Etteplan

Get the Most from the CompactRIO Platform in Advanced Test Rig Development

NI Days Stockholm 2017

Marcus Carlberg, CLD

Etteplan

NATIONAL INSTRUMENTS Gold Alliance Partner

History

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History

1983

Etteplan is founded

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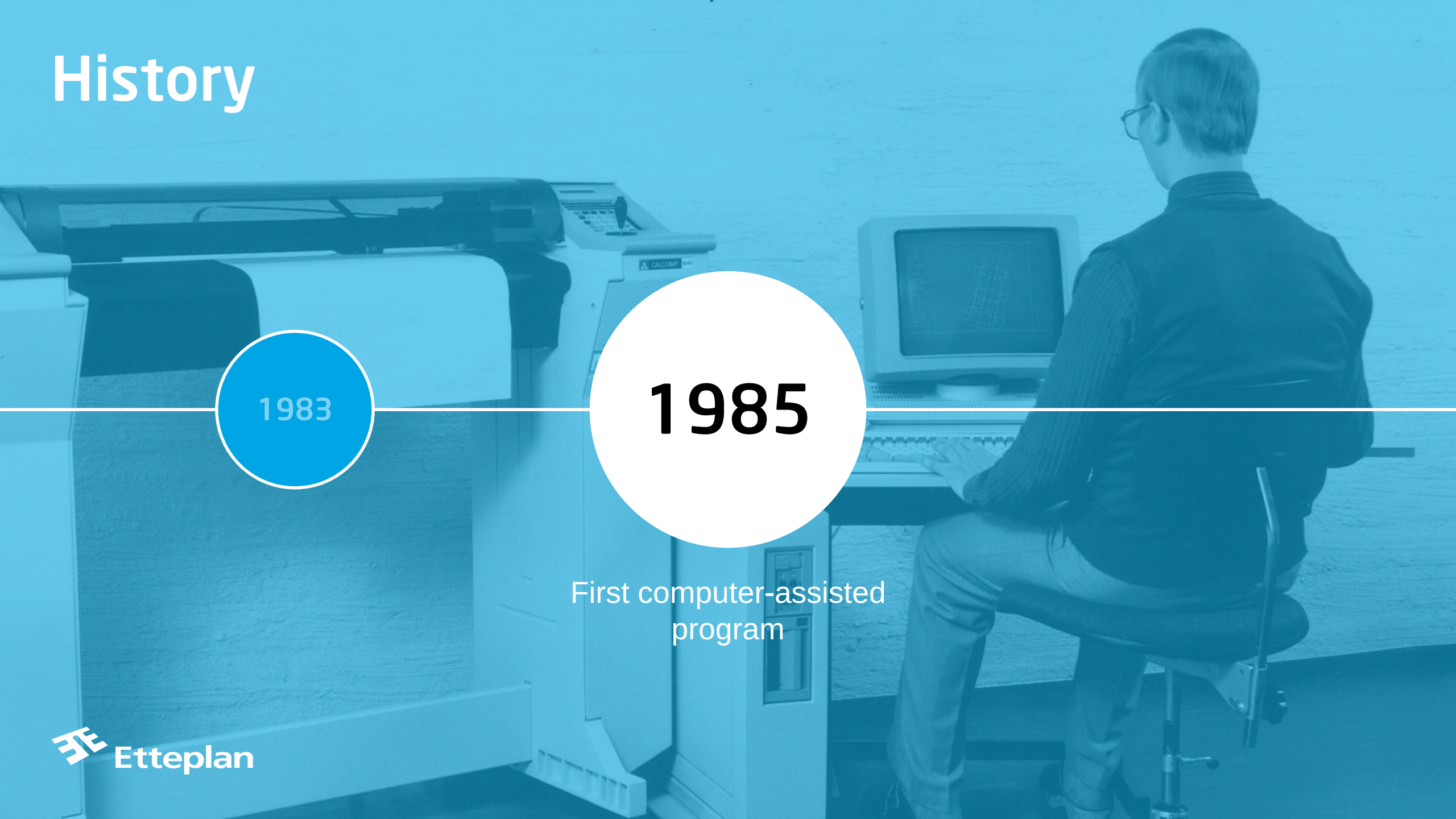
History



1983

1985

First computer-assisted program

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History

1983

1985

2004

China operations commence

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History

1983 1985 2004

2017

Geographical expansion

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NI Hubs

Göteborg, Sweden

Esboo, Finland

Wroclaw, Poland

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Our customers

VOLVO
Volvo Group

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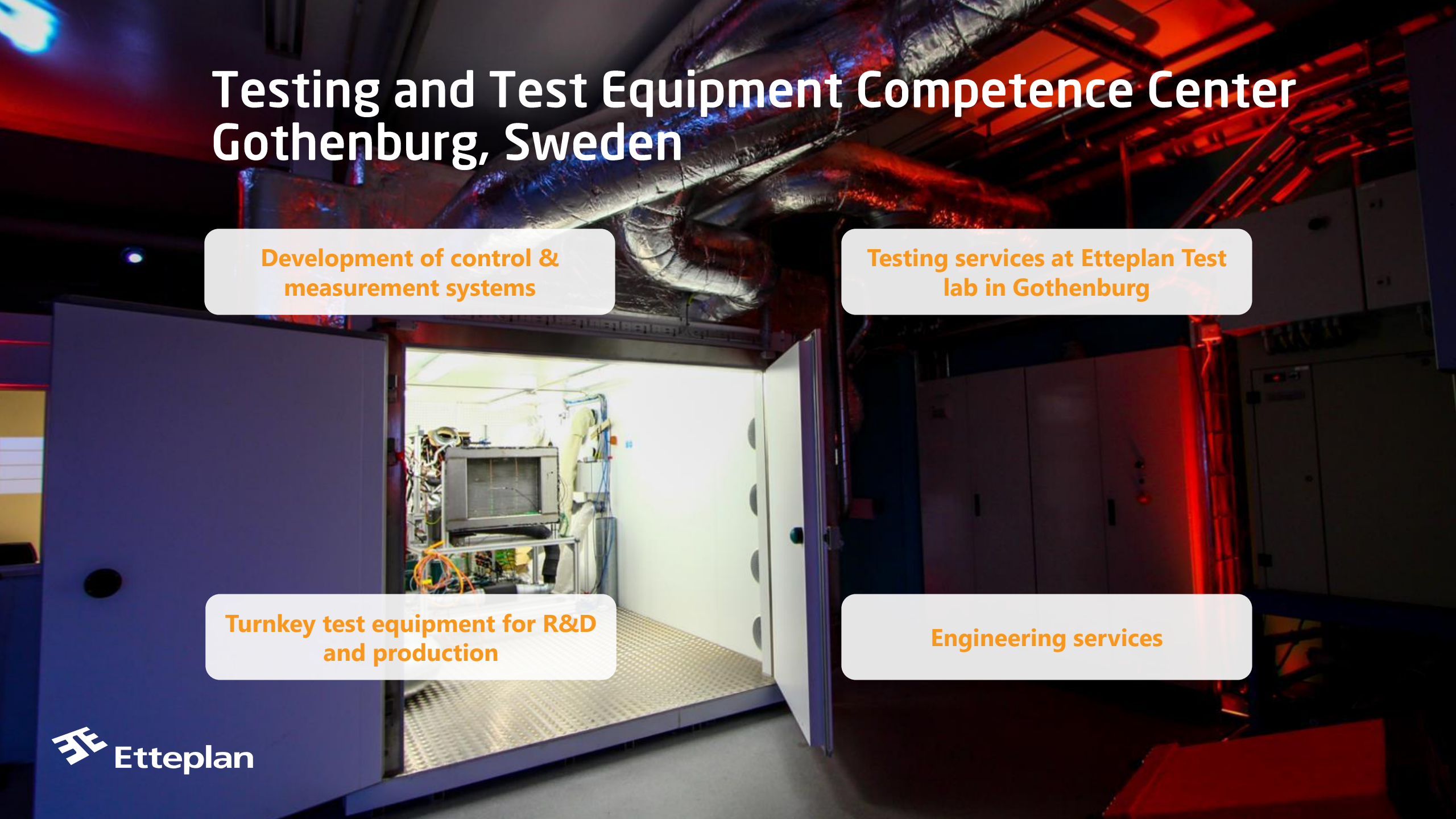
Testing and Test Equipment Competence Center Gothenburg, Sweden



Development of control & measurement systems

Testing services at Etteplan Test lab in Gothenburg

Turnkey test equipment for R&D and production

Engineering services

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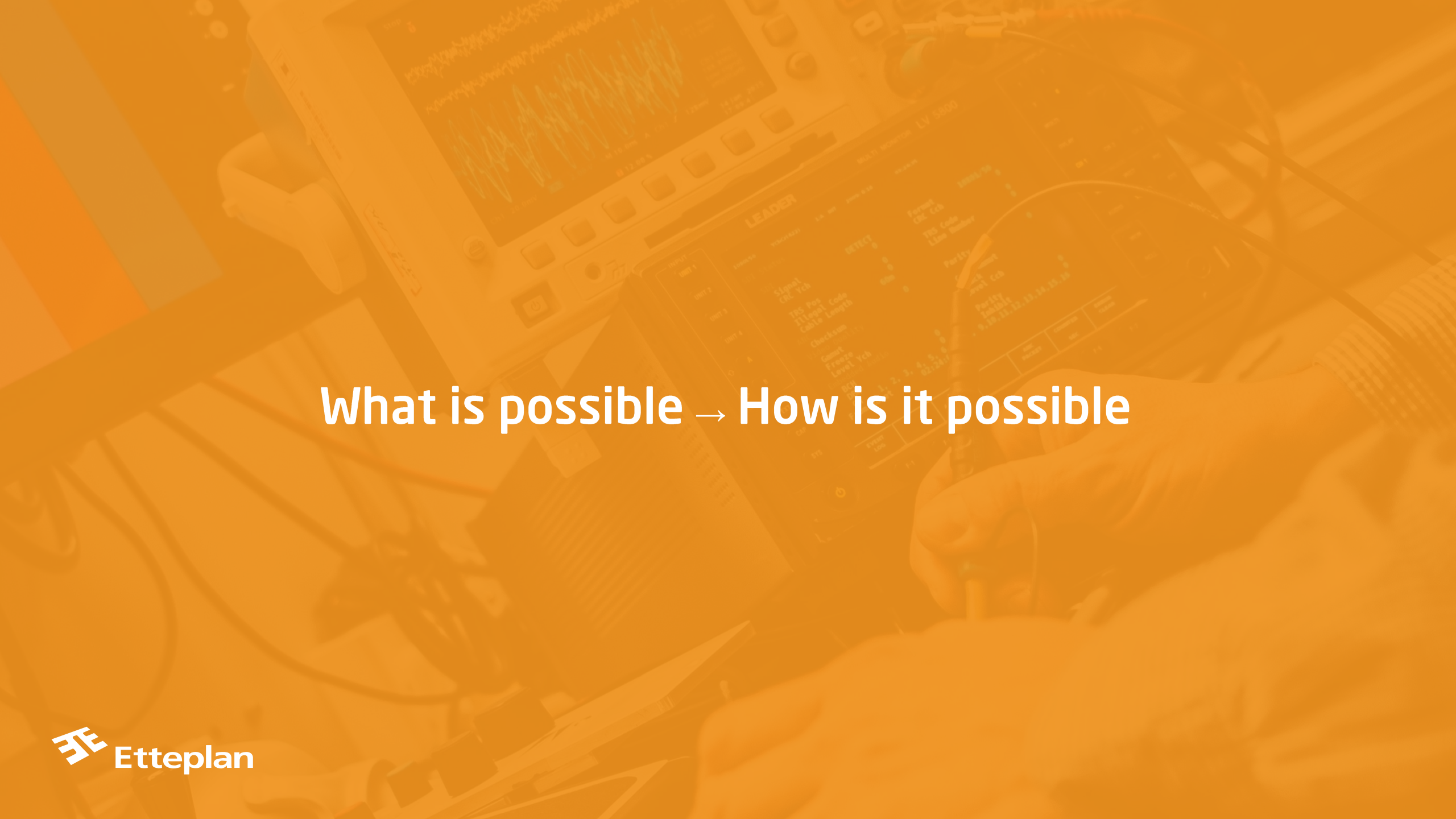
Get the Most from the CompactRIO Platform in Advanced Test Rig Development



What is possible → How is it possible

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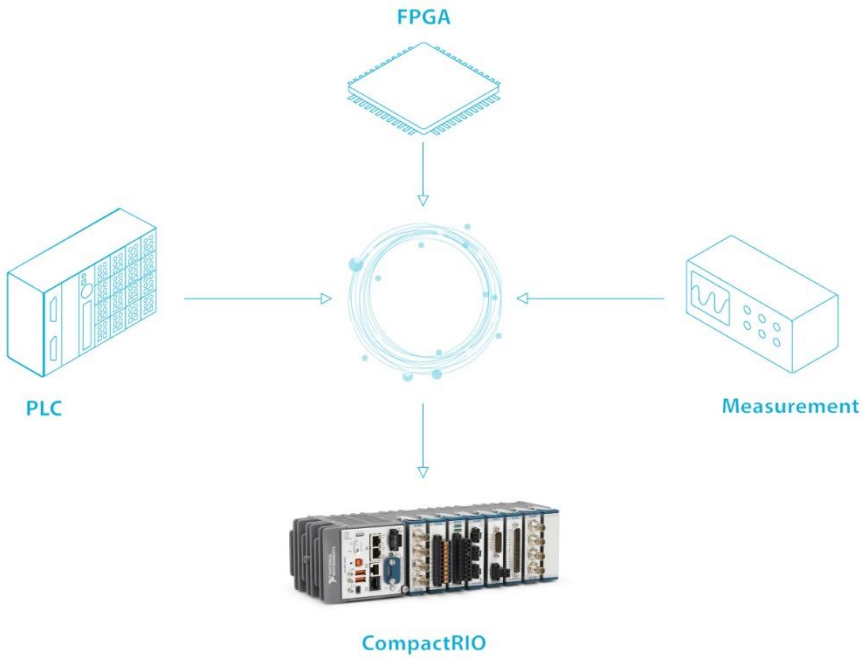

Worlds of measurement and automation

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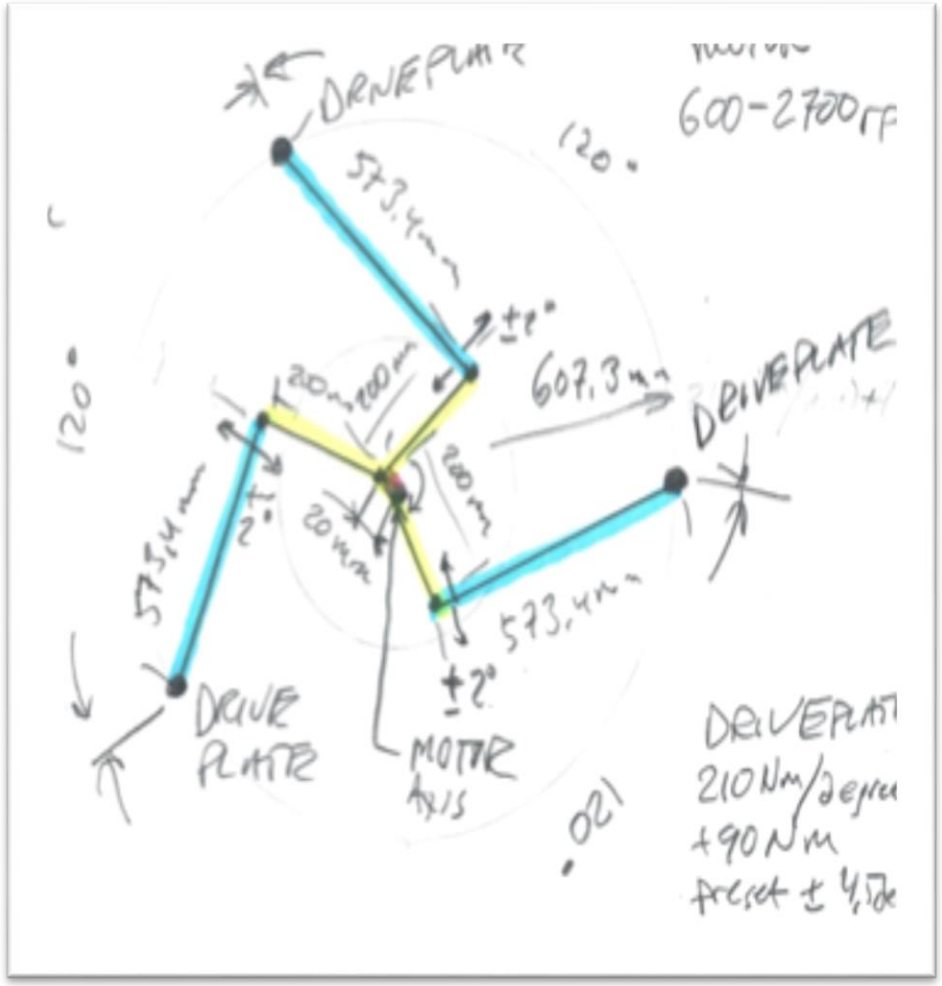
Development process Step by Step

1 !

Feasibility study



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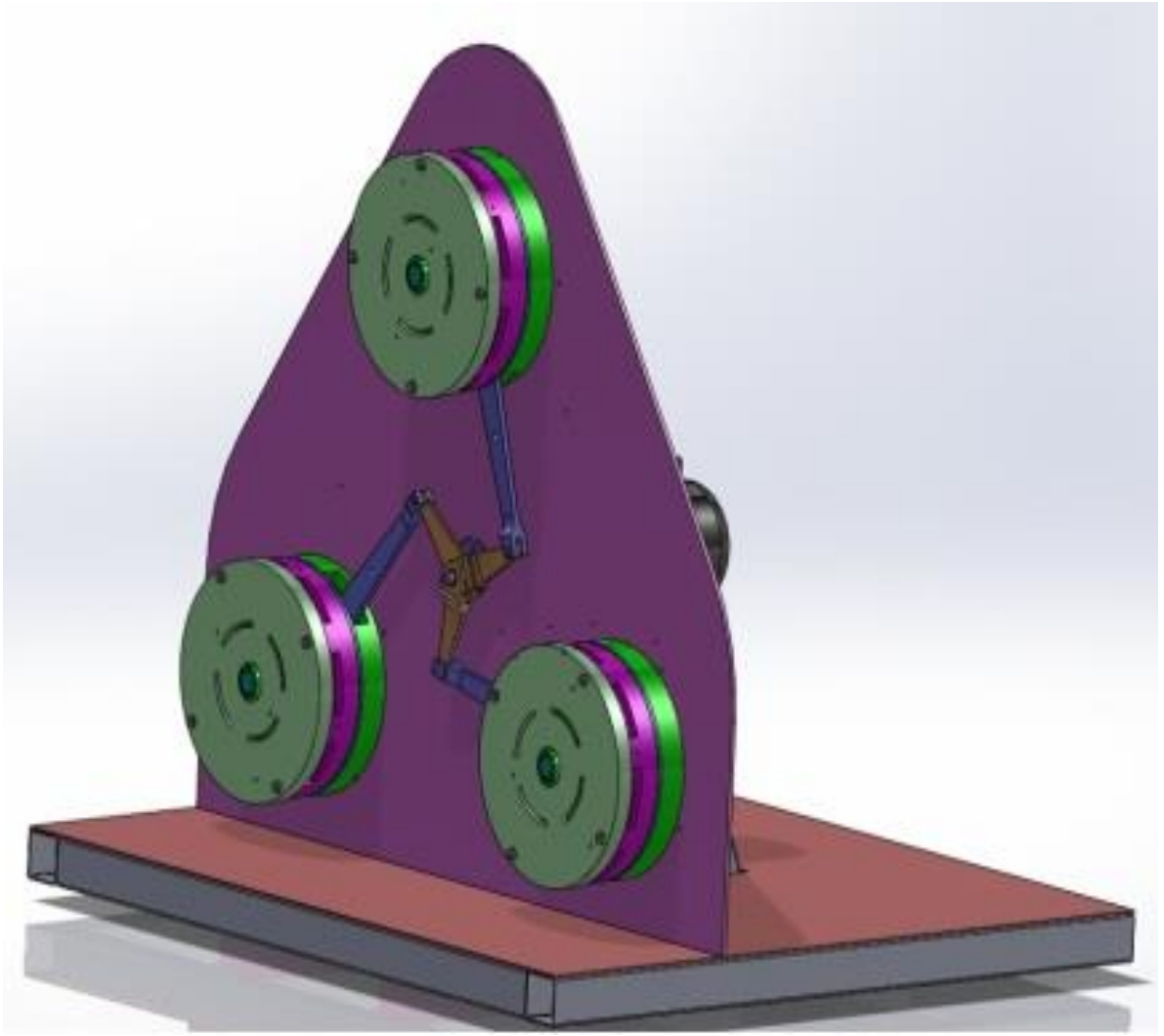
Development process Step by Step

1 !

Feasibility study

2

Design



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Development process Step by Step

1 !

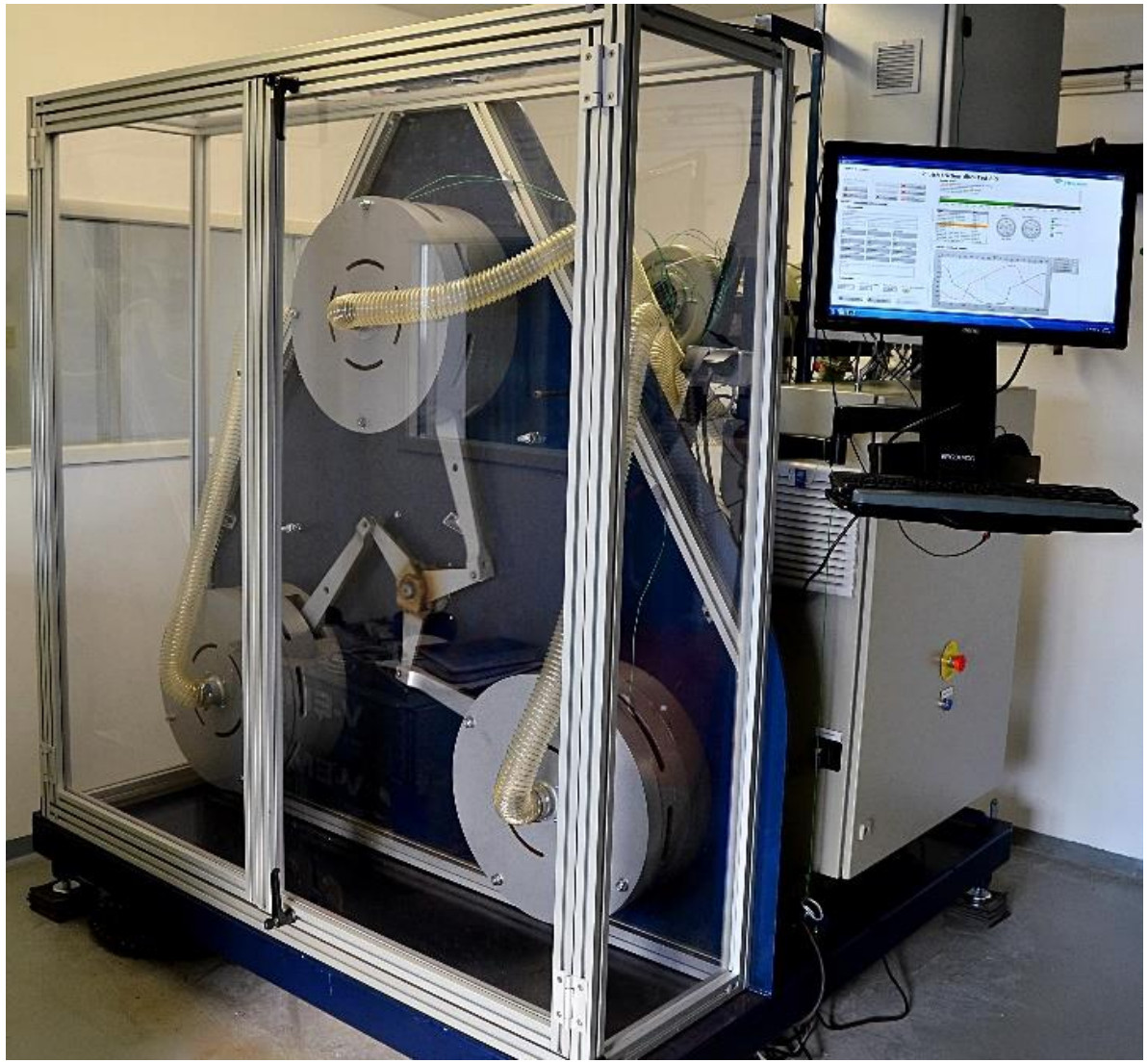
Feasibility study

2

Design

3

Commissioning and Operation



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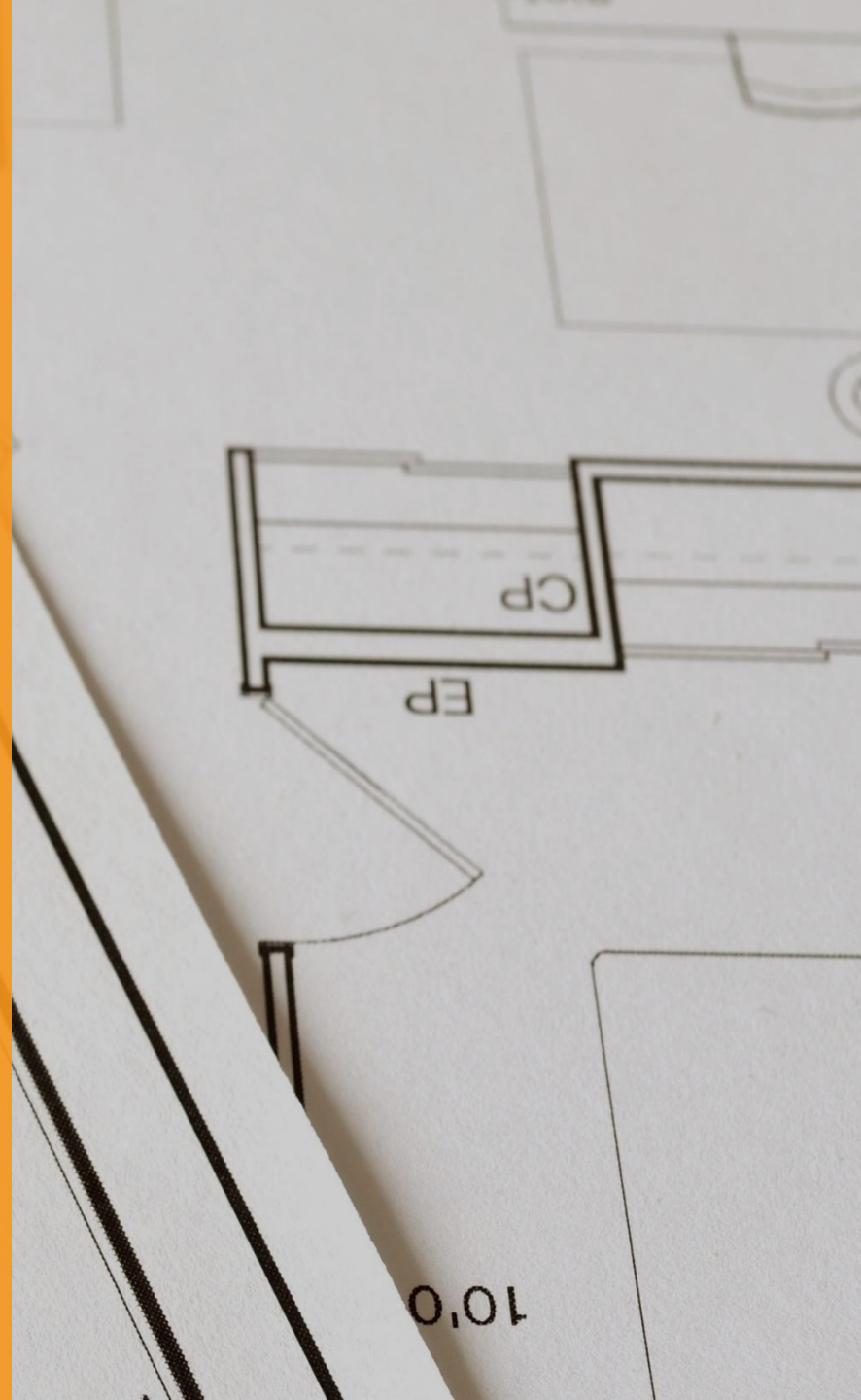
Feasibility study

- Understanding and defining customer needs
  - Testing goal
  - Requirements
  - Functionality
- Clarify cooperation form
  - How should we work in the project?
  - Include customer competence
- Feasibility
  - Technical possible
  - Calculations/Simulations
- Concept



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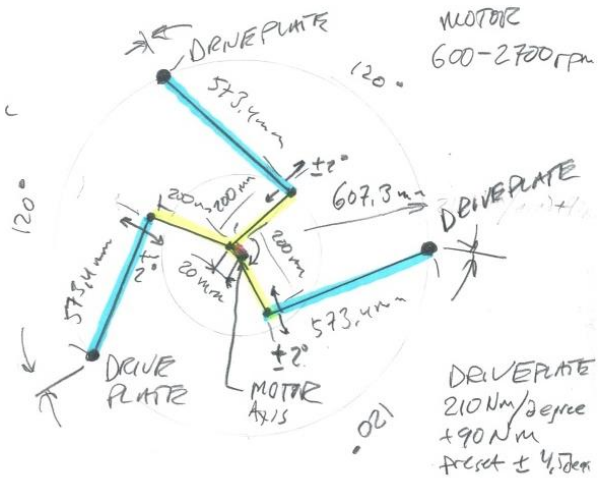
Feasibility study

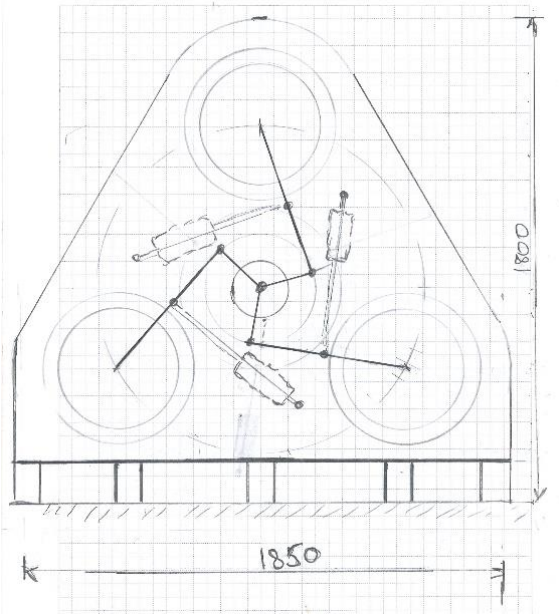
Feasibility
- Understanding problem
- Torque, magnitude

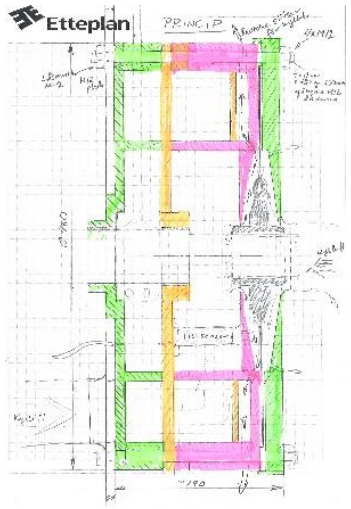
Basic concept
- 3 clutches

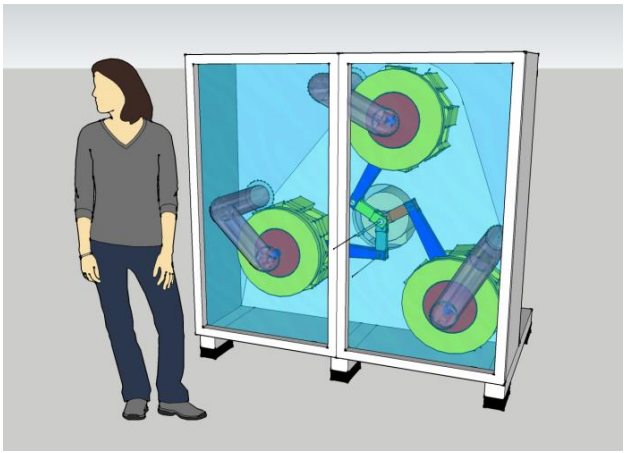
Architecture
- “Samples per degree”
- cRIO platform

Software development
Verification
Testing









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Requirements test method and rig

cRIO Rig Control

- Testing method standards
- Level of automation
- Applicable regulatory standards and directive ATEX, CE etc.
- Maintenance and calibration
- Operational documentation and education

cRIO Test object Interaction

- Sample frequencies
- Accuracy
- Sensor types
- Test object stimulus

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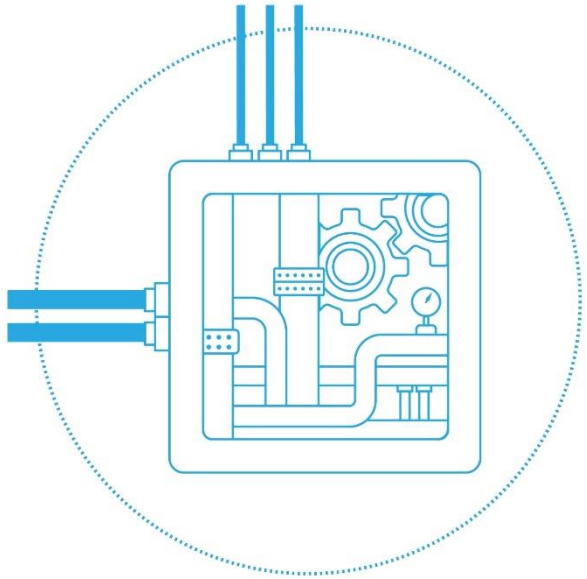
Conceptual Design

- Overall design
- Technical calculations
- Cost estimation
- Definition of regulatory affairs
- Verification plan
- Initial risk analysis



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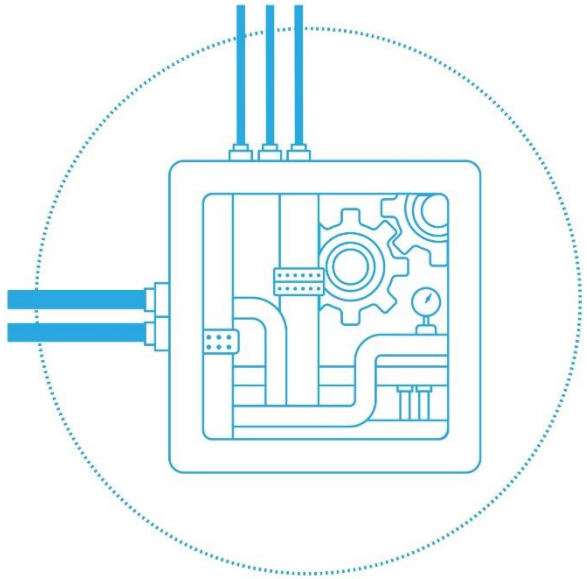
Conceptual Design

- Drive motor, setpoint to FO 600-2700 rpm via modbus TCPIP
- IR temp on test object surface
- Torque measurement, SG full bridge (0 - 5kHz)
- Load cell connected at calibration, SG x 1
- Drive motor encoder 2048 pulses/turn + zerop DI (25kHz - 111kHz)

System architecture

- Defining subsystem
- System layout
- I/O list
- Third party devices
- Host environment



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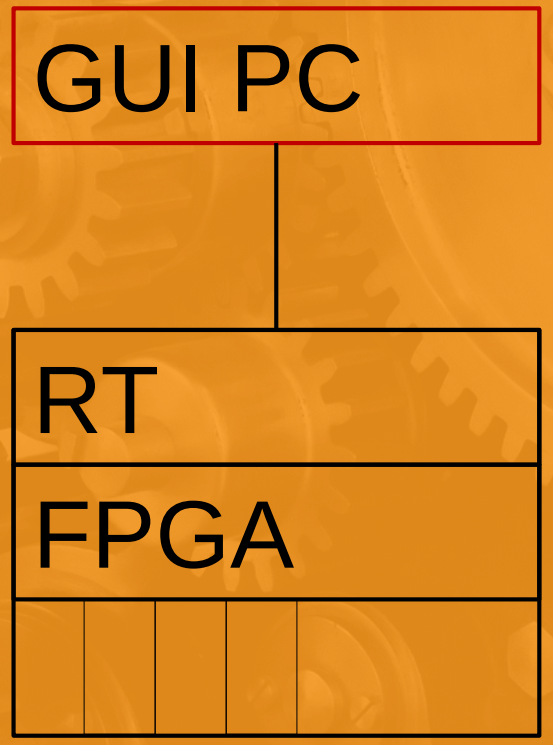
System architecture

HW

PC

cRIO-9074 8 slot

NI-9264 (AO 16ch)
NI-9239 (AI 4ch)
NI-9237 (SG 4ch)
NI-9213 (TC 16ch)
NI-9211 (DI 6ch 500ns)



SW functions

Want to see “torque over the turn”
HMI/GUI Start, stop, graphs, logging

Network communications
shared variables

Control loops PID

Signal processing, fast control loops

DAQ, anti-aliasing filters

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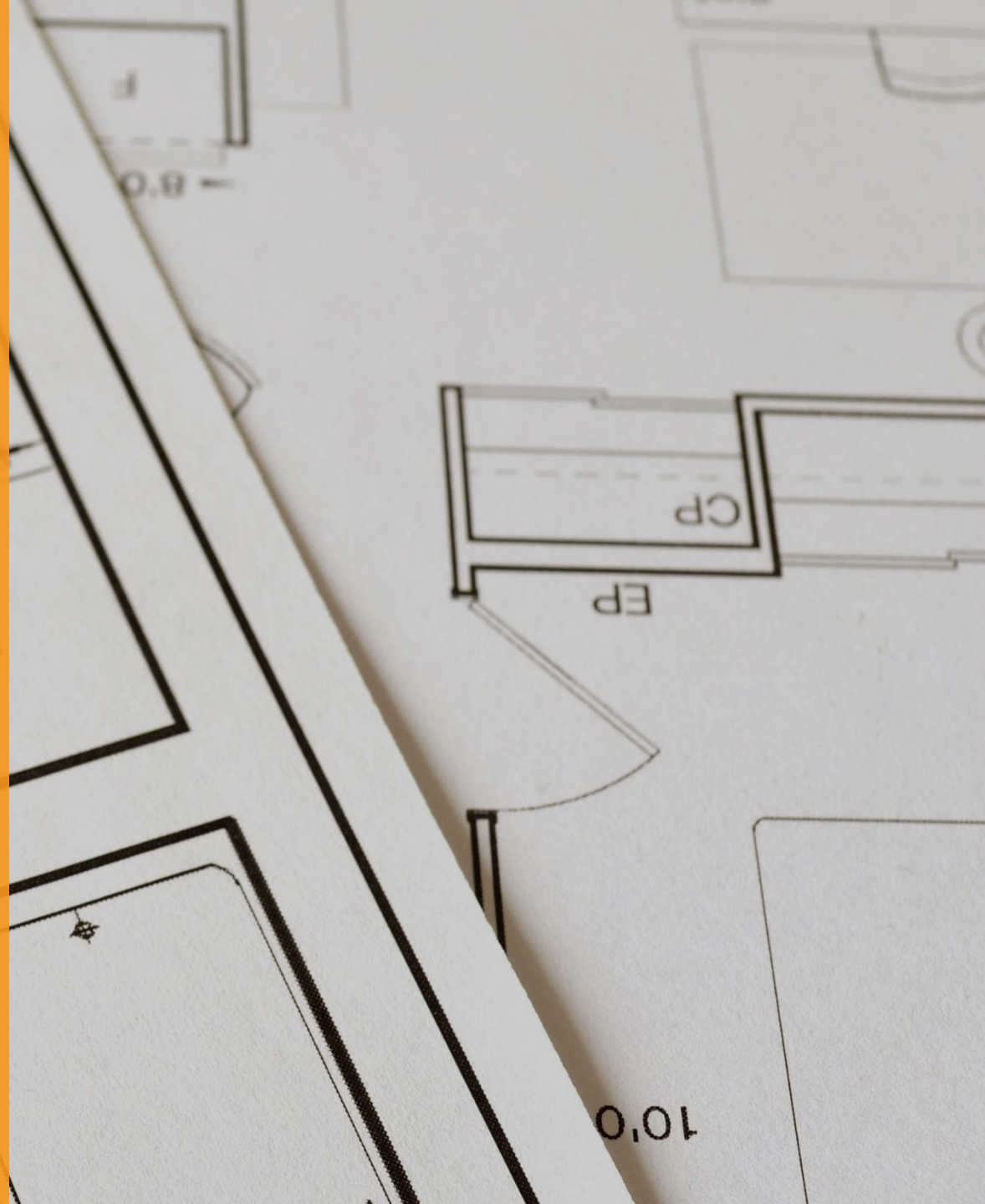
Detail Development

- Functional description
- Software development FPGA
- Software development RT
- Software development Host



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Functional requirements

- System description
- System functions
  - Functional requirements
  - Non-Functional requirements
  - External requirements
- Other requirements

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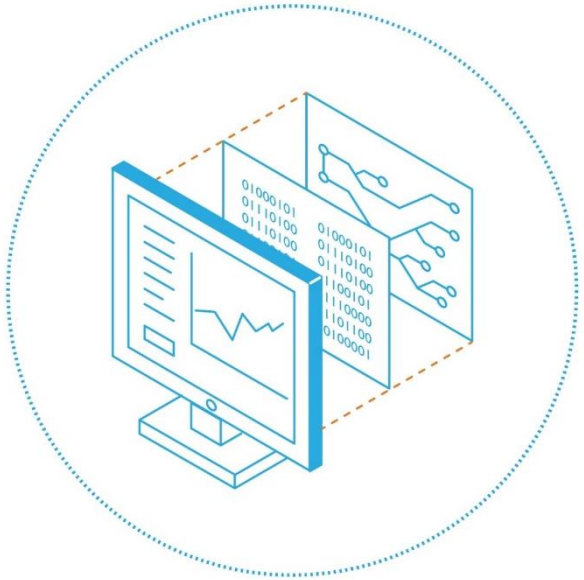
Software development RT

- Establish a design pattern
- Programming mode
  - FPGA
  - Scan mode
  - Hybrid mode
- Rig control
  - Control loops
  - Warning and stop functions
- Measurement
  - FPGA reading/writing
  - Analysis/Post processing



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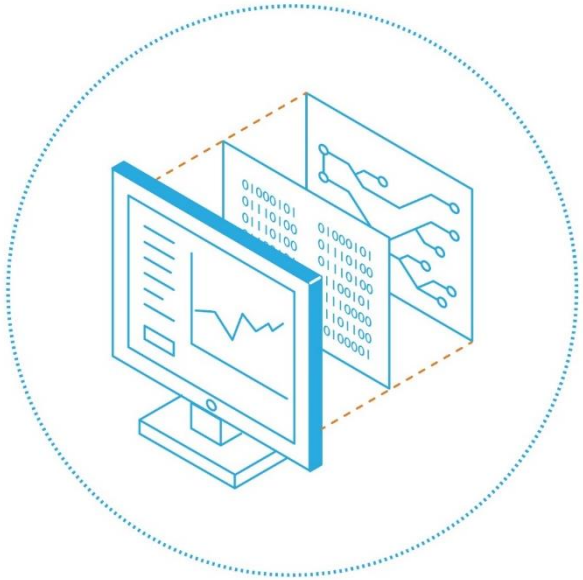
Software development RT

- User interface command loop
  - Network communication
- RT System health and FPGA-monitoring
- Third party devices



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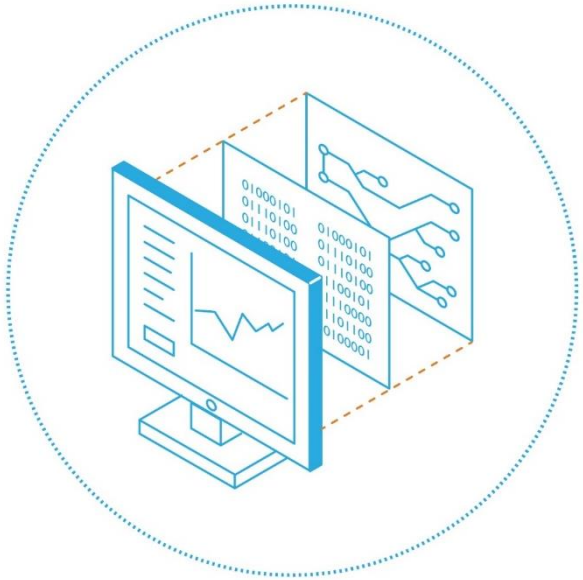
Software development FPGA

- Control task
- Sampling
- Filtering
- Safety
- Calibration and scaling
- Watchdog



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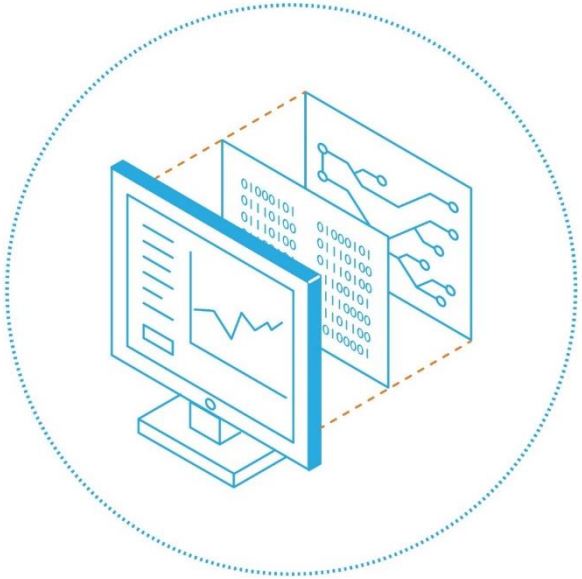
Software development FPGA

- FPGA requirements
- Software architecture – NI template or own template
- Implement
- Test and debug



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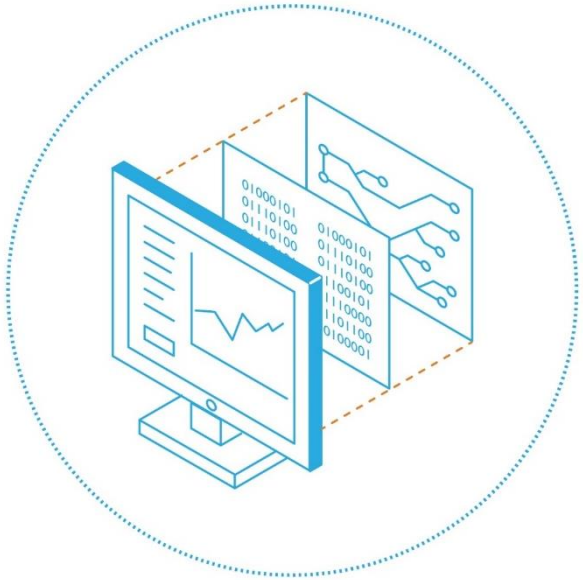
Software development Host

- User interface
  - Updating UI
  - Event handling
  - Communication
- Test object meta data
- Test data handling
- Network communication



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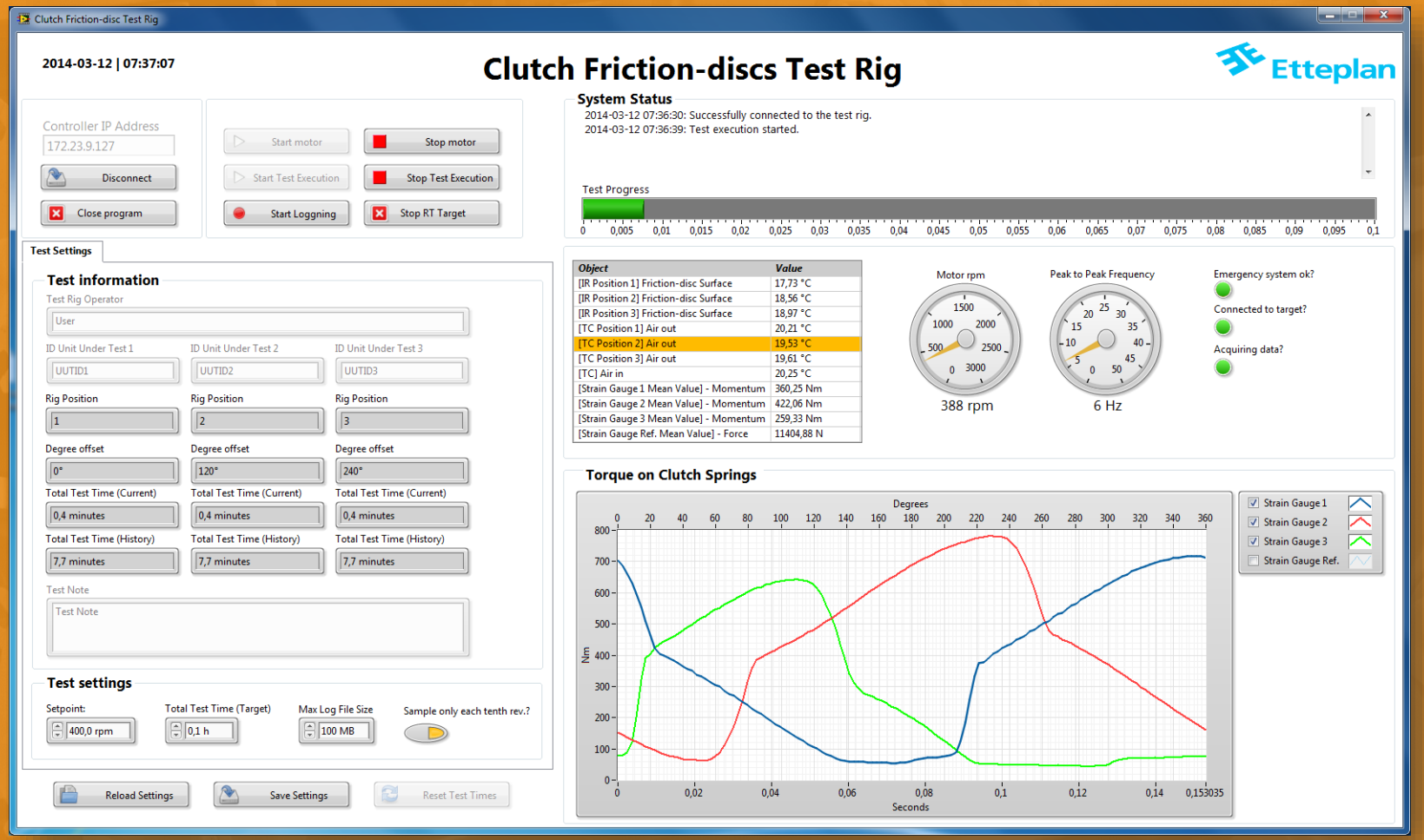
User interface



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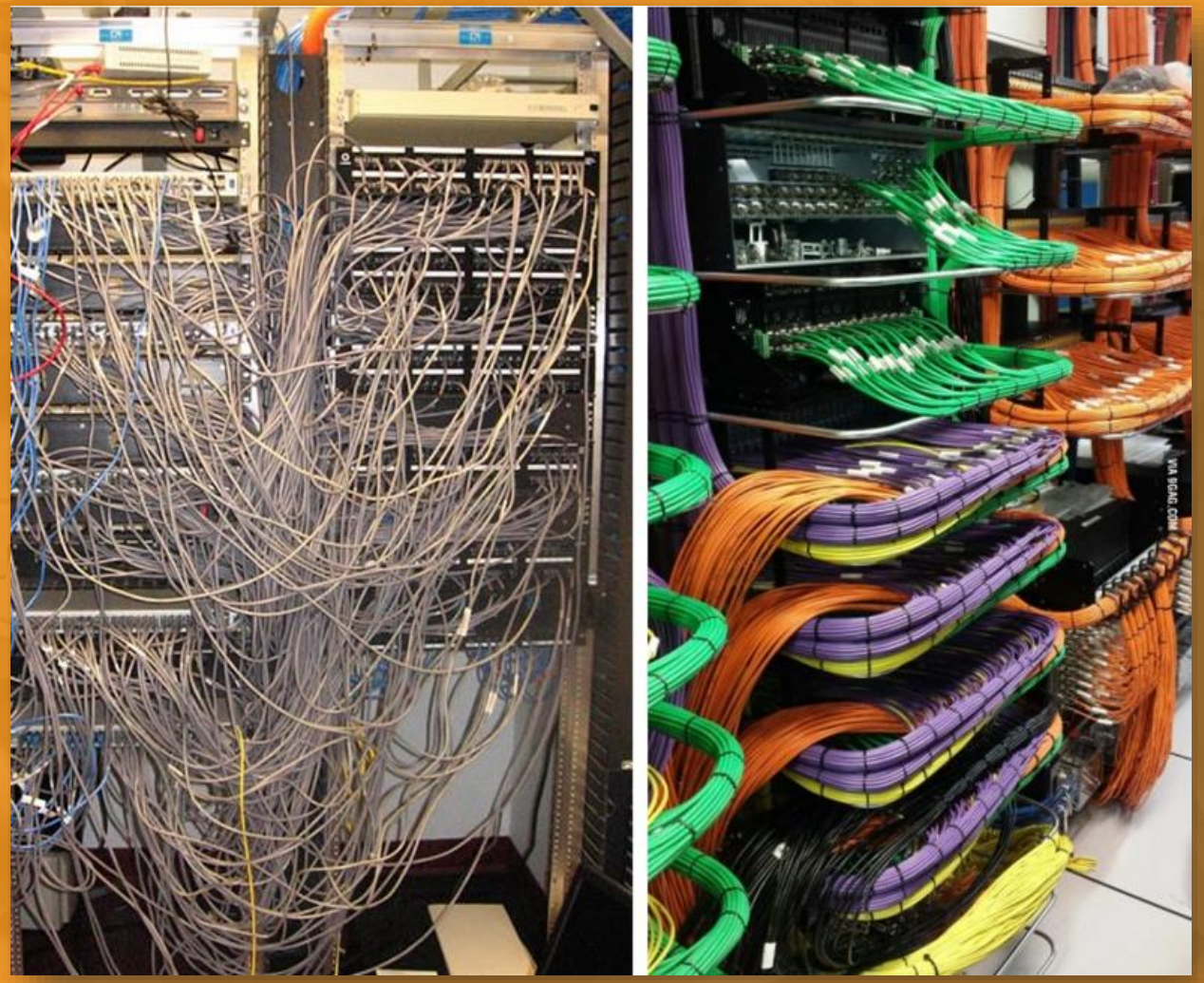
User interface



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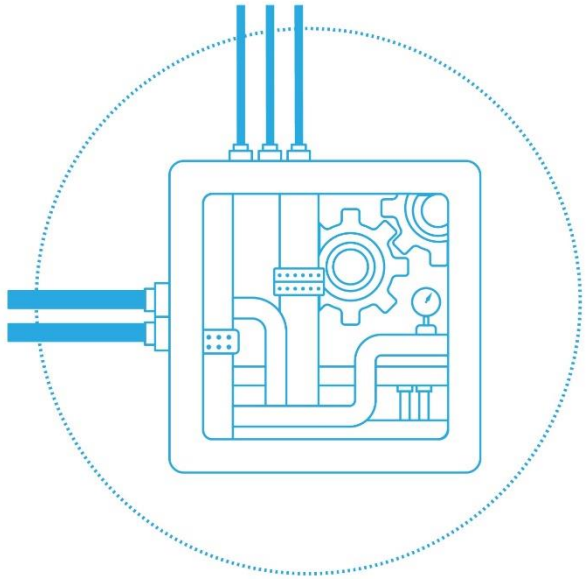
Commissioning & Verification

- IO-testing
- Control loop tuning
- Performance testing
- Verification plan



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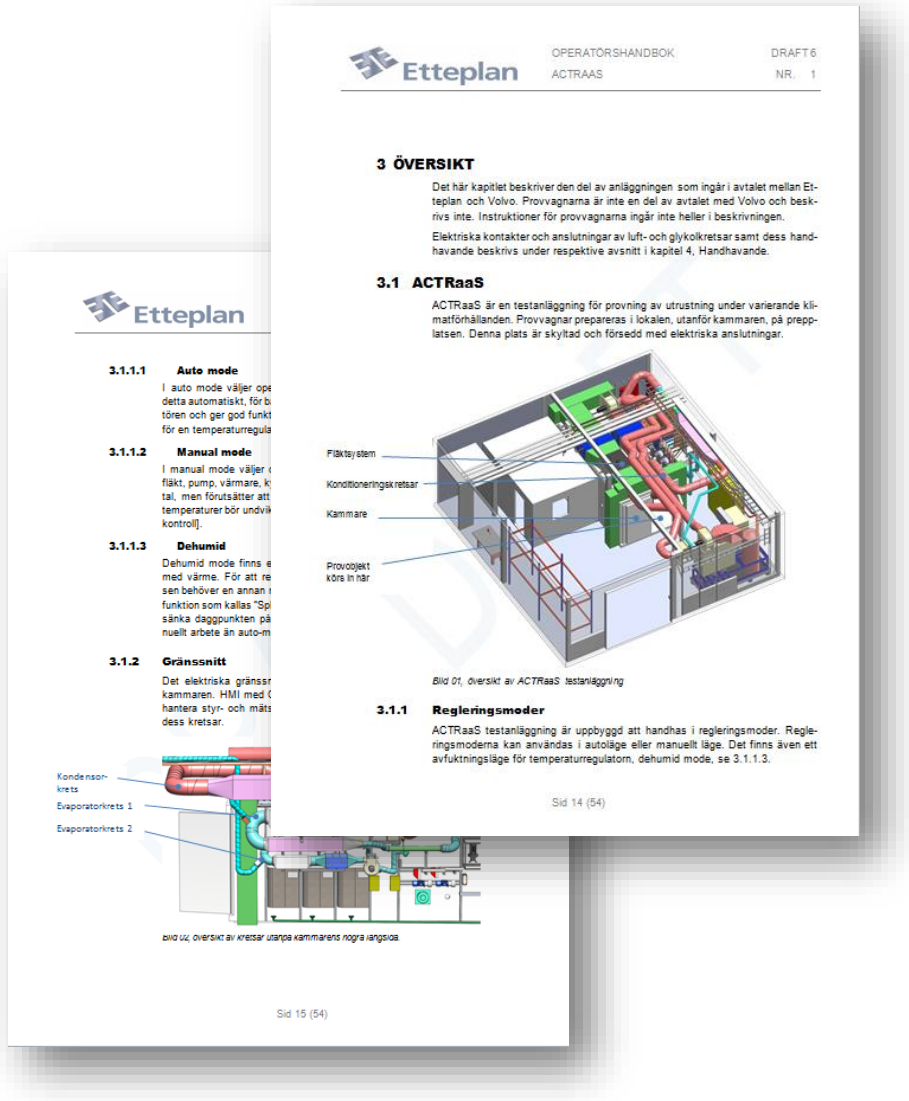
Documenation & hand over

- Technical writer
- Operator instruction
- Maintenance instruction
- CE-documentation



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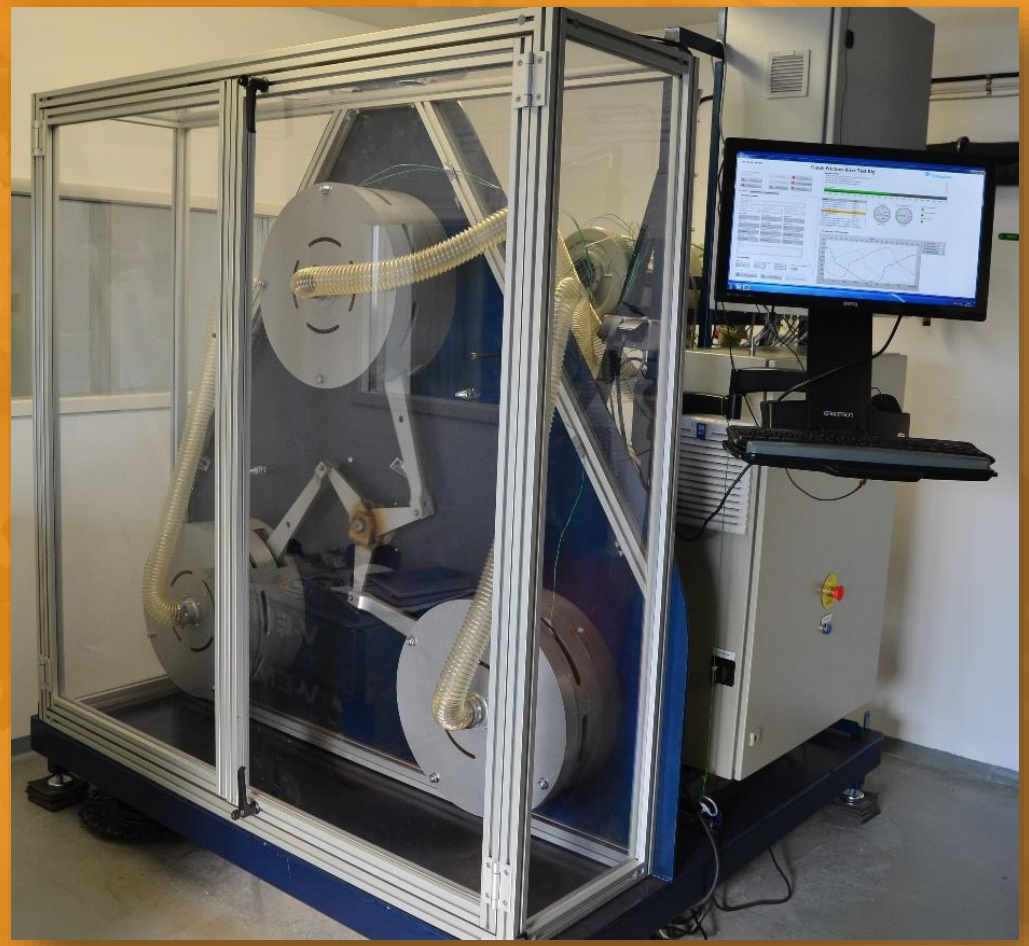
Testing and analysis



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Why do we use the cRIO platform

- Quality high speed measurement, processing and control, very fast loops possible in FPGA
- Rugged, reliable, deterministic, (like PLC)
- Flexible reconfigurable hot swappable big variety of I/O modules available
- Easy and effective to use, one platform fit a lot of different applications.
- LabVIEW

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Trends & Future

- High performance fieldbuses
- Industrial Ethernet
- cRIO price
- NI Veristand in test cell development

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