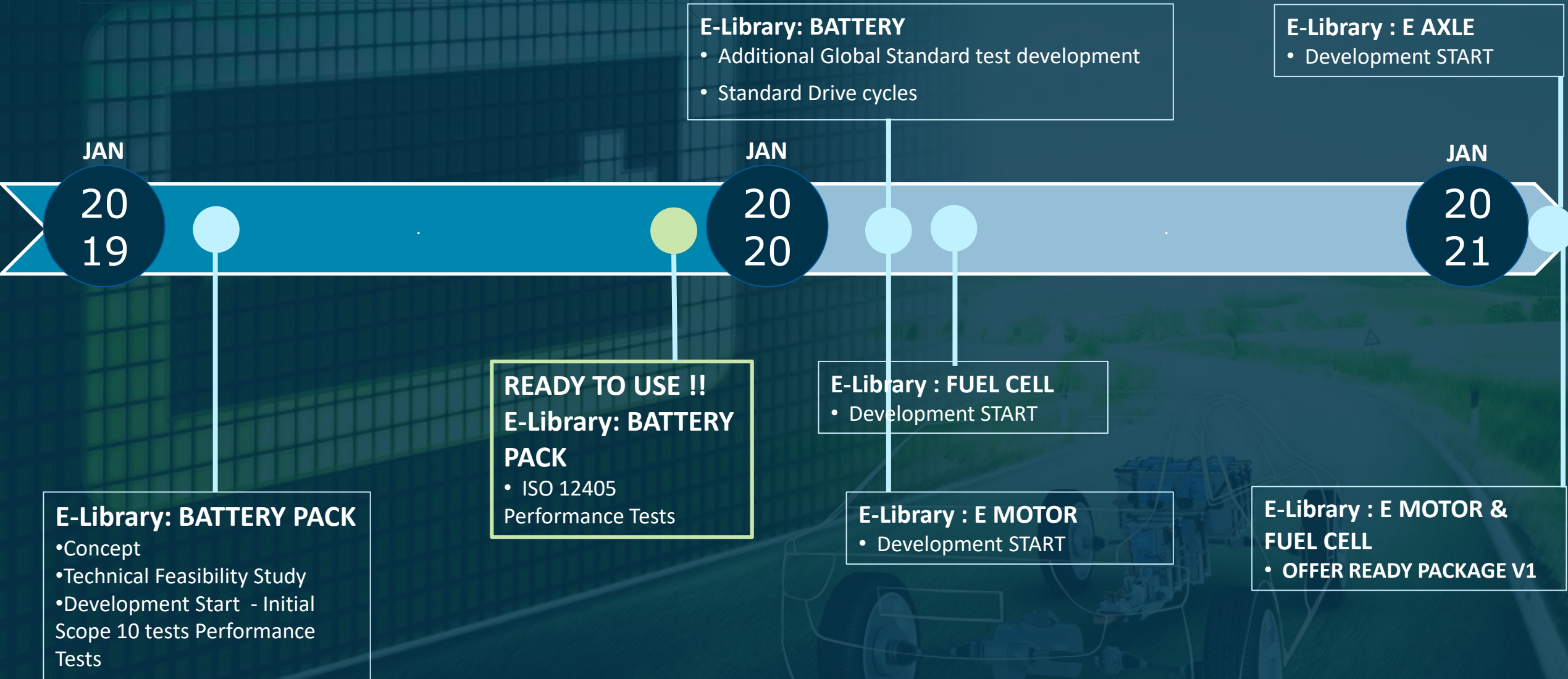
- Learning on the job ,while being productive
- Access to training / knowledge transfer



SCALABLE & SUSTAINABLE PERFORMANCE

- Optimized & Interoperable between AVL Systems.
(Also non AVL integration possible).
- Enables benchmarking

E LIBRARIES: TIMELINE & PLAN



CONCLUSION



COMMON PURPOSE
CONNECTED MISSION.

We aspire to approach **SERVICE** solutions by understanding the **PURPOSE**.

Connect the capabilities of **PRODUCT** to the **PURPOSE**

#PurposeBeyondProduct