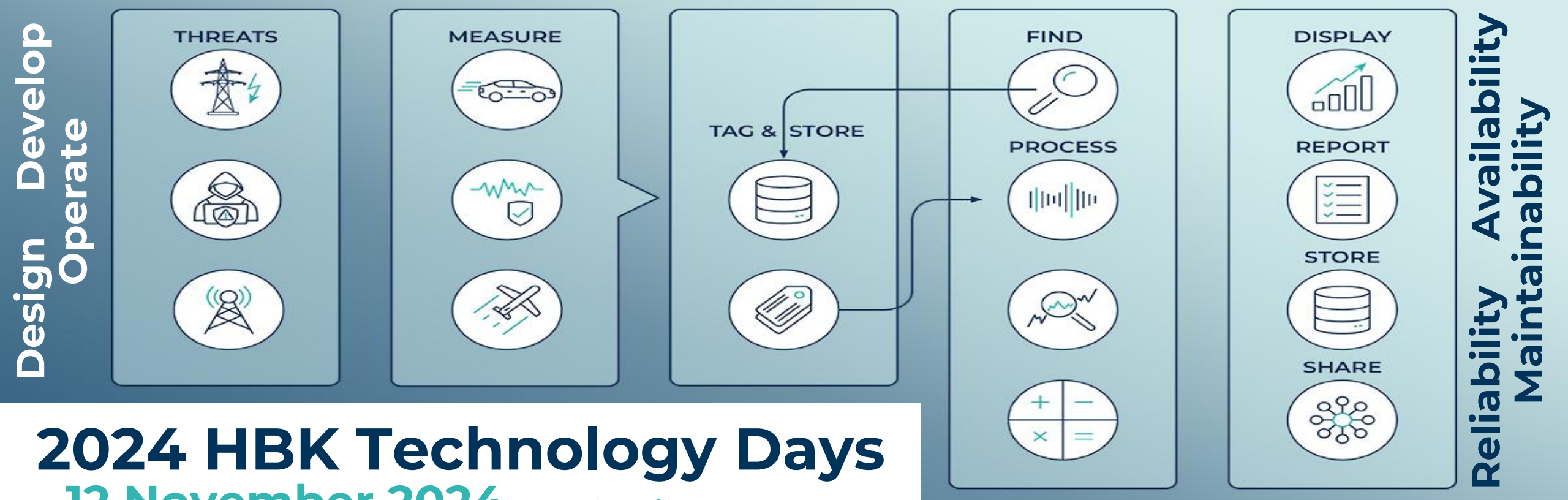




2024 HBK Technology Days

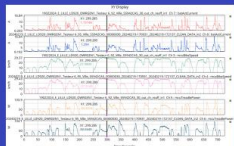
12 November 2024

Session 4: Vehicle Network Analytics

DECATHLON

HBK HOTTINGER
BRÜEL & KJÆR

E-bike development using CAN data loggers,
AWS cloud and nCode analysis to build endurance motor profile.



- e-Bike development using CAN data loggers, AWS cloud and nCode analysis to build endurance motor profile

Maxime Darnois, Test Engineer, DECATHLON

Nicolas Baron, Application Engineer – Durability and Reliability, HBK

e-Bike development using CAN data loggers, AWS cloud and nCode analysis to build endurance motor profile

Abstract

- DECATHLON design and develop e-Bikes for a rapidly growing and diversifying consumer market. To meet rider expectations, it is necessary to design and optimise e-Bike components and performance as close as possible for their use: mountain bike, city bike, cargo bike, etc. We use multiple sources of information to get massive data from different testers to learn their riding habits; average speed, distance trip, assistance power, etc. Use of CSS data loggers is standard practice for a fleet of e-Bike rider measurements.
- This fleet allows monitoring battery and electrical motor in relation to e-Bike use events. The purpose is to understand conditions and parameters of defaults on motors, batteries, and reproduce defaults on testing bench to improve these products. These data allow development of representative field tests, simulation models and electro-mechanical tests, especially for endurance motor tests. The main objective of this test is to accelerate endurance motor testing from several weeks to a few days to reduce time to market on project and be able to test quickly and continuously improve our motors.
- This presentation will give an overview of CSS dataloggers uses in DECATHLON, and use of nCode & Aqira for measurement data analyses for accelerated test development; from e-Bike riders to the test bench.

e-Bike development using CAN data loggers, AWS cloud and nCode analysis to build endurance motor profile

▲ About the presenters,

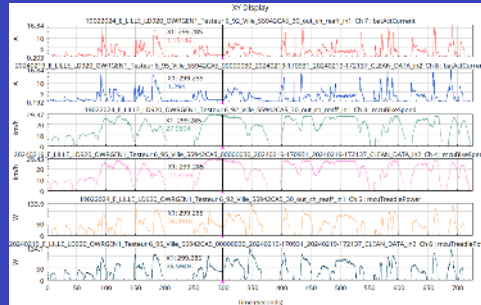
▲ Maxime Darnois, Test Engineer, DECATHLON

- Maxime has an engineering diploma (Master) in mechanical engineering. Since 2018, he worked as testing engineer at Decathlon company. He has an experience of structural dynamics, fatigue and testing. He worked on structural products studies (wheel, cargo bike, luggage carrier...) by using instrumentation to understand customer expectations, to develop fatigue and static reliable tests from field tests. Since 2023, he has developed skills on electrical bikes, especially in collecting data from CAN network and make it available for teams in Decathlon (R&D, conception, simulation). Before Decathlon, he was working in the automotive motor industry at Stellantis Douvrin.

▲ Nicolas Baron, Application Engineer – Durability and Reliability, HBK

- Nicolas Baron has been an Application Engineer at HBK since 2018, where he performs support, training and pre-sales activities for nCode (durability) and ReliaSoft (reliability) software products. His background is acoustic and vibrations with a thesis at the KTH university in Sweden. He has worked for the automotive industry for about 10 years, as a test engineer for acoustic and durability tests and then as an FEA engineer in the numerical simulation department for an OEM supplier. He has a master's degree in mechanical engineering from ENSIAME.

E-bike development using CAN data loggers, AWS cloud and nCode analysis to build endurance motor profile.





 **DECATHLON**

UNRESTRICTED

INNOVATION AT DECATHLON

Honouring our legacy, **embracing innovation** across our five pillars



A company providing innovations on a wide range of sports products



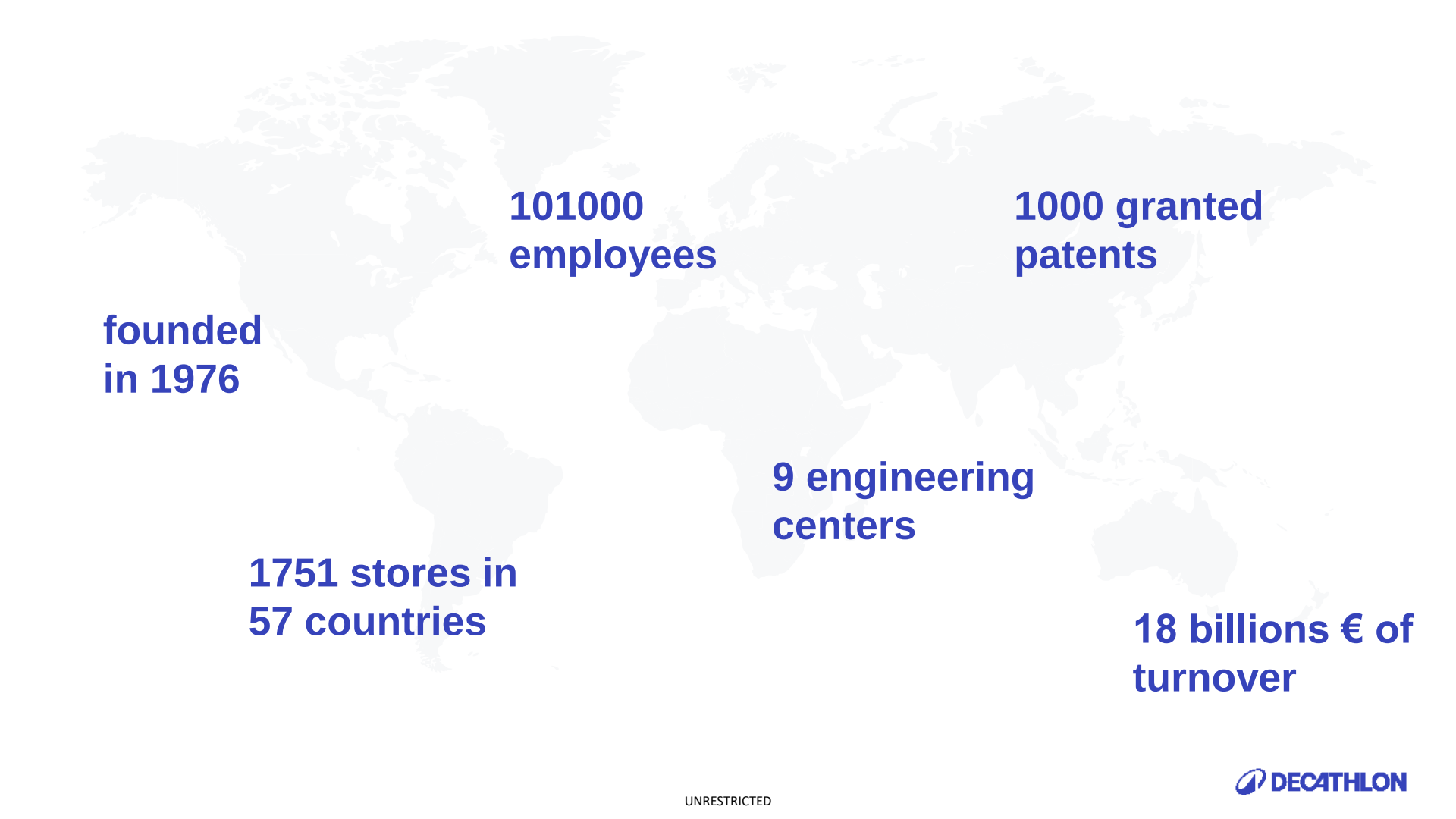
2 SECONDS TENT -
2005



EASYBREATH - 2014



Automatic Ebike LD920 -
2023

A light gray world map serves as the background for the slide. The text is overlaid on the map in various locations.

**founded
in 1976**

**101000
employees**

**1000 granted
patents**

**1751 stores in
57 countries**

**9 engineering
centers**

**18 billions € of
turnover**

E-bike development using CAN data loggers, AWS cloud and nCode analysis to build endurance motor profile.



Global data process

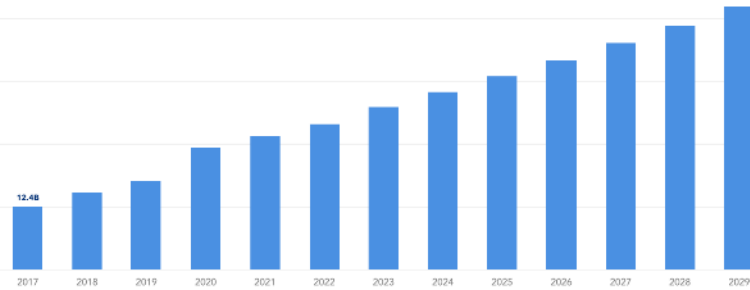
Focus on
instrumentation

Focus on Analysis

Introduction

Introduction

GLOBAL E-BIKE MARKET, VALUE, USD MILLION, 2017 - 2029



Global market size (in USD billion) :
2024: 34,98
2029: 51,78

Source: Mordor Intelligence



Bike use	Use characteristics
Cargobike	Extra load (~ 250kg)
Mountain bike	Brutal slope change (~30%)
City bike	Many start/stop
Road bike	Long continuous slope (> 10 km)

E-bike development using CAN data loggers, AWS cloud and nCode analysis to build endurance motor profile.



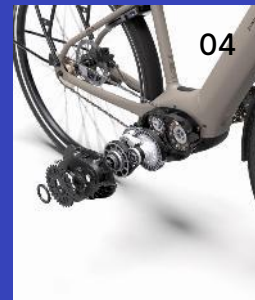
Introduction



Global Data process



Focus on
instrumentation



Focus on analysis

From the use to the test bench

Raw datas:

- **User:** power, speed, mode
- **Motor:** T°, cadence
- **Battery:** SOC, SOH
- **GPS**

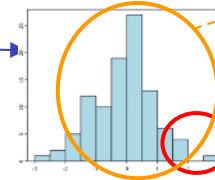
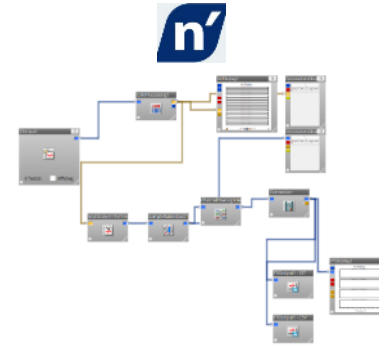


Metadatas:

- **Bike model**
- **User parameters** (weight, size, level)
- **Test date**

Instrumentation

Use test



- Use knowledge (average, critical)
- Mission profile for tests :
 - autonomy
 - endurance
 - performance

Analysis (process)



Bench motor



Bench motor

E-bike development using CAN data loggers, AWS cloud and nCode analysis to build endurance motor profile.



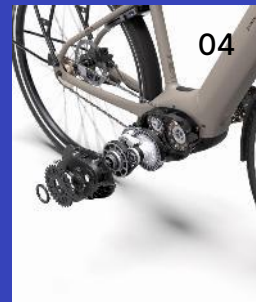
Introduction



Global data process



Focus on
instrumentation



Focus on analysis

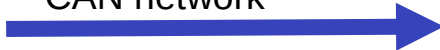
Instrumentation



Instrumentation needs:

- Waterproof
- With proper electric alimentation
- Wifi connected
- Practical (no use change)

CAN network



Data Type	With dataloggers
User Identity	
Weight	
Bike Identity	
Model	
Type of practice	
Consumption	
Timestamp	x
GPX Point	x
Speed	x
Distance	x
Mode	x
User Power	x
Pedaling Cadence	x
Battery & Drive unit data	
Timestamp	x
Battery SOC	x
Battery Voltage	x
Battery Current	x
Temperatures	
Timestamp	x
Motor Temperature	x

Collect data to serve durability



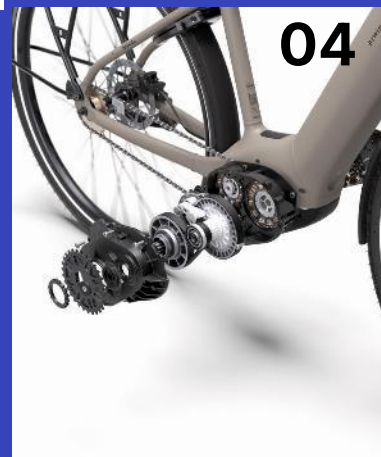
Introduction



Global data process



Focus on
instrumentation



Focus on Analysis

Endurance Analysis on LD920 bike

LD 920E



- more than 100000 km
- over 500 users
- in Europe

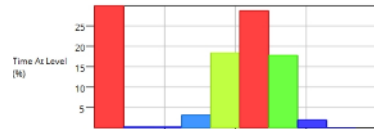
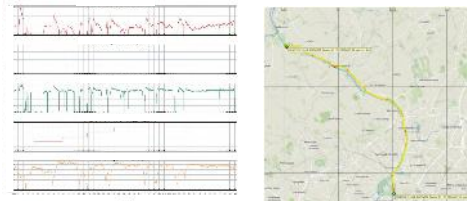


Testing time:

From several weeks to few days

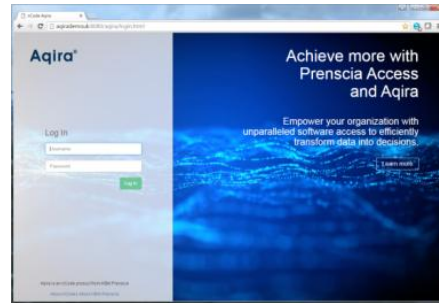
Testing method:

same damage with a virtual endurance profile



Questions

Contact: maxime.darnois@decathlon.com



E-bike development using CAN data loggers, AWS cloud and nCode analysis... through Aqira

HBK Technology Days 2024 —
Vehicle Network Analytics

Nicolas Baron,
Application Engineer



Separate files on an individual's PC



Engineers develop many different analysis processes



Multiple copies of the same process in your organization

Different departments have similar but different analysis methods



No version control



Knowing who is using it



Little or no documentation



Sharing &
Standardization

- Big Data storage and management to ensure digital continuity
- Offers Data Base + nCode analytics + Python runner
- Apps to encapsulate and democratize complex analytic process

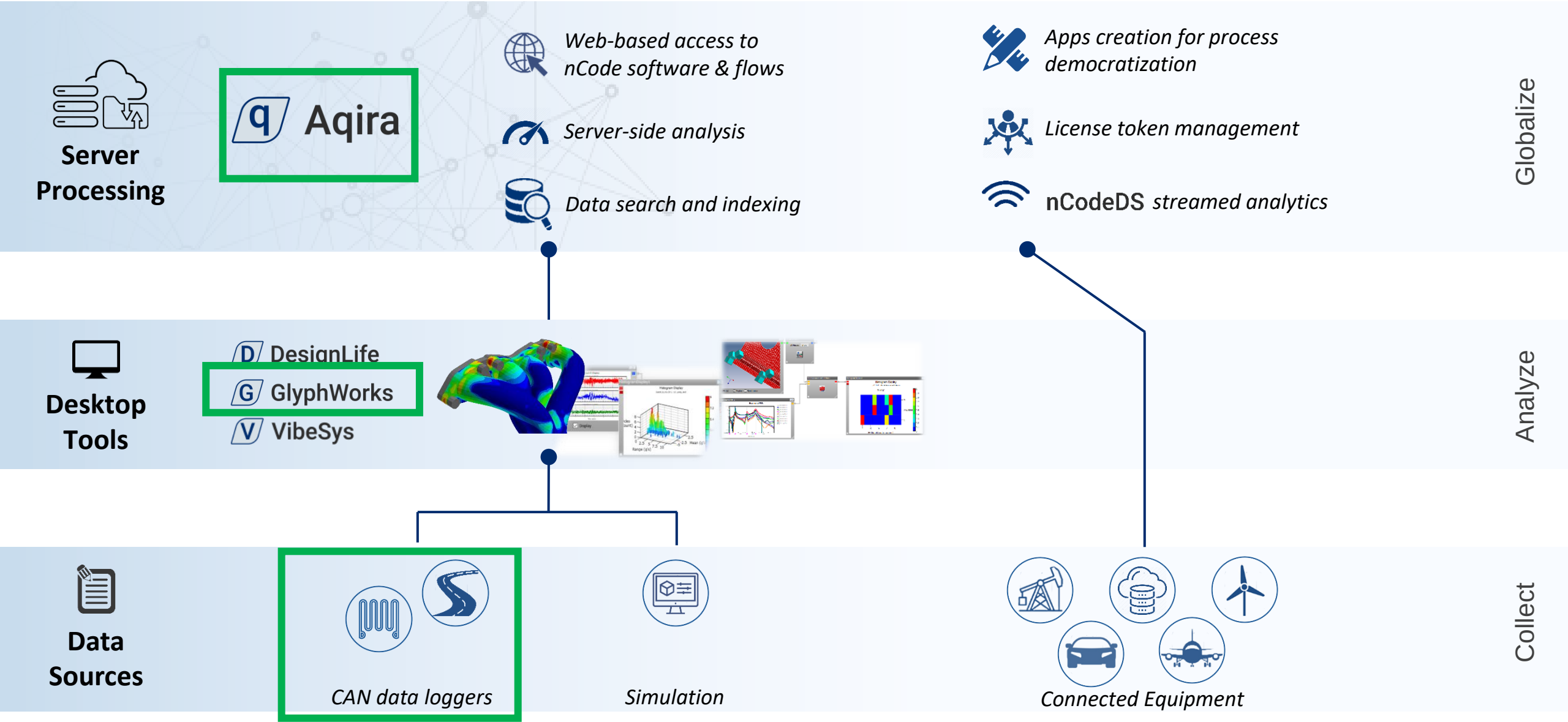
Global **collaborative engineering software platform** to:

- Store
- Centralize
- Share
- Aggregate
- Analyze data...

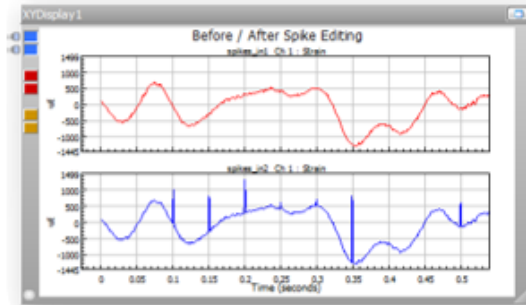
and **transform it to engineering information**

Remote global access to nCode Software to delivers advanced analysis for acoustic, vibration, durability

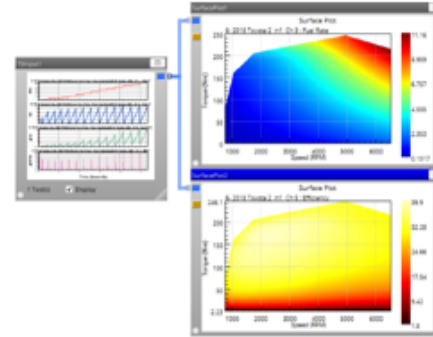




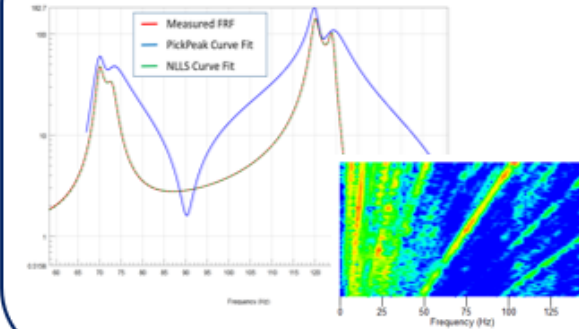
Anomaly detection



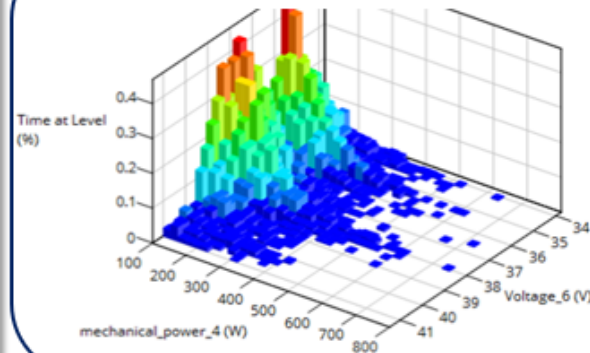
Electrical analysis



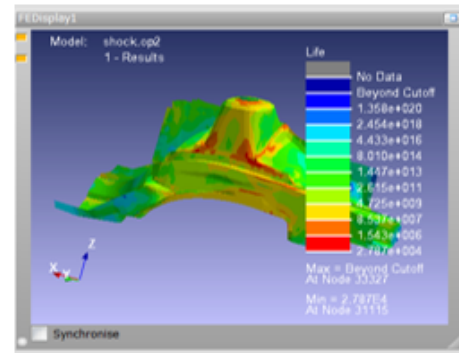
NVH Analysis



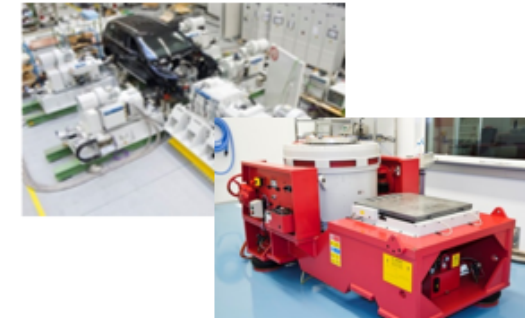
Cycle counting / Mission Profile



Life prediction using Mechanical Digital Twin



Accelerated durability test bench specification

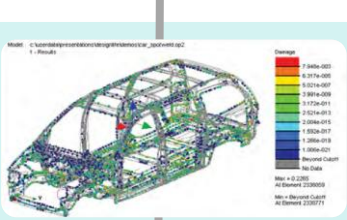


HBK
HOTTINGER BRÜEL & KJÆR

HBK
HOTTINGER BRÜEL & KJÆR



Customer usages



Fatigue Simulation



Durability Test Bench



Electrical test Bench

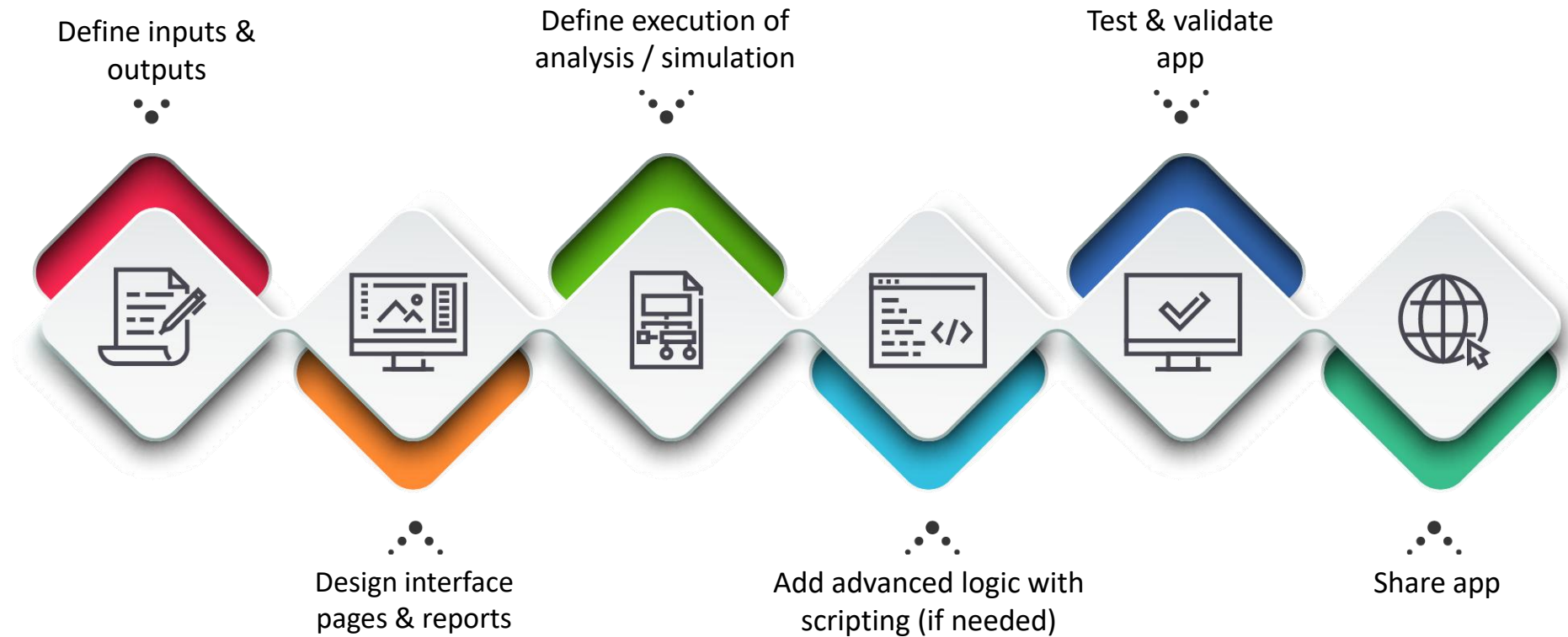
Add context, clean data, Store & Share

Duty Cycle Vibration Profile

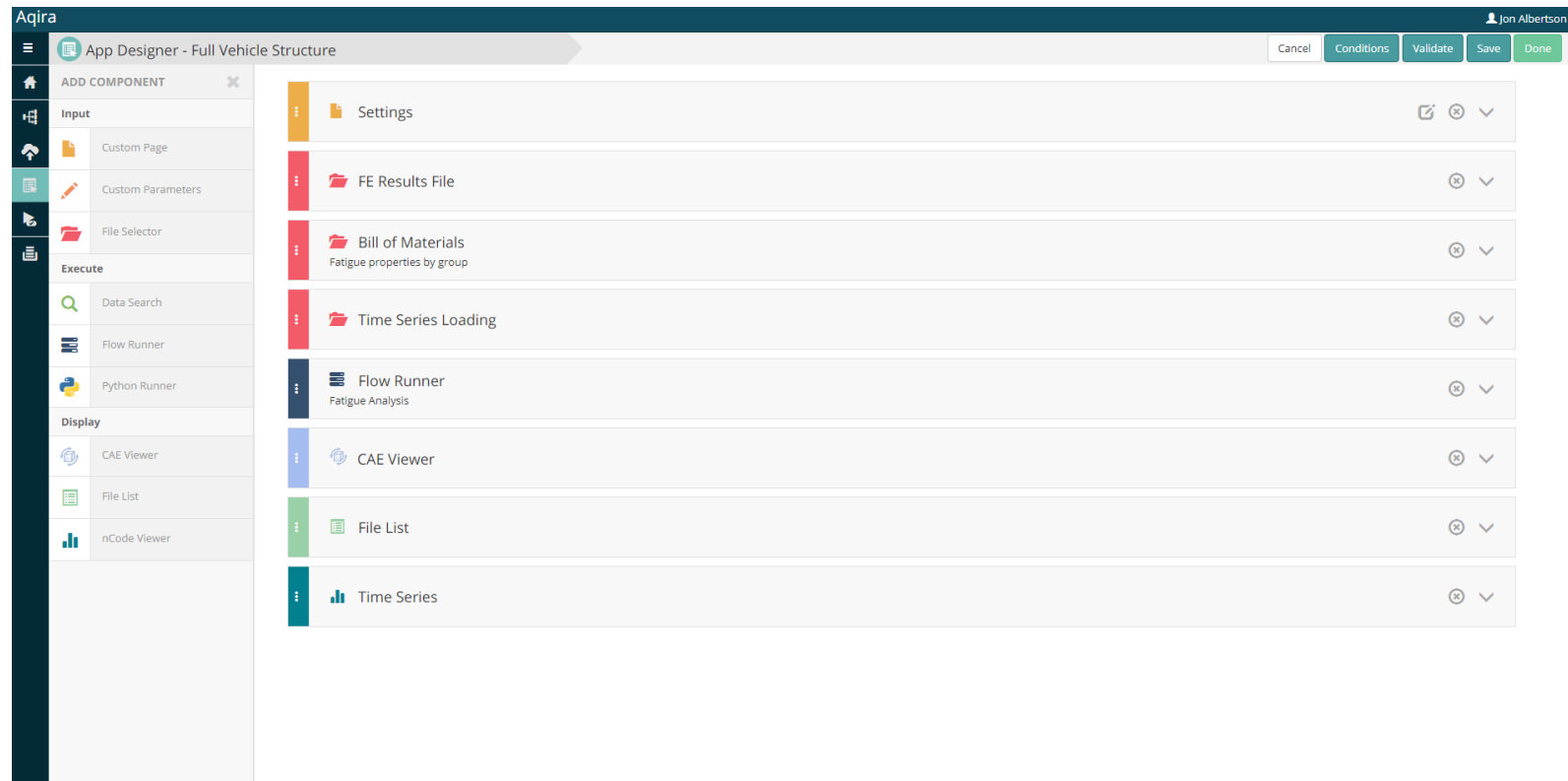
Create Smart durability or electrical test Bench specifications

Insights Dashboard

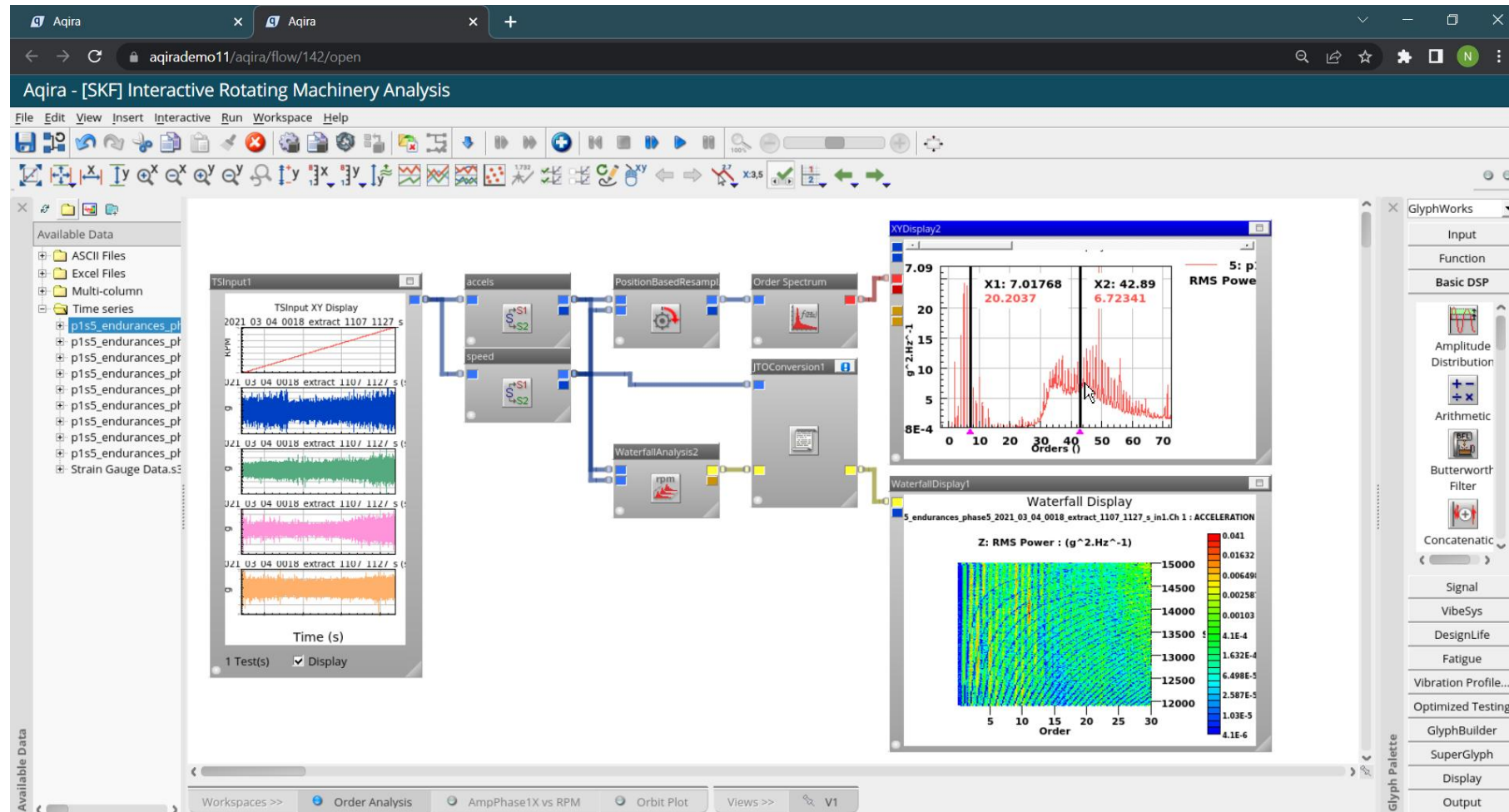
Apps

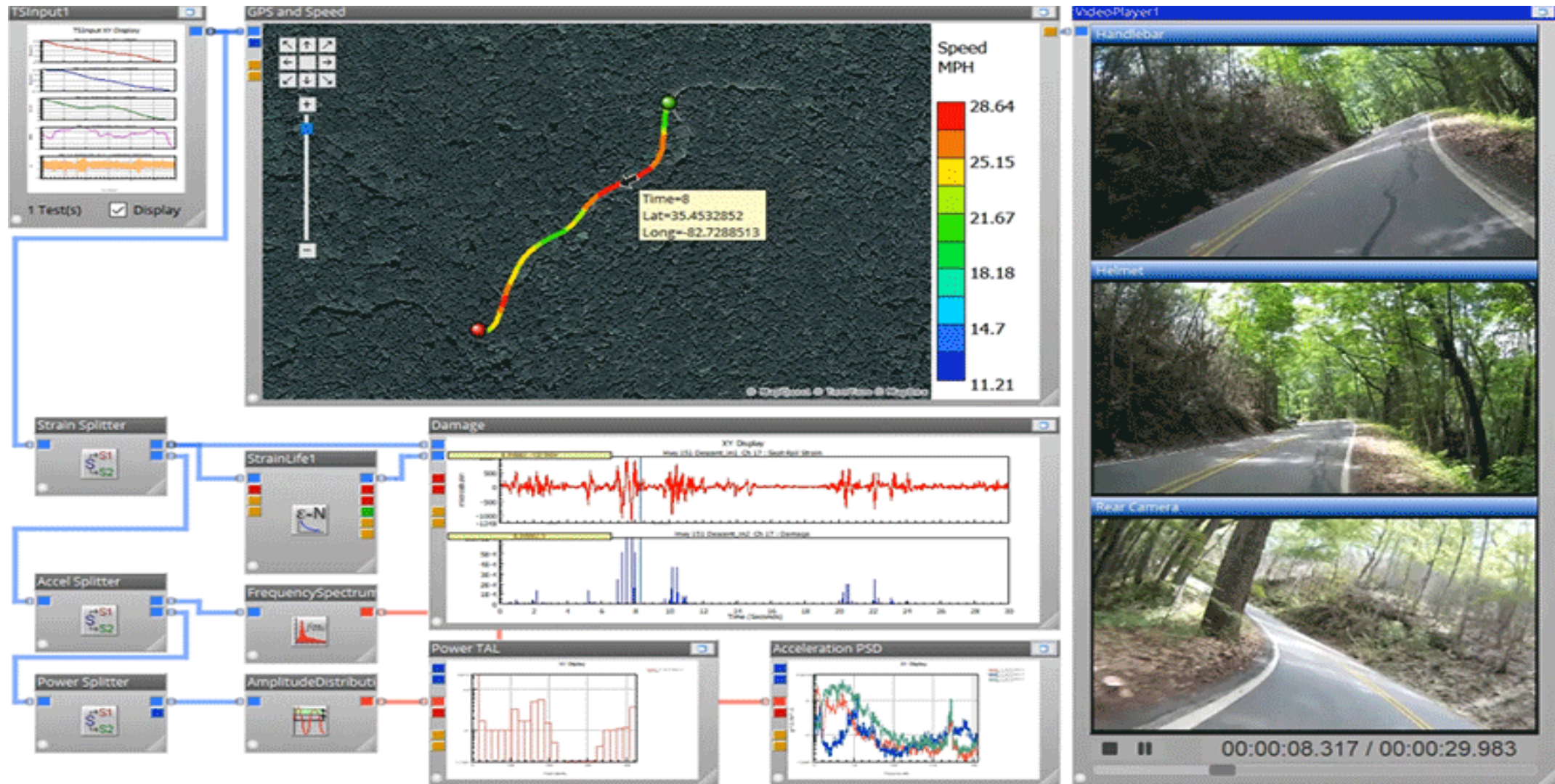


- Apps are all about making an analysis easy to use
- But they are also easy make. If you make a flow, you can design an app
- The App Designer creates the app using a drag and drop interface, for each step in the process



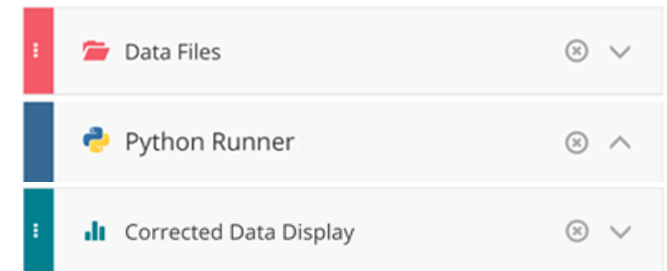
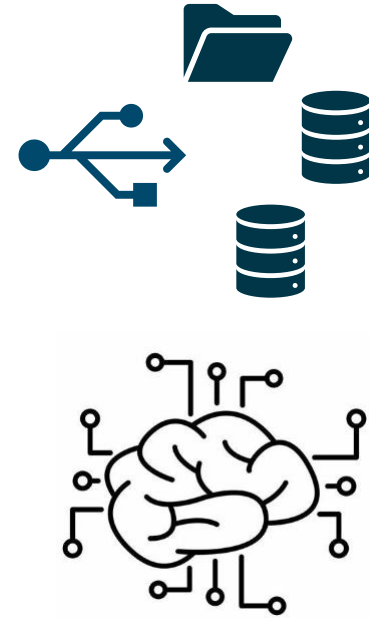
- One centralized software version available remotely to everyone







- Create connectors for indexing other data repositories
- Do Machine learning like Training & running neural nets
- Encapsulate Python script into a simple, easy to use App



Create custom
interface, form,
information

Find data on different
repositories, and
combine flow and/or
Python analysis

Display

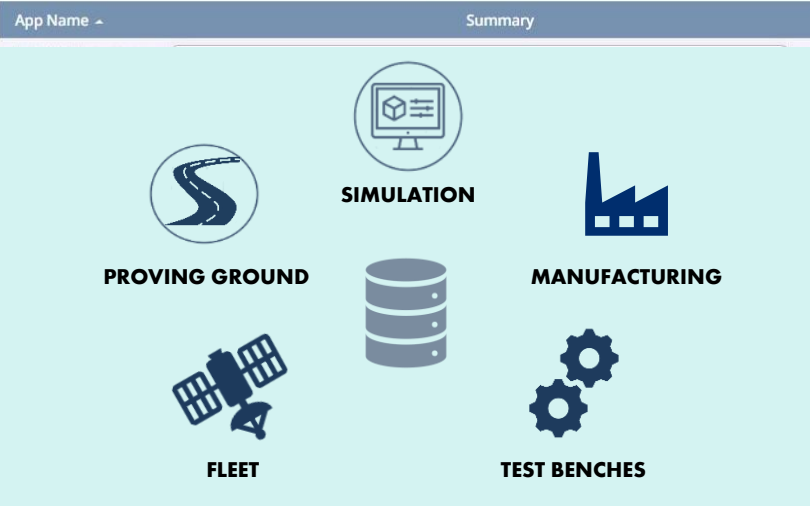
The screenshot shows the 'App Designer - FCA003_Severity Comparison' interface. On the left is a 'COMPONENTS' panel with three categories: 'Input', 'Execute', and 'Display'. The 'Input' category includes 'Custom Page', 'Custom Parameters', and 'File Selector'. The 'Execute' category includes 'Data Search', 'Flow Runner', and 'Python Runner'. The 'Display' category includes 'CAE Viewer'. On the right is the 'Canvas' area showing a workflow with five components: 'Search User Criteria', 'Data Search' (with a sub-description 'Finds the data based on user criteria'), 'Search Results' (with a sub-description 'Manual Data Selection after Search'), 'Severity Comparison Analysis', and 'Level Crossing Display'. A mouse cursor is pointing at the 'nCode Viewer' component, which is partially visible at the bottom of the canvas.

Category	Component
Input	Custom Page
	Custom Parameters
	File Selector
Execute	Data Search
	Flow Runner
	Python Runner
Display	CAE Viewer

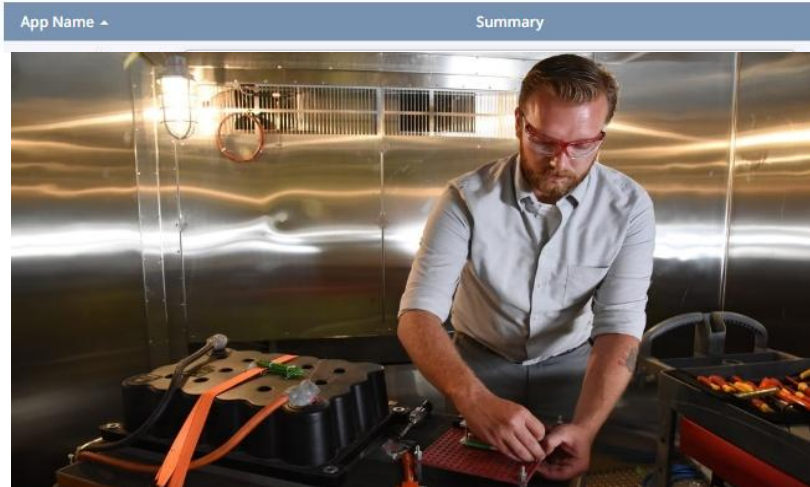
Canvas Components:

- Search User Criteria
- Data Search (Finds the data based on user criteria)
- Search Results (Manual Data Selection after Search)
- Severity Comparison Analysis
- Level Crossing Display
- nCode Viewer

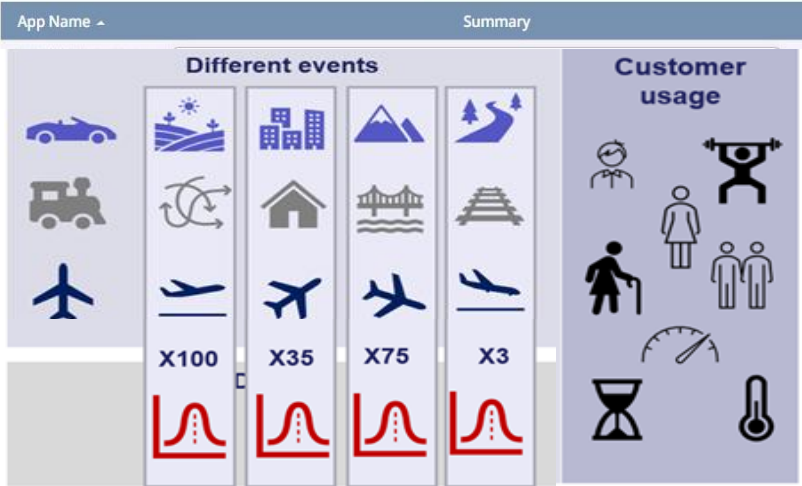
Test data sharing / correlation / ML-AI



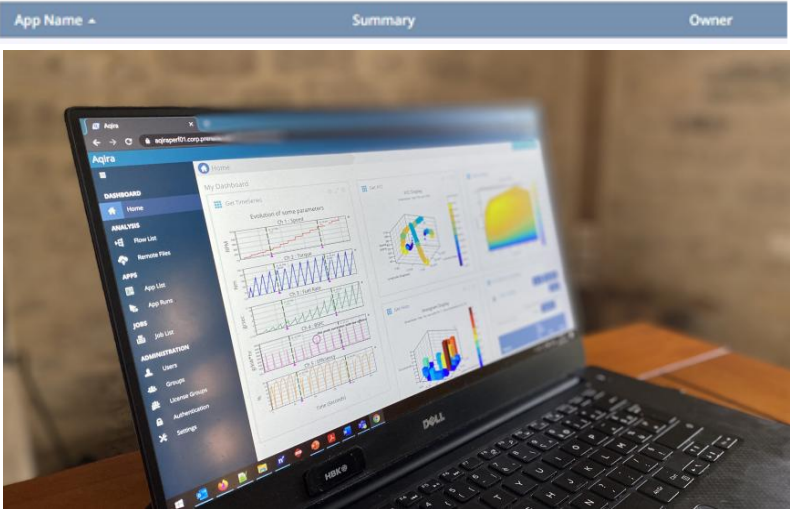
Test bench specification & data analysis



Customer usage / Mission Profile



SHM/ Predictive Maintenance



Aqira management features

nCode Apps + Flows management: *sharing, versioning, keeping traceability*

Aqira

DASHBOARD

Home

ANALYSIS

Flow List

Remote Files

APPS

App List

App Runs

JOBS

Job List

App List

Filter by Name

Filter by Summary

Filter by Owner

Reset

Apply Filter

App Name	Summary	Owner	Last Edited Date	Actions
Mission Profile - TaL		Jon Albertson	Mar 18, 2019, 12:05:25 PM	
Test Report	Creates a PDF report of time series data	Jon Albertson	Jan 7, 2019, 10:11:21 AM	
Simple demo SN	demo with suspension arm	Jon Albertson	Jan 2, 2019, 7:57:54 AM	
PSD Envelope	Calculates the max envelope of multiple PSDs	Jon Albertson	Oct 4, 2018, 10:45:14 AM	
Shaker Test Simulation	Vibration fatigue using XYZ loading in a sequential duty cycle	Jon Albertson	Oct 1, 2018, 9:54:49 AM	
Equivalent Sound Level	Calculation of LAeq	Anaya Chandra	Feb 26, 2018, 7:19:05 PM	
CAE Strain Life	E-N with time series loading	Jon Albertson	Jan 8, 2018, 7:51:19 AM	
Time Series Display	XY Display Viewer	Jon Albertson	Apr 11, 2017, 4:09:08 PM	
CAE S-N Analysis	S-N with time series loading		7, 3:52:07 PM	
Engine Usage Comparison	Plot showing differences in driver usage		7, 5:16:59 PM	

Flow List

psd

Simple PSD Analysis

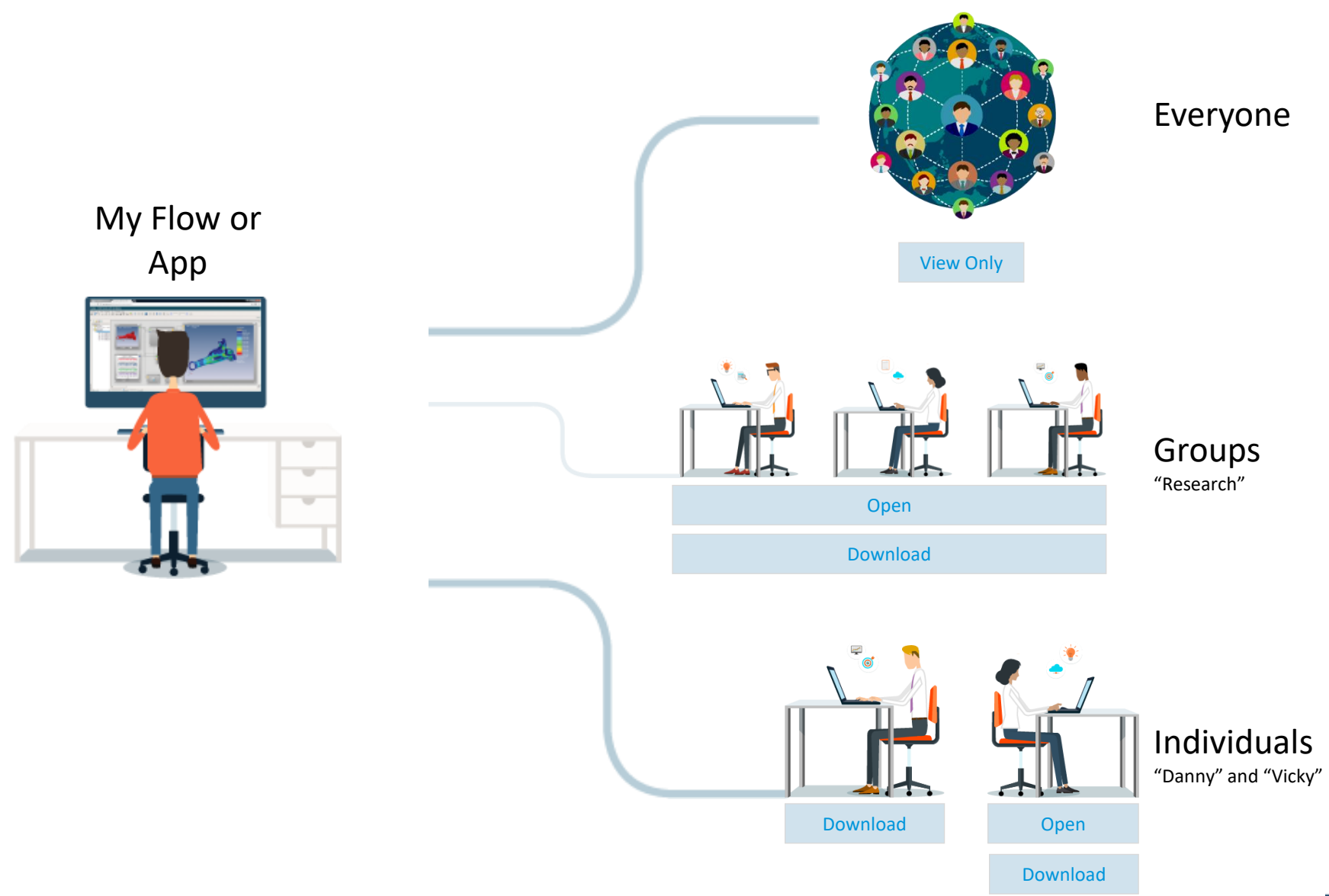
PSD for Road Loads

PSD Max Envelope

Create PrePostFilter PSDs

Share

Delete





E-bike development using CAN data loggers, AWS cloud and nCode analysis to build endurance motor profile



Aqira

[Decathlon] 2 - Analysis | Files in DB

Back

Analyse Usage

FILTERS (0)

Search Project

ExcelConfig.Antenne GPS

Search ExcelConfig.Antenne GPS

ExcelConfig.CAN MOD input

Search ExcelConfig.CAN MOD inpt

ExcelConfig.Datalogger

Search ExcelConfig.Datalogger

ExcelConfig.Localisation test_track

Search ExcelConfig.Localisation te

ExcelConfig.Motorisation

Search ExcelConfig.Motorisation

ExcelConfig.Nom du test

Search ExcelConfig.Nom du test

ExcelConfig.Reference_velo

Search ExcelConfig.Reference_velo

testName

Search testName

ExcelConfig.MF4 associe a la premiere_derniere sortie

Reset

Apply Filters

Tests (143 Results)

2024-02-16_E_LILLE_LD920_OWGRG

fileName: 2024-02-16_E_LILLE_LD920_OWGRGEN1_Te

Entity: TechOFF

ExcelConfig.Datalogger: 55942CA5

ExcelConfig.Reference_velo : LD920

Extra.BikeSpeedMean: 8.041584

Extra.PedalTorqueMean: 10.10797

2024-02-16_E_LILLE_LD920_OWGRGEN1_Testeur 33_2_CY_55942CA5_271_

fileName: 2024-02-16_E_LILLE_LD920_OWGRGEN1_Testeur 33_2_CY_55942CA5_271_.s3t

Entity: TechOFF

ExcelConfig.Datalogger: 55942CA5

ExcelConfig.Reference_velo : LD920

Extra.BikeSpeedMean: 8.041584

Project: e-bike

ExcelConfig.Localisation test_track: LILLE

ExcelConfig.MF4 associe a la premiere_derniere sortie: 271.0

Extra.PedalTorqueMean: 10.10797

2024-02-16_E_LILLE_LD920_OWGRGEN1_Testeur 33_2_CY_55942CA5_271_

fileName: 2024-02-16_E_LILLE_LD920_OWGRGEN1_Testeur 33_2_CY_55942CA5_271_.s3t

Entity: TechOFF

ExcelConfig.Datalogger: 55942CA5

ExcelConfig.Reference_velo : LD920

Extra.BikeSpeedMean: 8.041584

Project: e-bike

ExcelConfig.Localisation test_track: LILLE

ExcelConfig.MF4 associe a la premiere_derniere sortie: 271.0

Extra.PedalTorqueMean: 10.10797

Select All / Deselect All

Expand All / Collapse All

Settings

Config.CAN MOD input:

Config.Nom du test : 2024-02-16_E_LILLE_LD920_OWGRGEN1_Testeur 33_2_CY_55942CA5_271_.s3t

batAbsSOCRange: 6.0

Per each bike use (cargobike, mountain bike, city bike, road bike), how is the battery responding in terms of discharge?

How does the cyclist's behaviour influence battery charge?

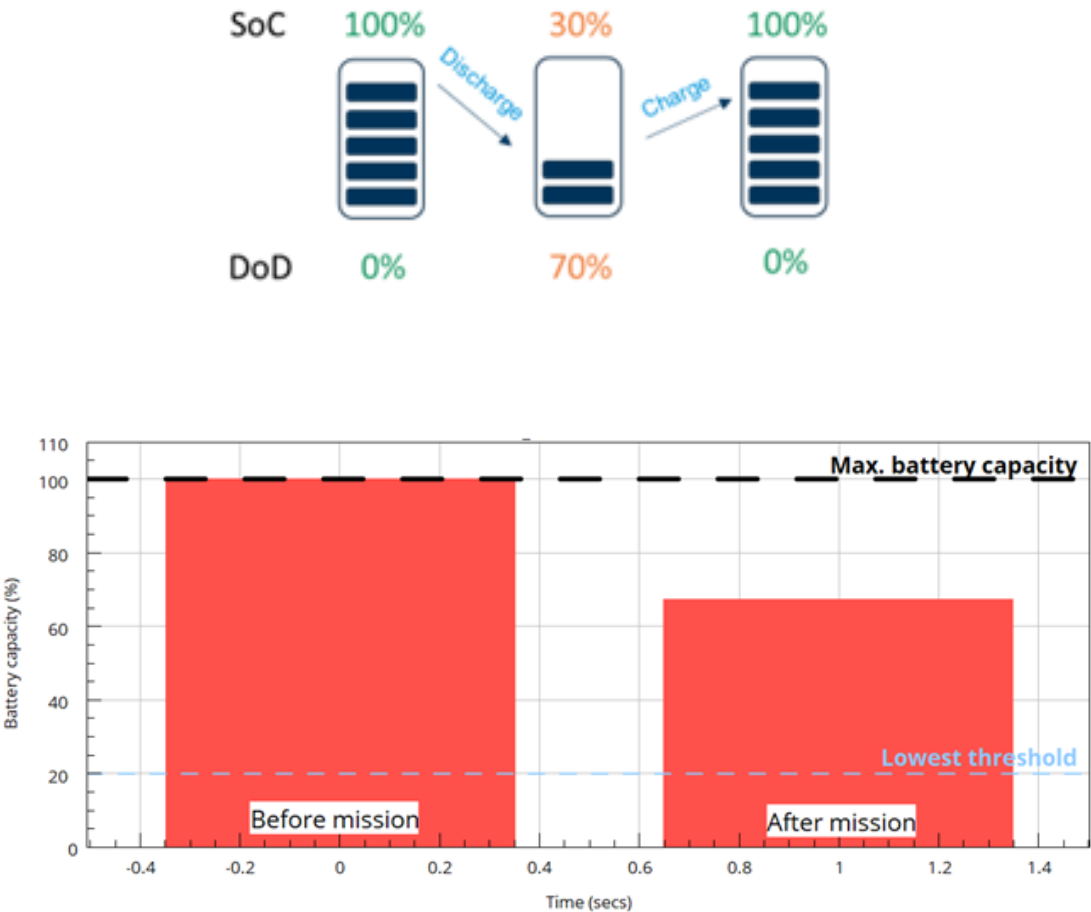
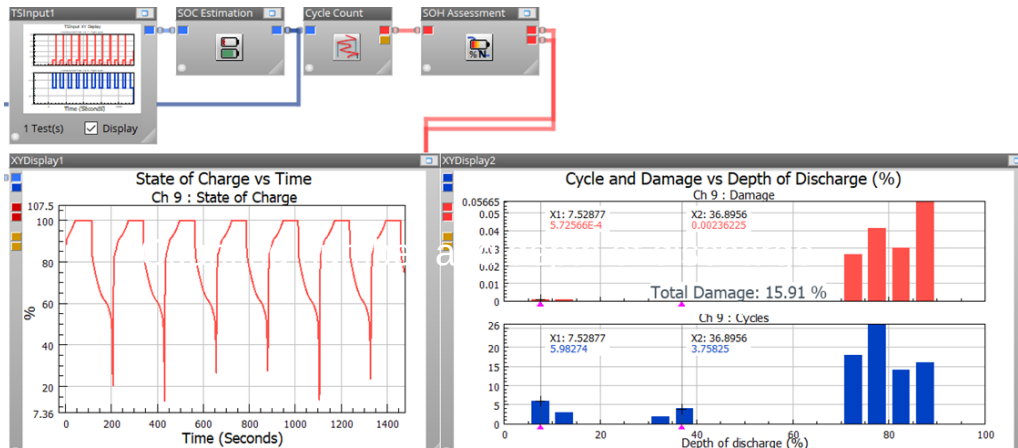
Over the last 5 years, what is the maximum torque seen in the field?

Find the right bit of information

HBK
HOTTINGER BRÜEL & KJÆR

UNRESTRICTED

Counting number and depth of discharge

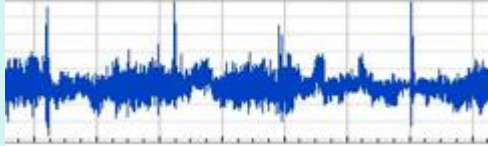


Bring insight into data

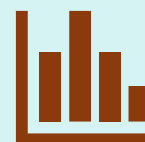
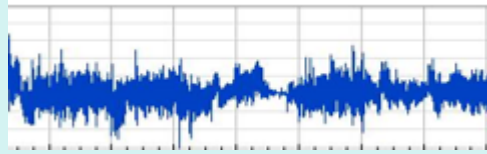


Extra-loads rides

Brutal slope change



E (Watt.h)
R (%)
T°...



E (Watt.h)
R (%)
T°...



E (Watt.h)
R (%)
T°...

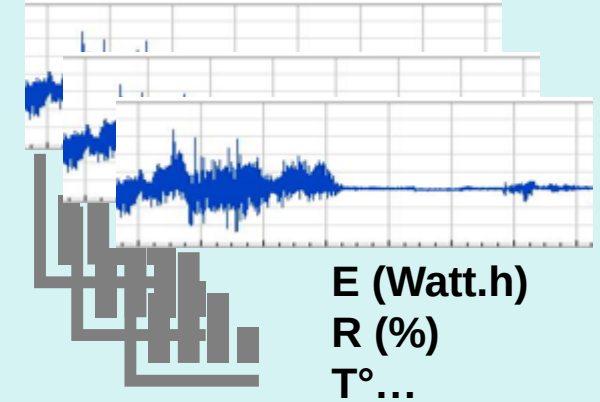
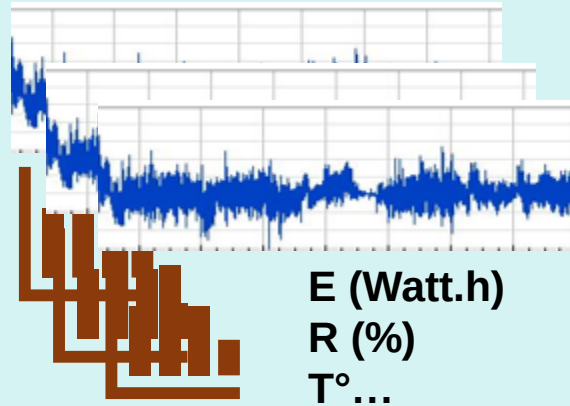
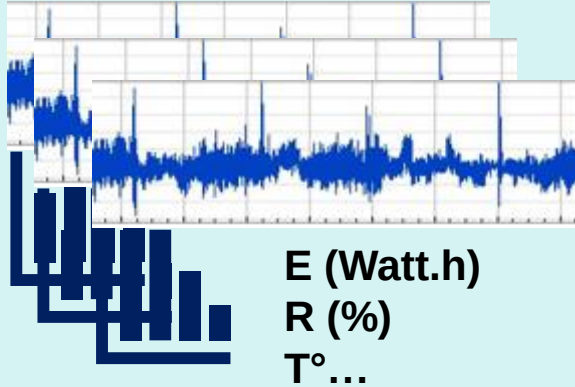
- Aqira allows to:
 - Load hundreds of files with thousands of channels
 - Clean and normalize them
 - Calculate statistics, key metrics
- Add contextual information, « tags » (location, weather conditions, etc.)



Extra-load rides

Brutal slope change

Many starts/stops



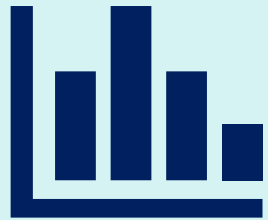
- Aqira allows to:
 - Load hundreds of files with thousands of channels
 - Clean and normalize them
 - Calculate statistics, key metrics
- Add contextual information, « tags » (location, weather conditions, etc.)



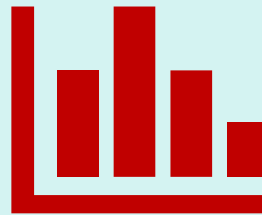
Extra-load rides

Brutal slope change

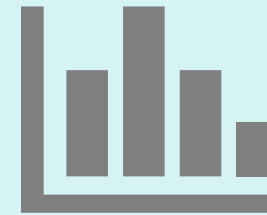
Many starts/stops



E1 max
R1 mean
T°...



E2 max
R2 mean
T°



E3 max
R3 mean
T°

Power calculation and
number of charges for
different rides

- 1 – Harsh
- 2 – Normal
- 3 – Easy

Mixture + Server
Calculation



10 kWatt

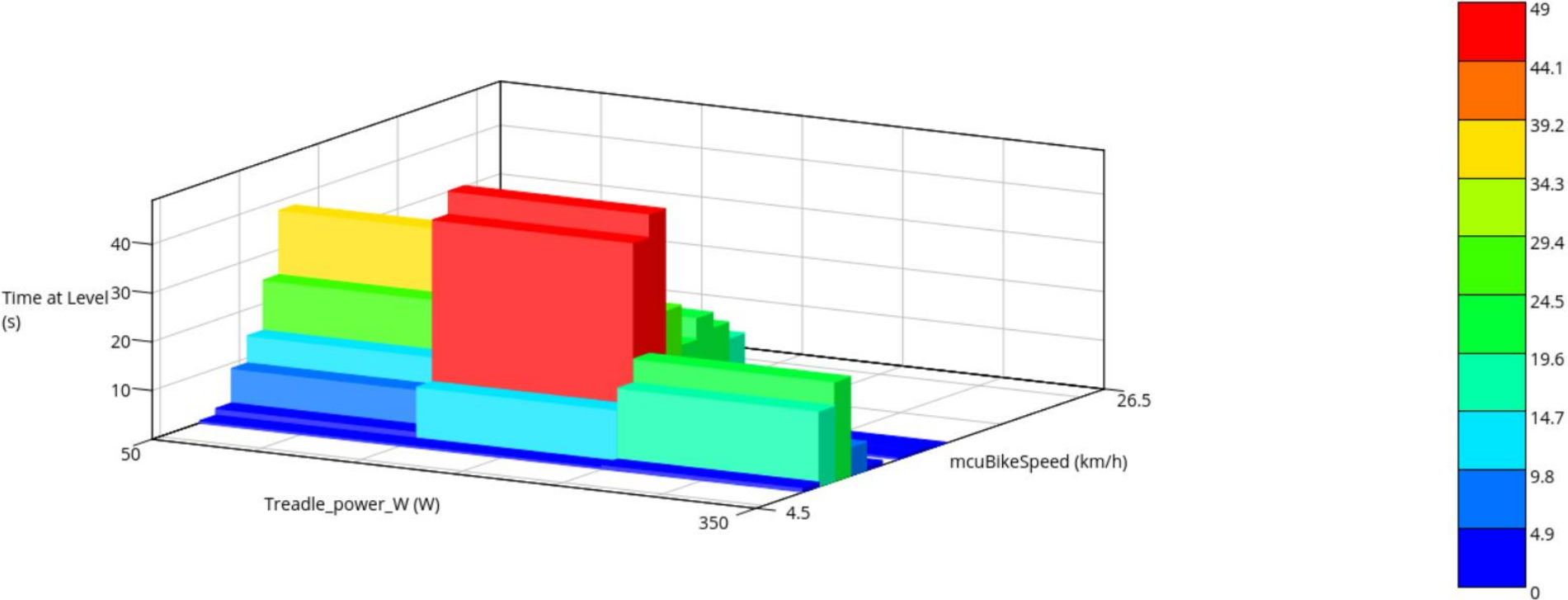


5 charges
at 20°C
6 charges
at 15°C

Provide answers



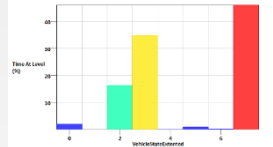
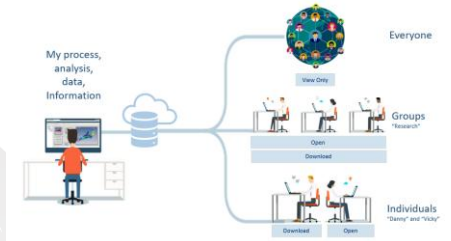
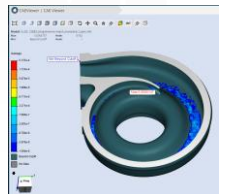
Histogram Display
MissionProfile_ (s3h) Ch 1 : Joint Distribution Ch. 5,3



Bring insight into data



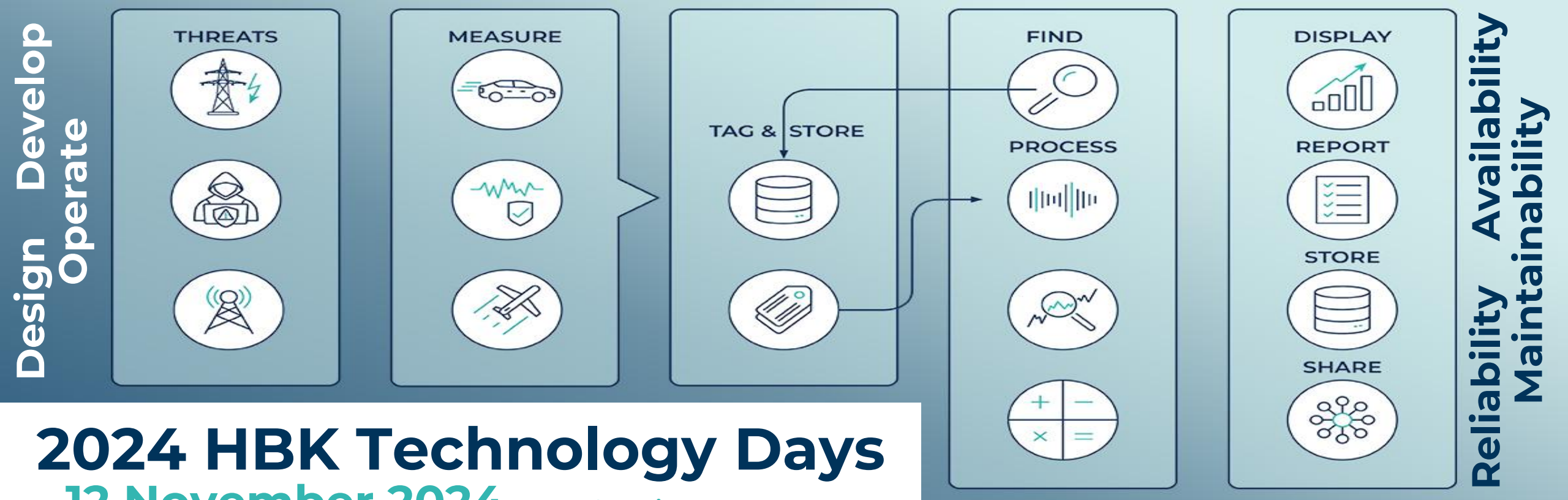
- **Easily Share data, process & analysis** in a secured way
- **Improve traceability, quality & security** : One version for flows + APPs + software, all people work on the same data and users/groups rights management
- **Improve productivity** using powerful server + parallel calculation with nCodeDS
- **Quick democratization** : Apps provide **easy to use interfaces** for non-expert users + thin client access
- **Save time** finding quickly the **right data**
- **Easy way to read, view, compare and correlate different data**
- **Save time** using **automated processes** in batch (upload, process, download)
- **Provide additional tools in remote access**: Python scripting, nCodeDS analytics, 3D CAE Viewer, nCode Desktop software, virtual sensors
- **Possibility to run neuronal nets** on data lake

www.hbkworld.com

Nicolas Baron

nicolas.baron@hbkworld.com



2024 HBK Technology Days

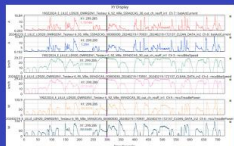
12 November 2024

Session 4: Vehicle Network Analytics

DECATHLON

HBK HOTTINGER
BRÜEL & KJÆR

E-bike development using CAN data loggers,
AWS cloud and nCode analysis to build endurance motor profile.



- e-Bike development using CAN data loggers, AWS cloud and nCode analysis to build endurance motor profile

Maxime Darnois, Test Engineer, DECATHLON

Nicolas Baron, Application Engineer – Durability and Reliability, HBK