



Optimization of an E-Drive System using Smart and Standardized methodologies

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2. Initial Process and Challenges
3. Process Improvements to make it Smart and Standardized
4. Conclusion



1. Typical Task-Process of an E-Drive System and Optimization

Typical Task-Process of an E-Drive System and Optimization

PRE-CALIBRATION



- Angle adjustment
- induced EMF Measurement
- Heat Run & Vibrations check
- Short circuit Measurements
- Calibrating Motor parameters
- ...

CALIBRATION



- EM characterization
- Controller optimization
- MTPA/MPTF
- Torque accuracy
- Efficiency
- ...

REPORTING



- Speed/Torque Curve
- Speed/Power Curve
- Efficiency Curve
- ...



2. Initial Process and Challenges

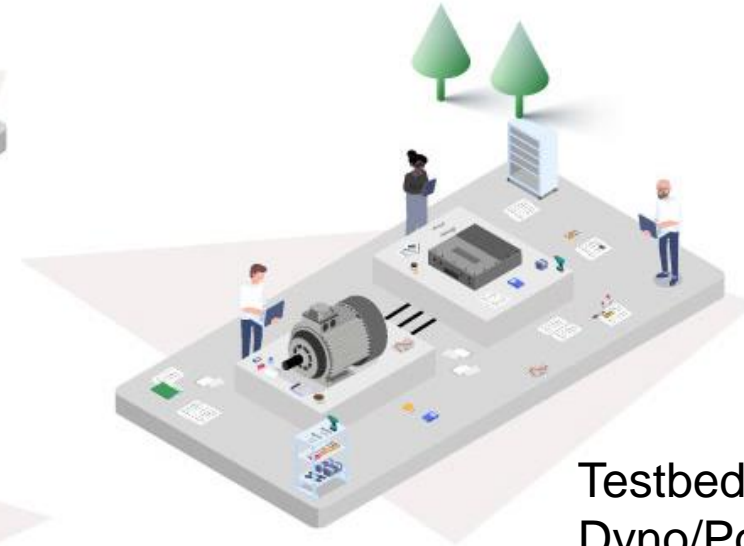
Testbed2
Dyno/Power HIL




Testbed3
Dyno/Power HIL




Testbed1
Dyno/Power HIL



UTILIZATION
Runtime vs. Time




DATA GATHERING RATE
Total Data vs. Runtime



DATA QUALITY
Good data vs. total Data



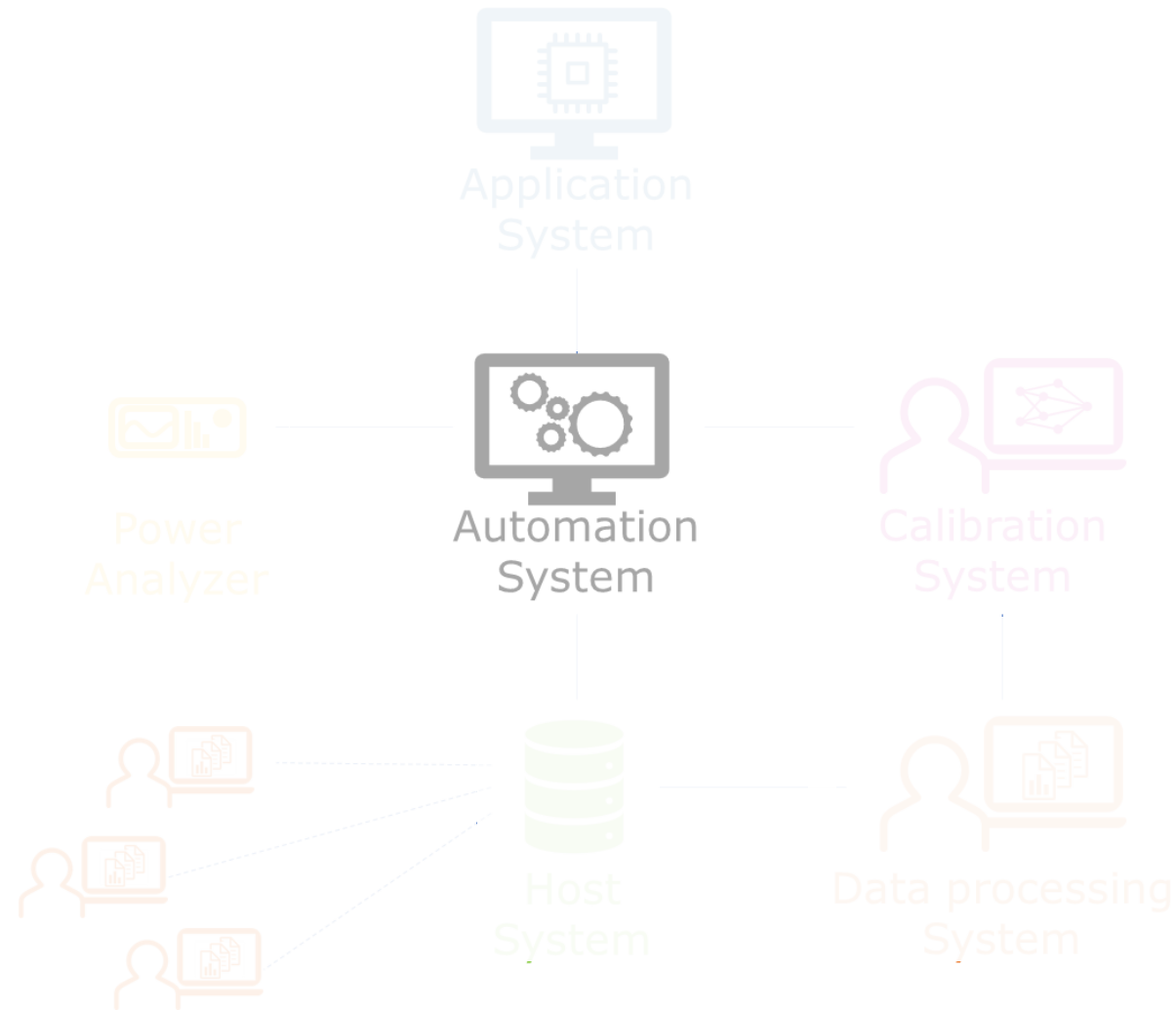
TESTING OUTPUT
Results vs. good Data



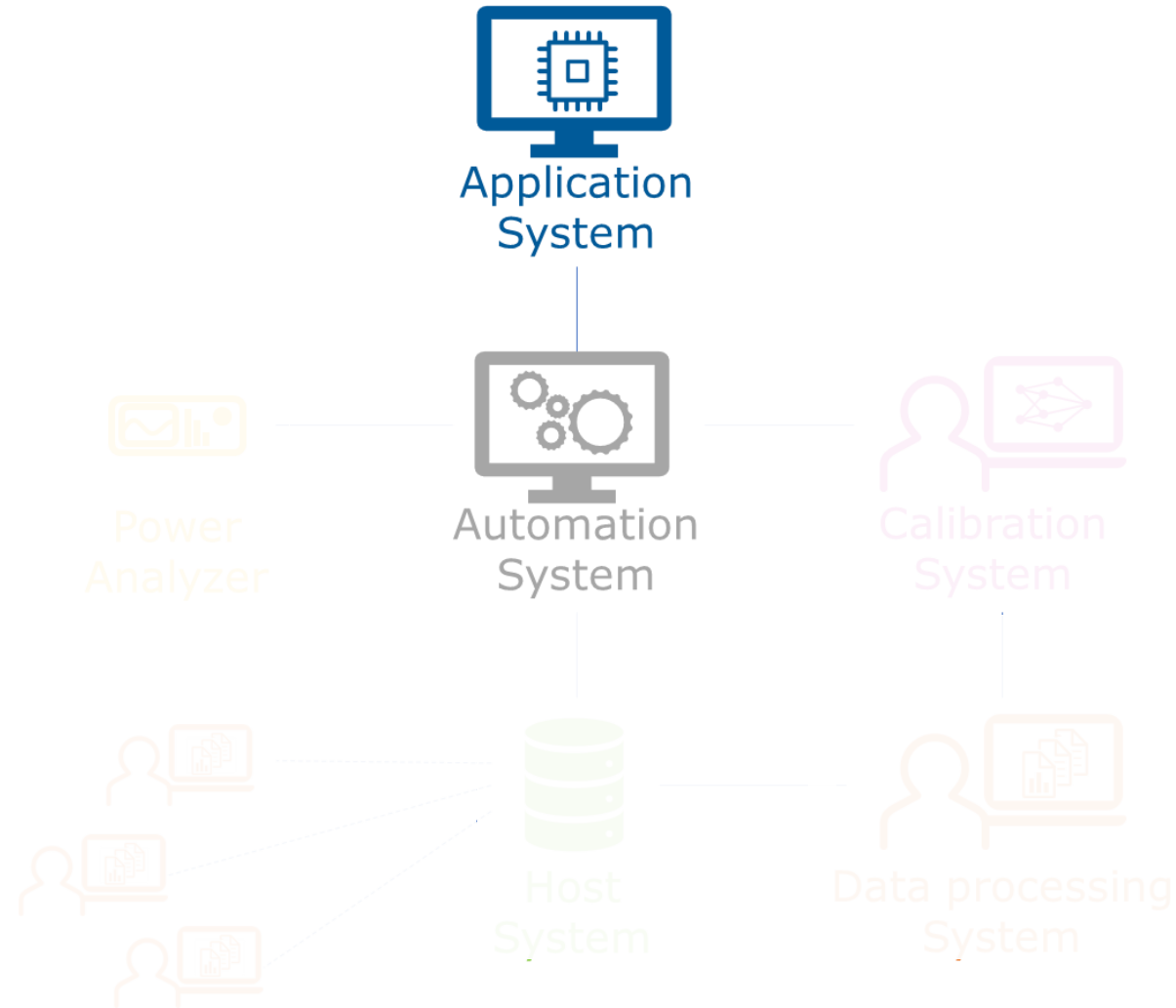


3. Process Improvements to make it Smart and Standardized

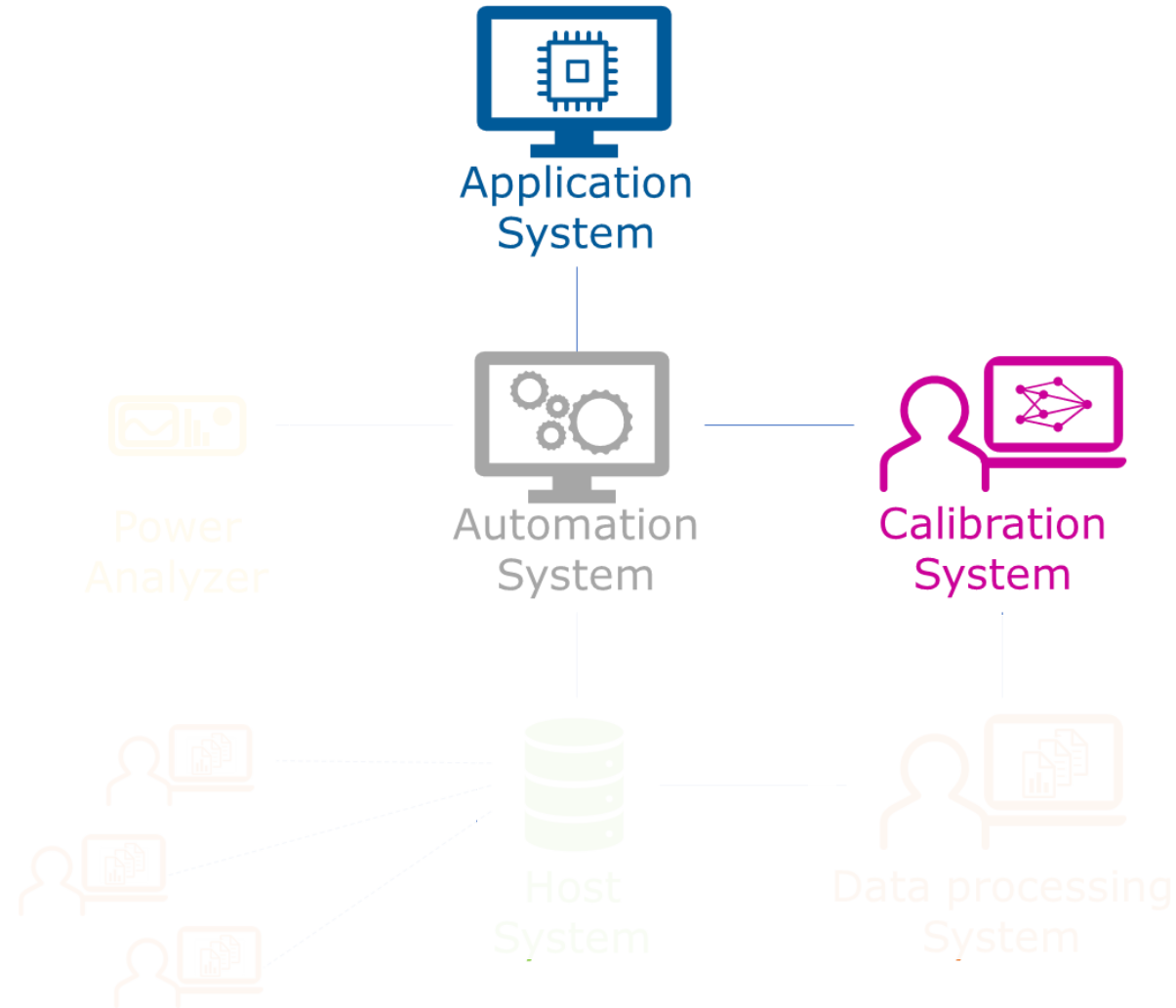
New Testing Topology supporting Complete Automation



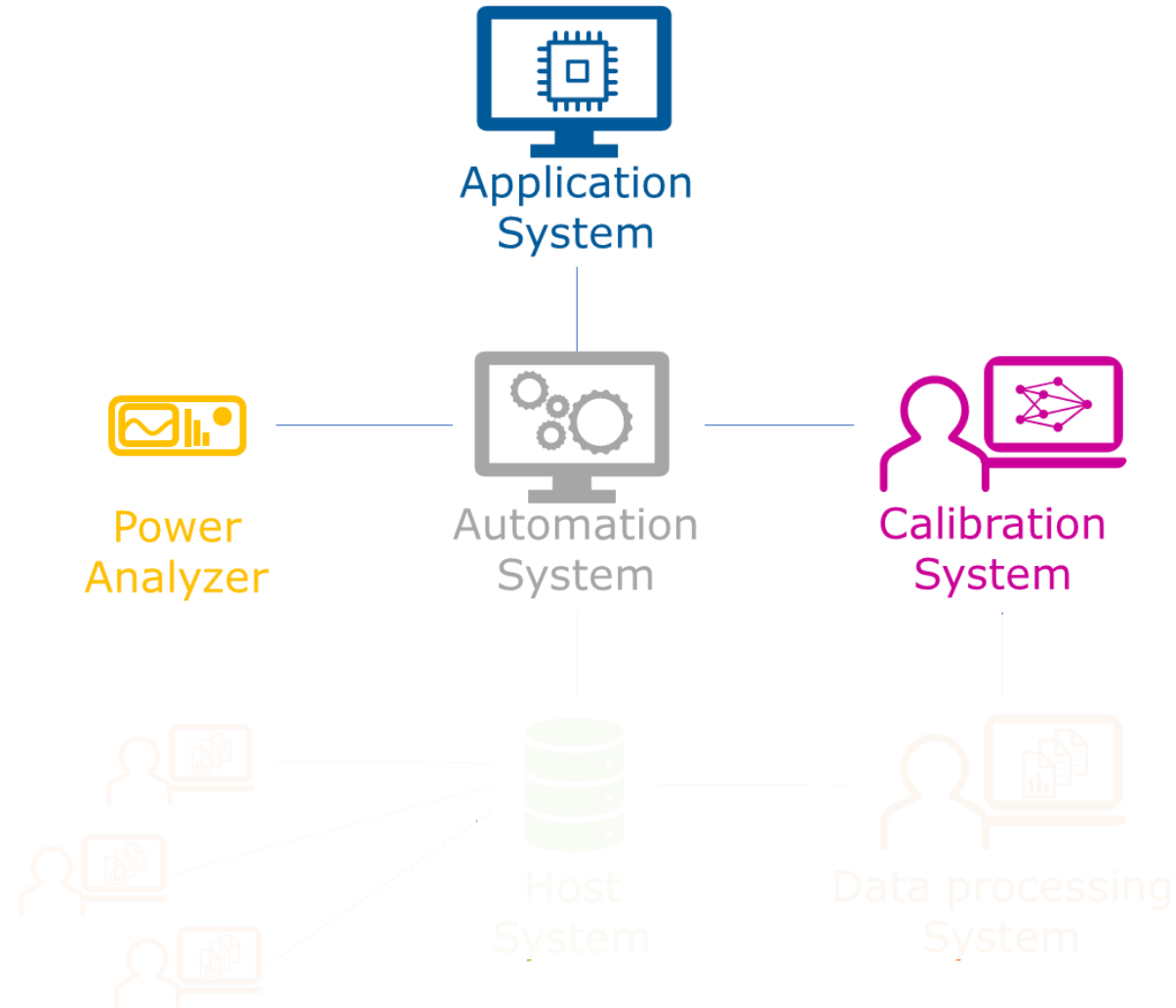
New Testing Topology supporting Complete Automation



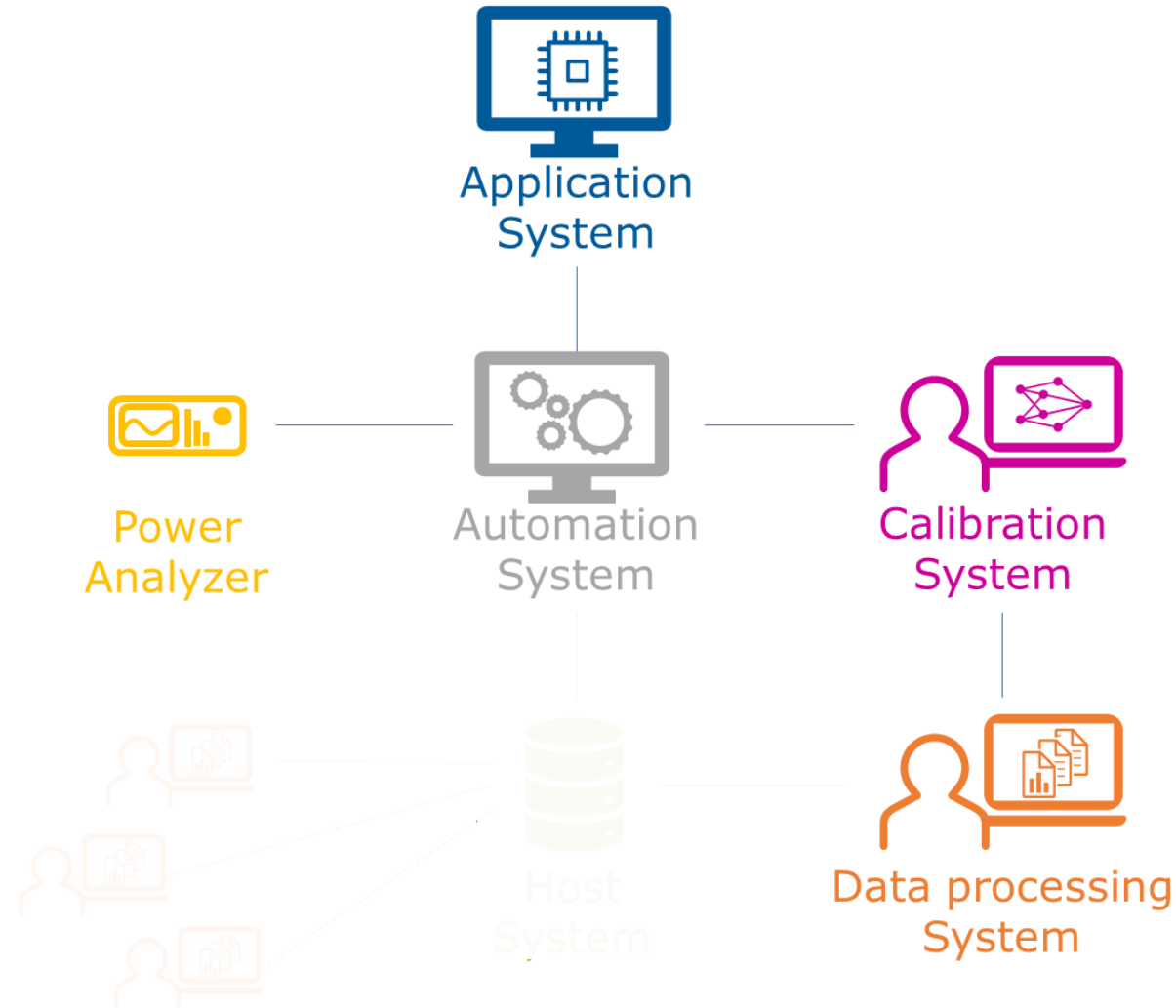
New Testing Topology supporting Complete Automation



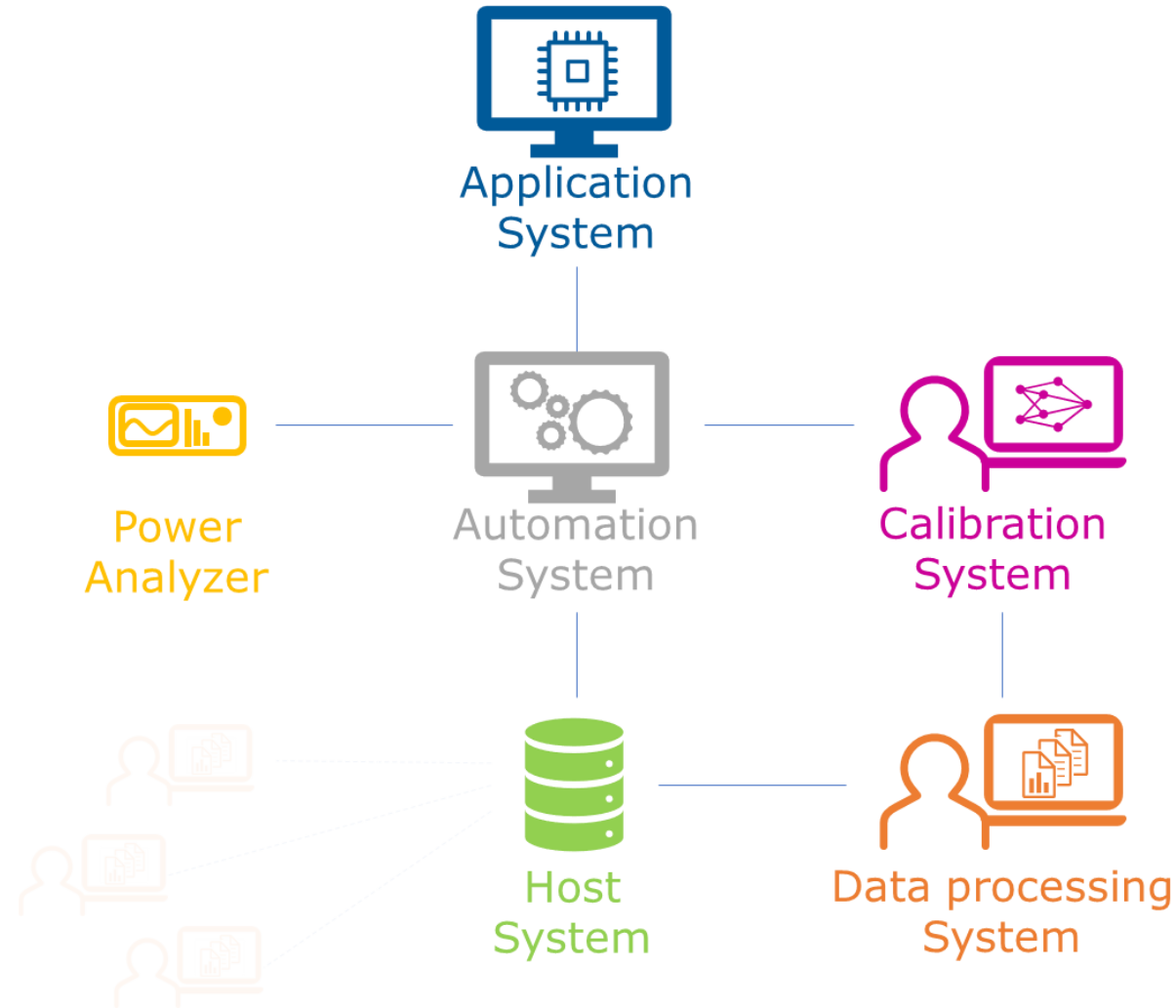
New Testing Topology supporting Complete Automation



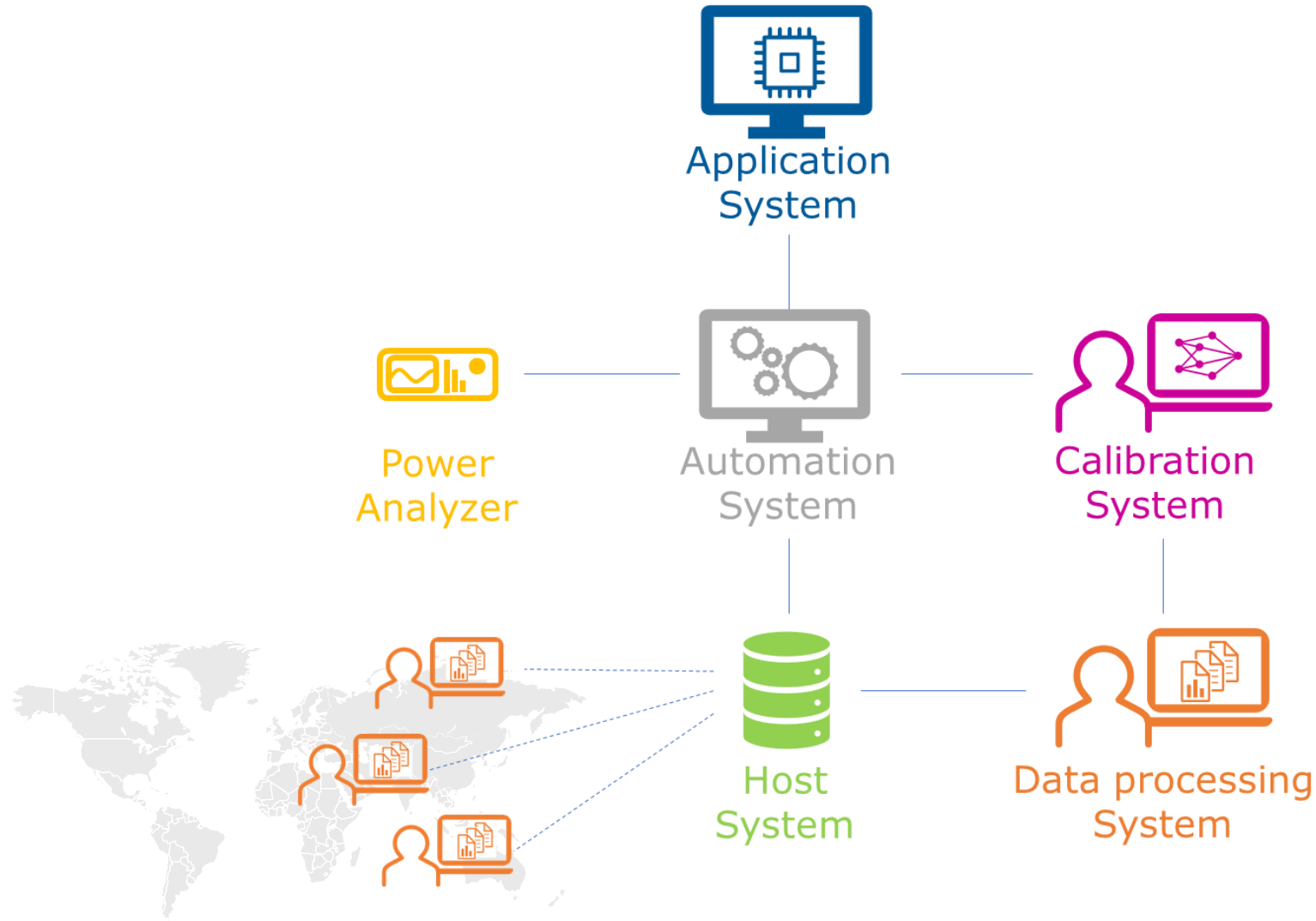
New Testing Topology supporting Complete Automation



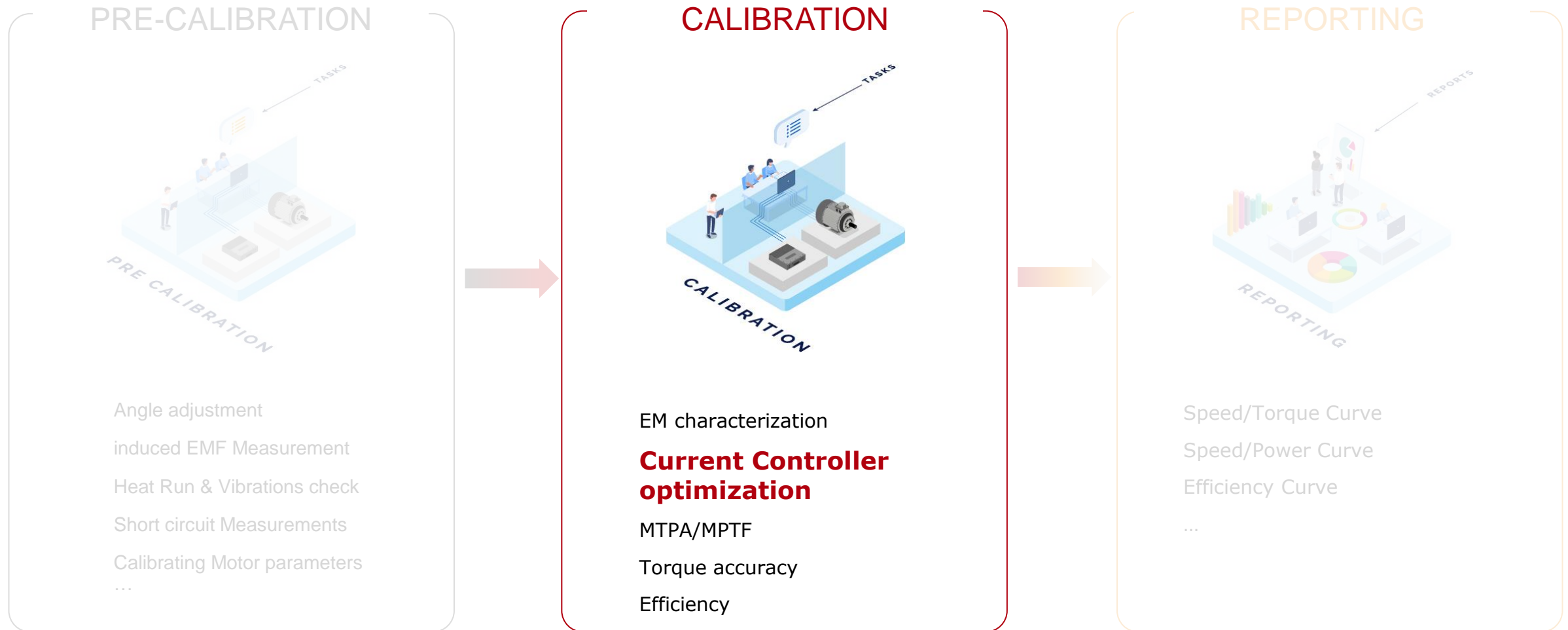
New Testing Topology supporting Complete Automation

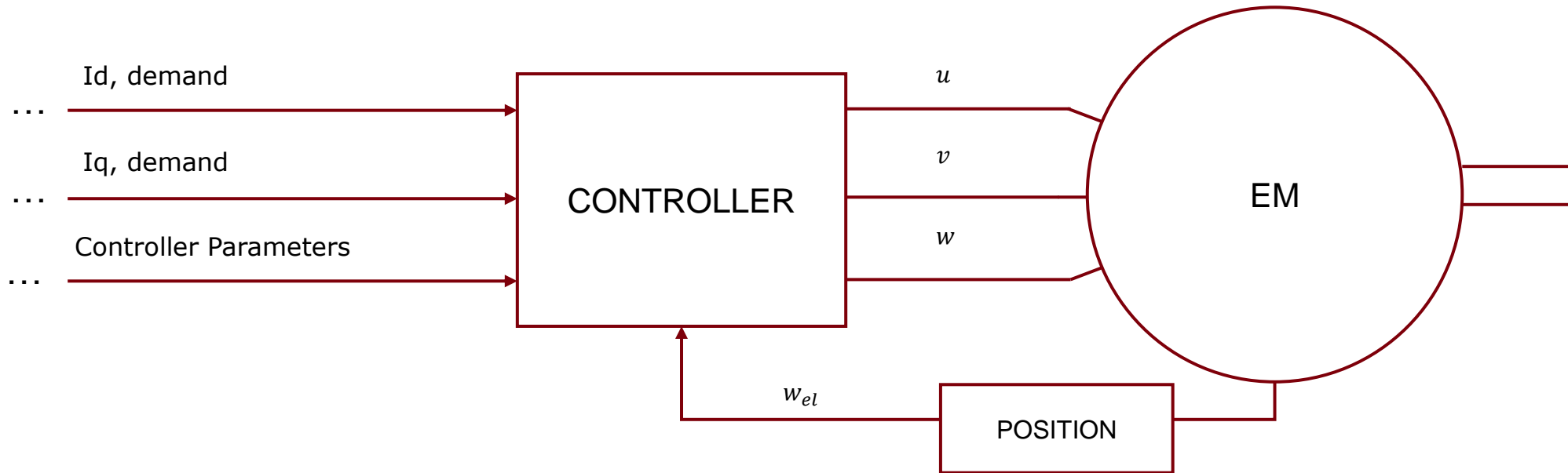


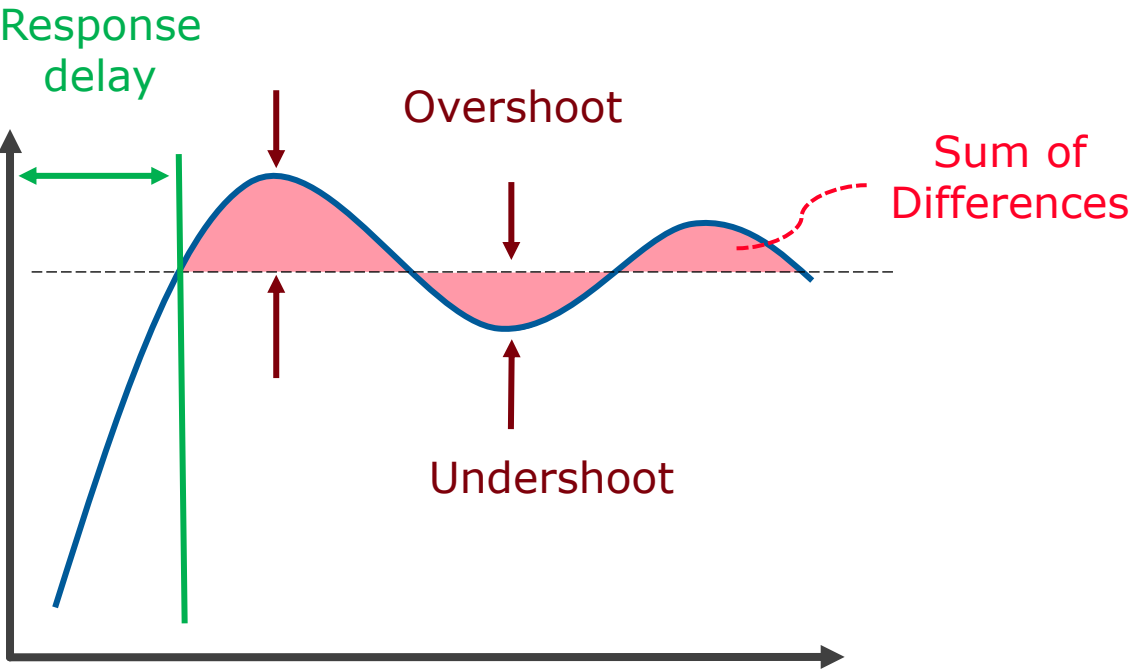
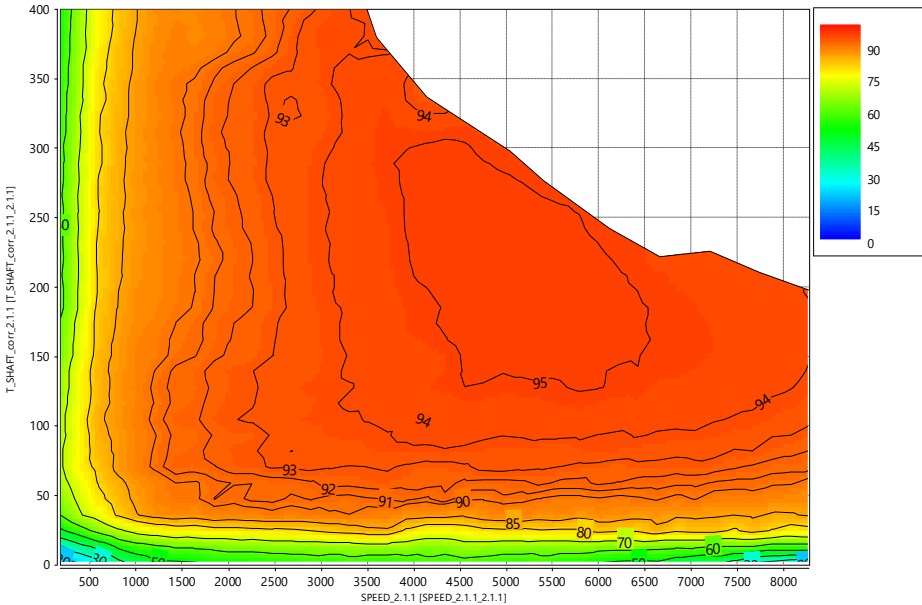
New Testing Topology supporting Complete Automation



Example Calibration Task: Current Controller Optimization









UUT CONDITIONS

Preconditions:

DC Voltage
Coolant and flow settings
Temperatures
Calibration parameters
Recorder path

Control / Variation Parameters

I_d , I_q
Speed
Switching frequency

Stabilizations

- Constant Temperature for all OPs

Limits

- Temperature Threshold (for EM, INV.)
- Voltage limits
- Current limits

Measurements

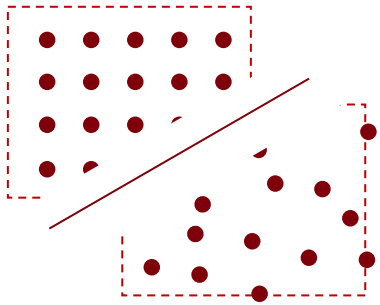
- I_d , I_q , U_d , U_q , η ...

Testing Program

- Static FF-mapping (if needed active DoE)

DESIGN OF EXPERIMENTS

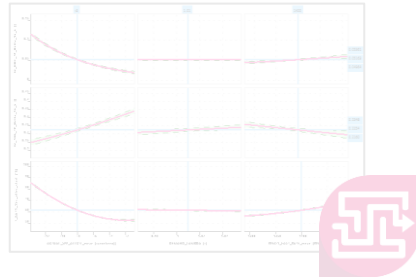
Full Factorial



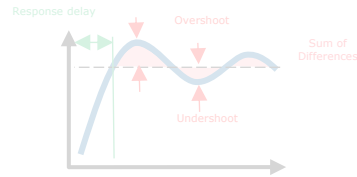
Active DOE



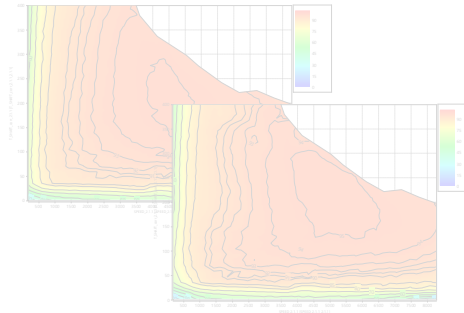
TEST EXECUTION



KPI CALCULATION



AUTO REPORTING

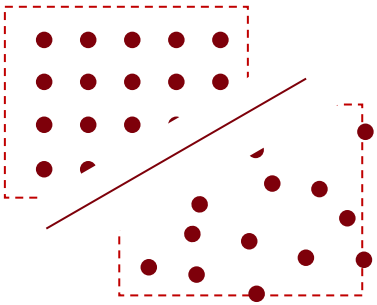


CENTRAL HOST



DESIGN OF EXPERIMENTS

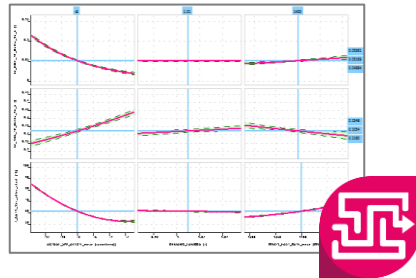
Full Factorial



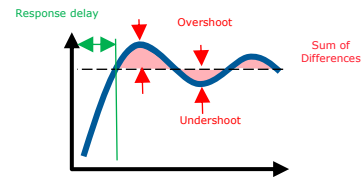
Active DOE



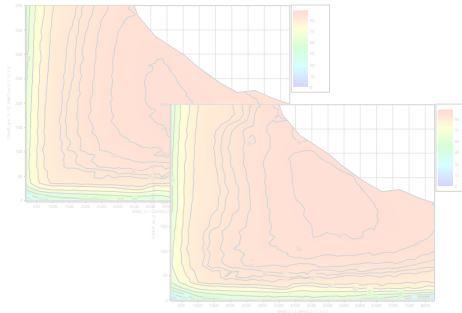
TEST EXECUTION



KPI CALCULATION

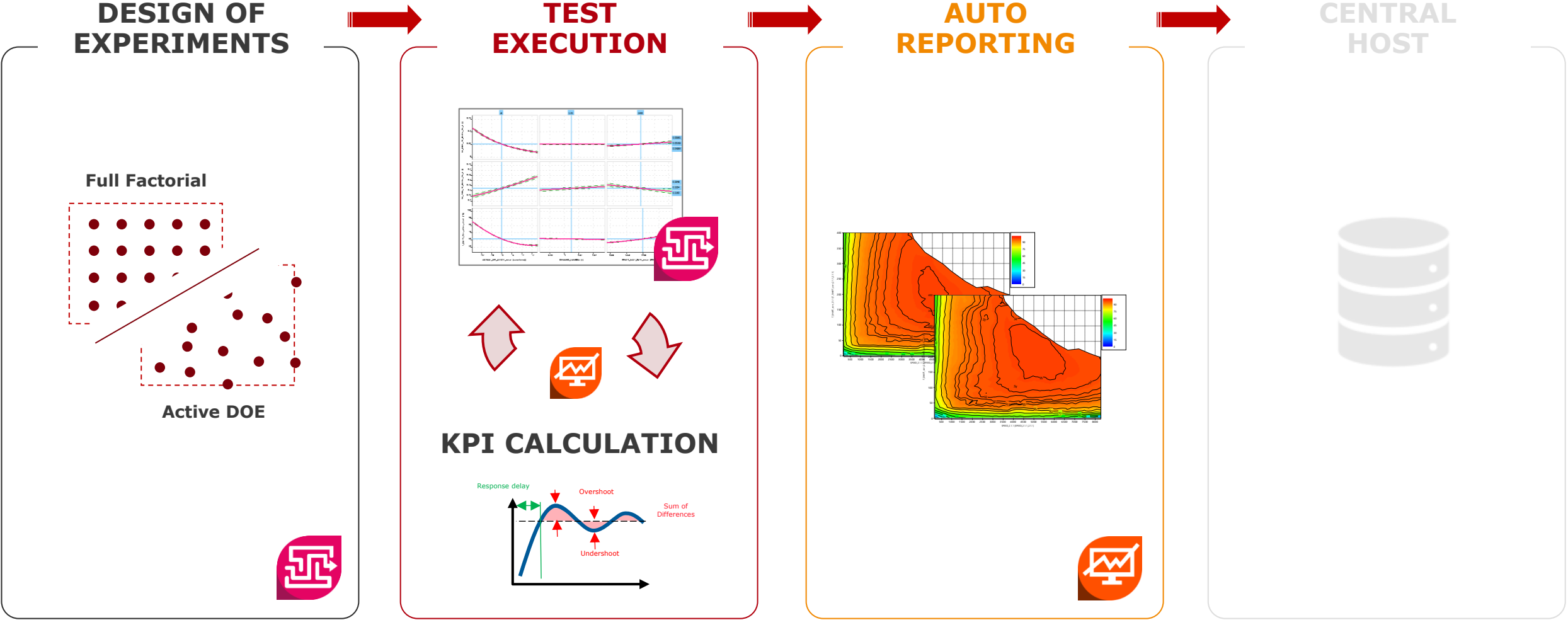


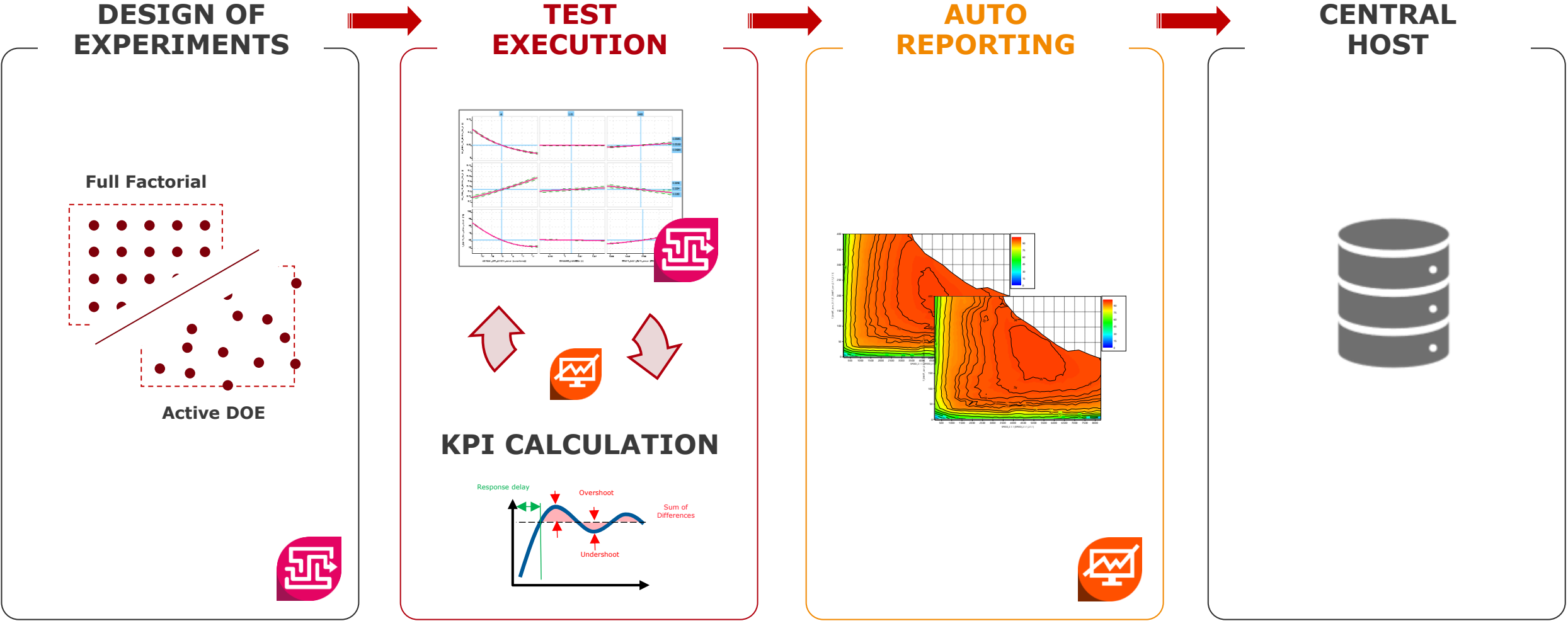
AUTO REPORTING

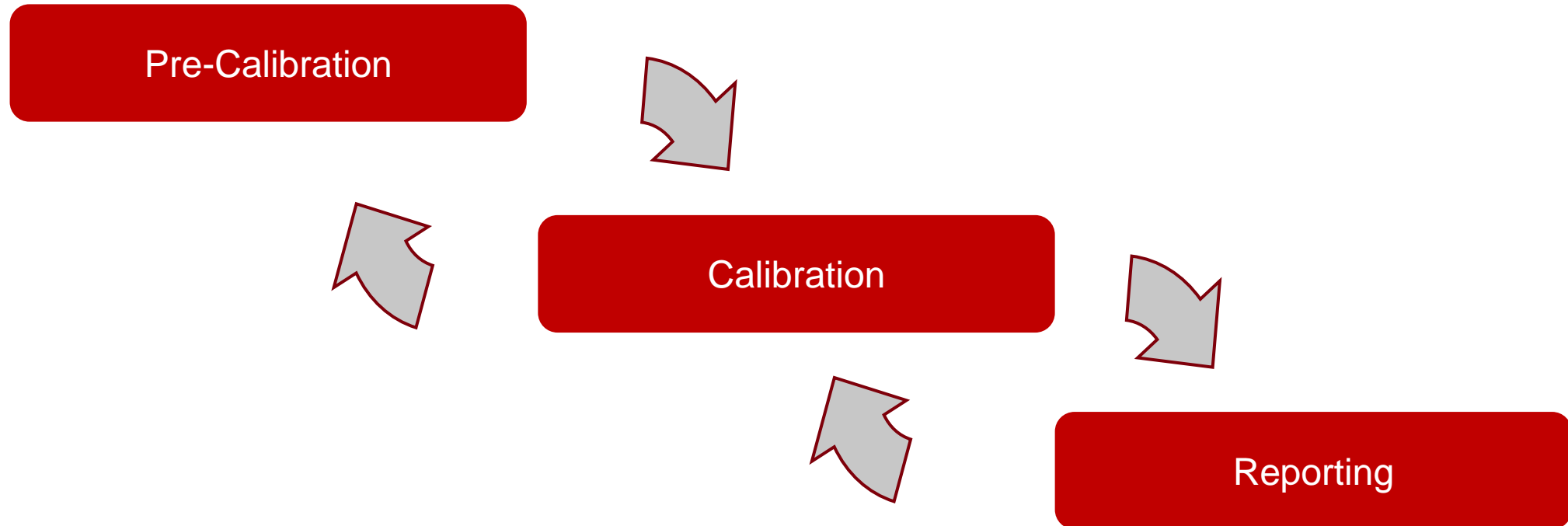


CENTRAL HOST

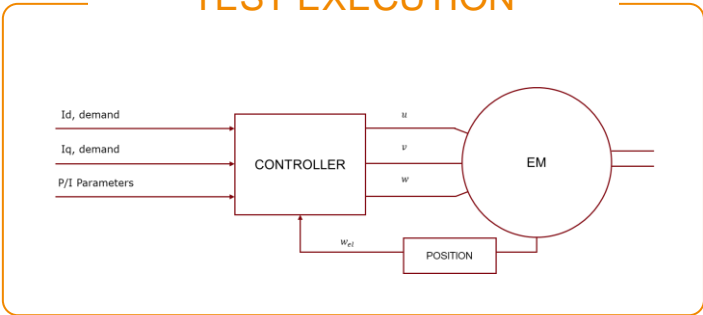




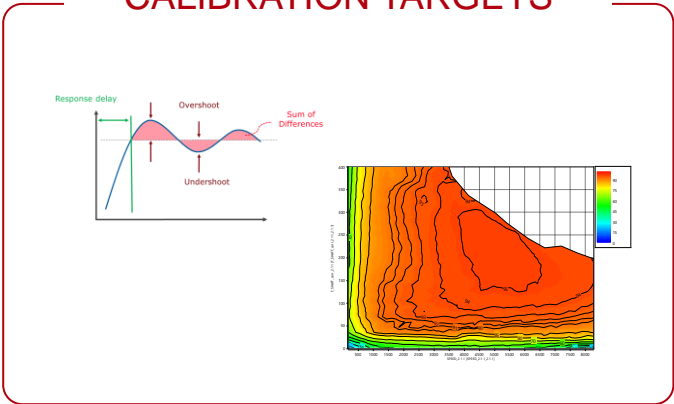




MONITOR TEST EXECUTION

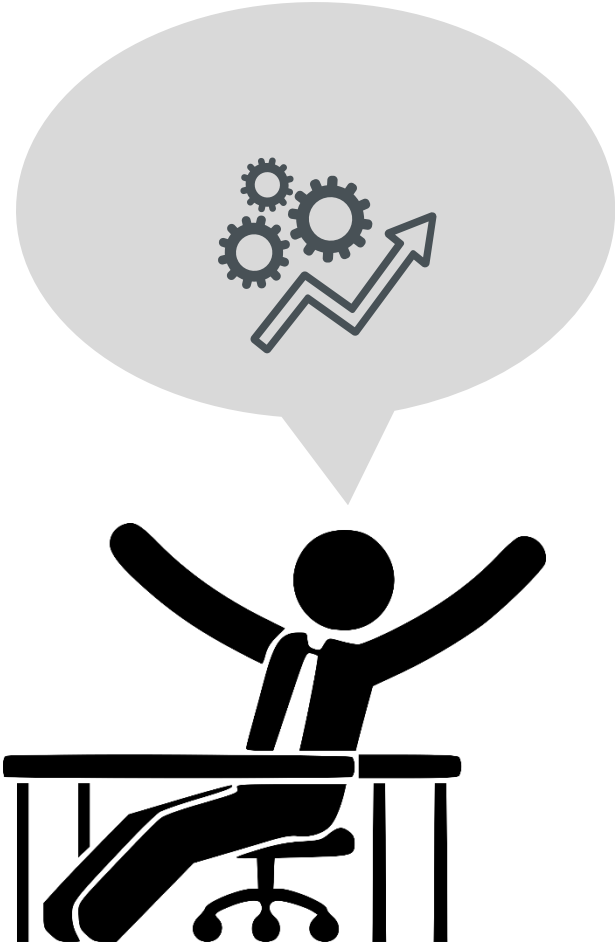


CALIBRATION TARGETS

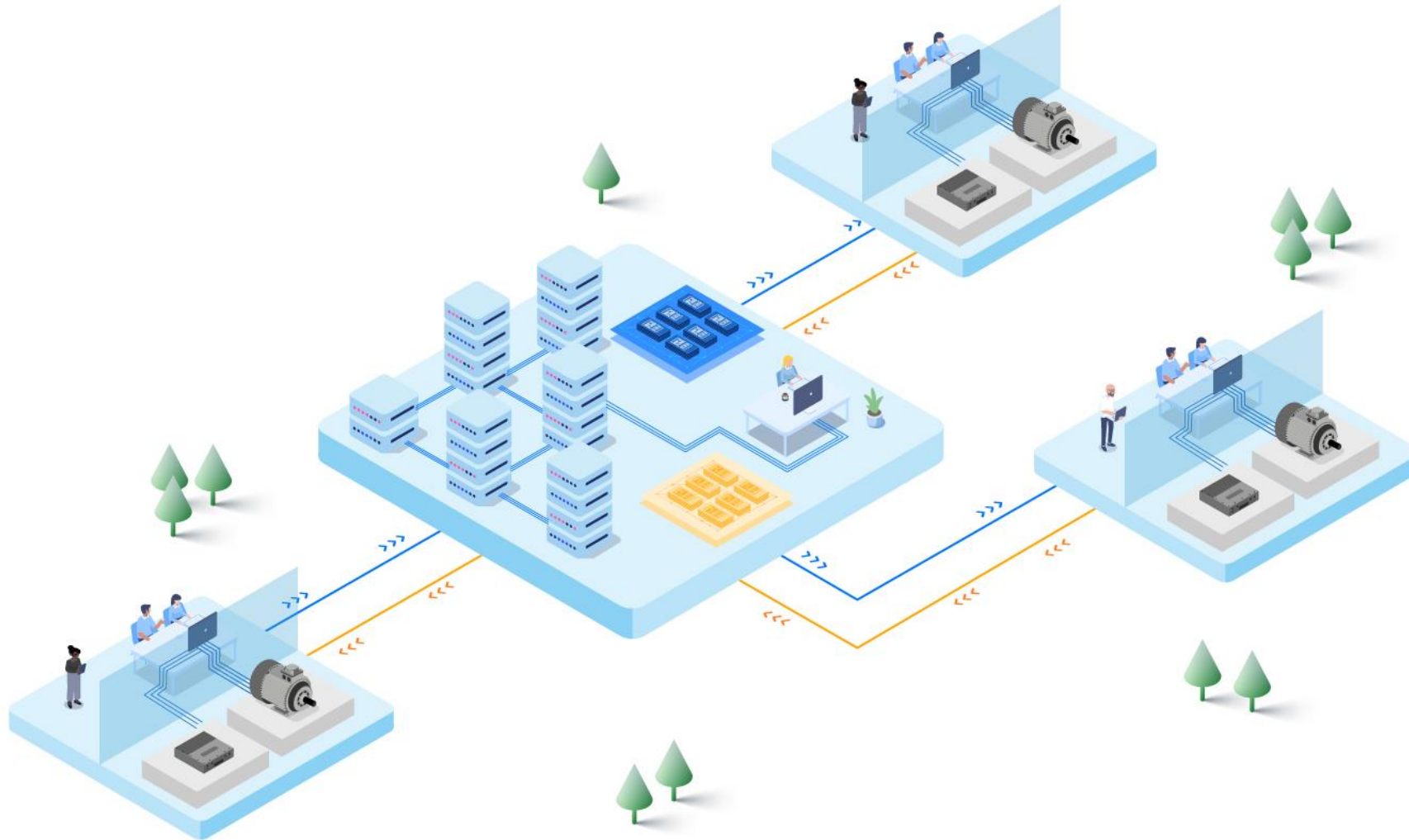


UUT CONDITIONS

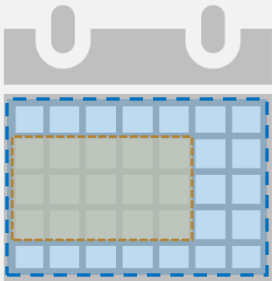
Preconditions:	Stabilizations
DC Voltage	• Constant Temperature for all OPs
Coolant and flow settings	Limits
Temperatures	• Temperature Threshold (for EM, INV.)
Calibration parameters	• Voltage limits
Recorder path	• Current limits
Control / Variation Parameters	Measurements
Id, Iq	• Id, Iq, Ud, Uq, η ...
Speed	Testing Program
Switching frequency	• Static FF-mapping (if needed active DoE)




Smart and Standardized Workflow




UTILIZATION
Runtime vs. Time



DATA GATHERING RATE
Total Data vs. Runtime



DATA QUALITY
Good data vs. total Data



TESTING OUTPUT
Results vs. good Data





4. Conclusion

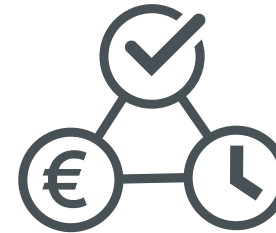
REUSE OF TEST TEMPLATES



REDUCED MANPOWER

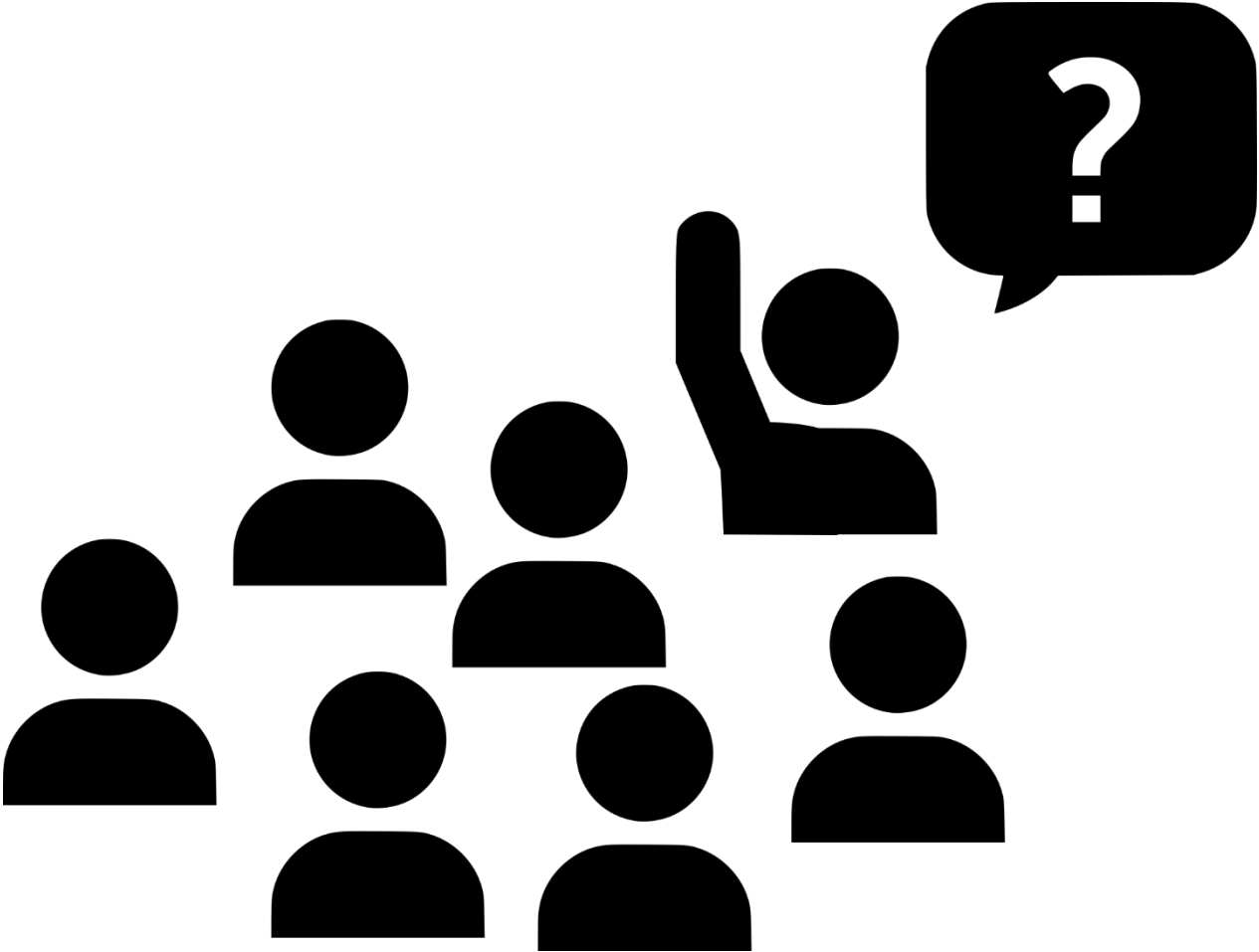


TESTBED UTILIZATION



QUALITY RESULTS





HITACHI
Inspire the Next 