



Business Unit

Mechatronic Systems

Introduction

LET'S
OUTSMART
TCMORROW

About us



Founded 2011
**Design & Engineering
company**

- R&D Projects & Consultancy
- Industrial equipment
- Autonomous mobility/robotics.



Founded 2012
Engineering company

- Industrialization projects & Consultancy
- Optimization of Manufacturing processes
- Supply Chain Management

TEAM

- +125 Nobleans
- 85% Academic & PhD level
- 13 Nationalities

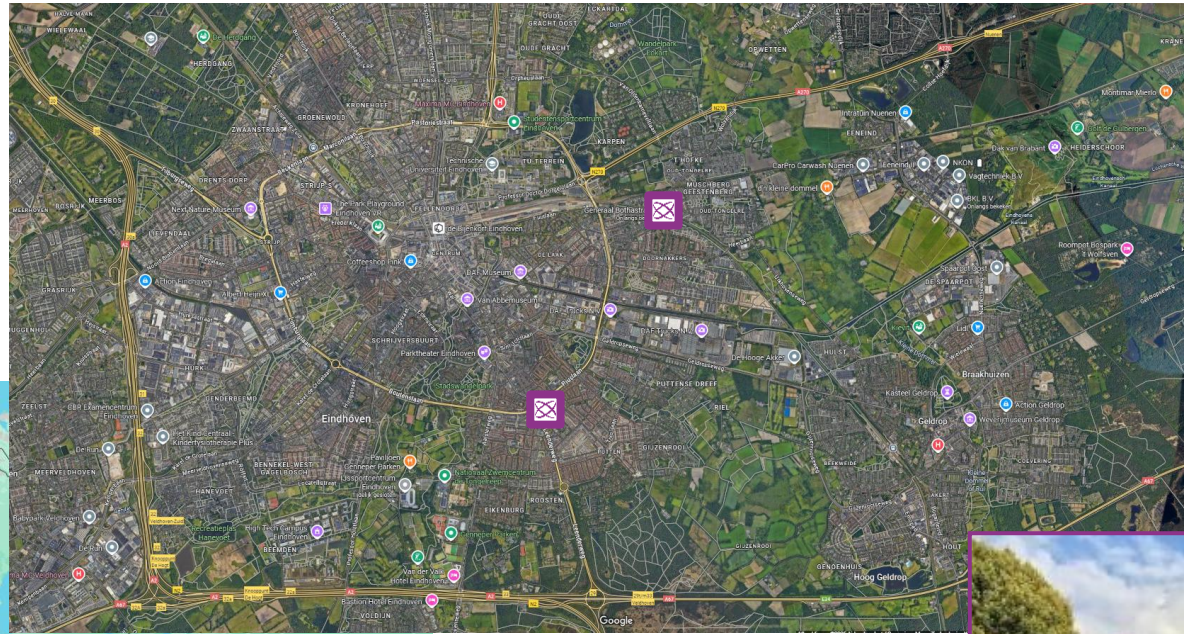
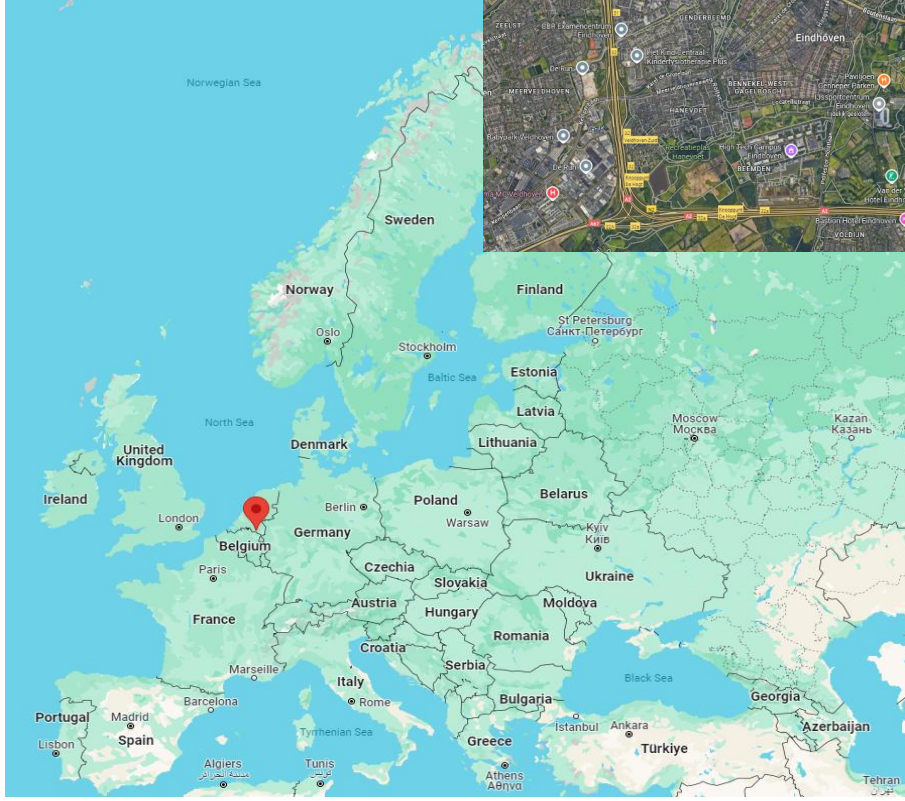
CUSTOMERS

- High-Tech OEM's
- SME's,
- research institutes,
- start- and scale-ups.

intelligent
systems



About Where



Lab, Assembly & Workshop Facilities
Generaal Bothastraat 3, Eindhoven
(1770m2)



Development & Engineering
Heggeranklaan 1, Eindhoven

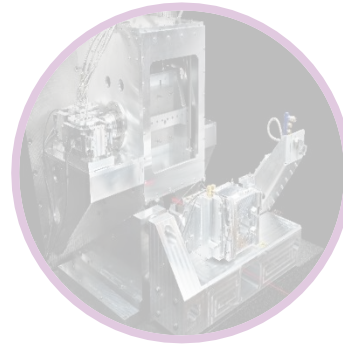
Business Units



Autonomous & Intelligent Solutions

Enabling machines & devices
to act autonomous & intelligent

Business Unit Director
Mark Poldervaart



Mechatronic Systems

Creating Motion Systems for
high precision & performance

Business Unit Director
Ruud van der Aalst



Embedded & Electronics

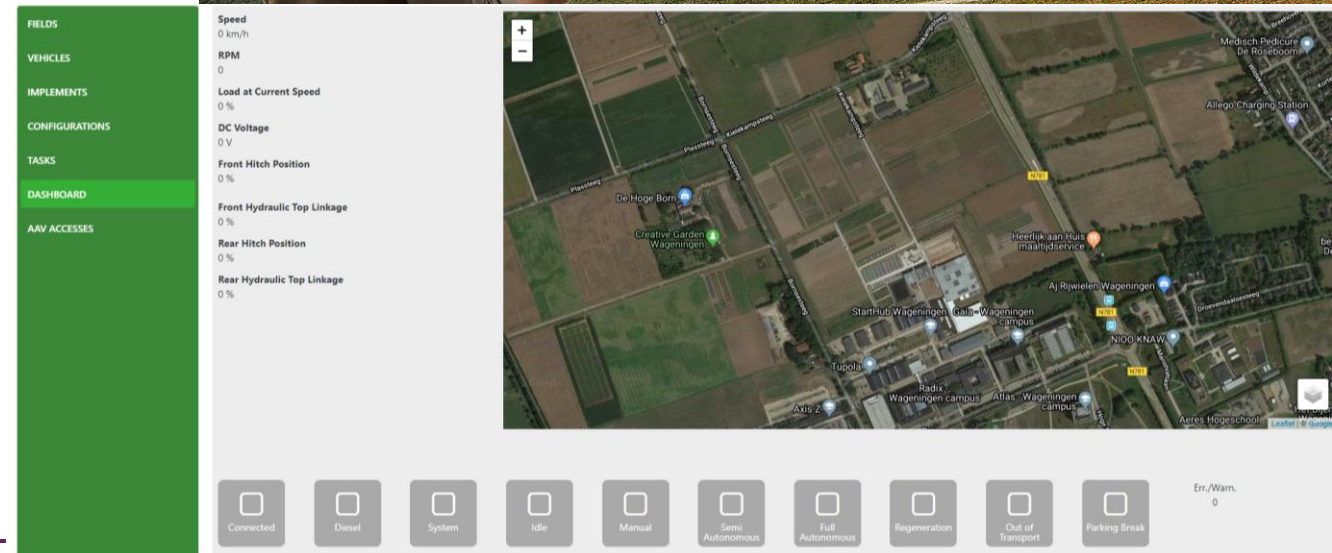
Developing the embedded control
platform, drivers & interfaces

Business Unit Director
Jeroen Dortmans

Example project: system Integration

Autonomous Tractor

- Together with multiple suppliers
- Autonomous field maintenance solution.
- Extensive web interface
- Safety certified autonomous tractor
- Nobleo delivers:
 - Autonomous Localization and Navigation
 - Safety for the autonomy (Bosch automotive components)



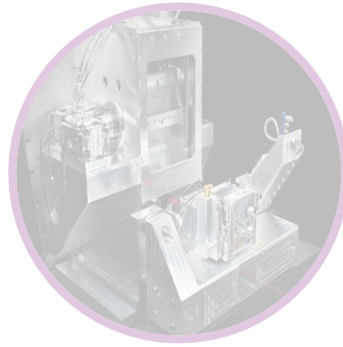
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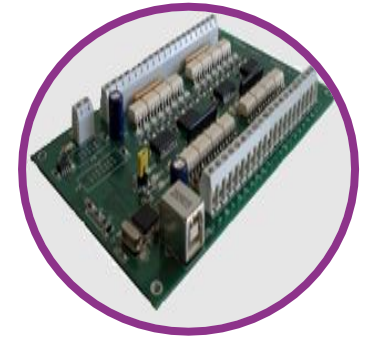
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Products and Services

Nobleo Autonomy Core

- Scalable CotS computer board
- Custom IO and sensor board.
- State-of-the-art ROS stack
- Available as OEM bare-board
- Available as OEM software



Nobleo Mainboard 2.0

Nobleo motherboard 2.0 hosts Nobleo ROS software stack, enabling any system to become a fully autonomous system. Nobleo's software stack is fully modular to enable several sensors, actuators and other hardware to be connected.



On board functionality

GPS
Multi-band, GPS, GLONASS, Galileo and Beidou.
RTK correction for centimeter level accuracy

IMU
3-axis Accelerometer
3-axis Gyroscope
3-axis Magnetometer

CANBUS
Up to 1000 kbit/s

GPIO
I2C-bus
10x Digital in/out (expandable)
2x PWM
4x Analog in (0-10V, 4-20mA selectable)

WATCHDOG
Onboard watchdog for monitoring software

CONNECTIVITY
3x USB 3.0
2x USB 2.0
UART
2x Gb Ethernet
HDMI
SATA3
mPCIe
M2 2230

Specifications

CPU
- Intel Celeron N3350 (2 x 2.4GHz)
- Intel Pentium N4200 (4 x 2.5GHz)

MEMORY
4 to 8 GB RAM
up to 128 GB eMMC storage

POWER IN
9-60V 25W (Excl Aux)

POWER OUT
9-60V 6A (sw switchable)
5V 6A

OPERATING CONDITIONS
0°C to +60°C

Nobleo Projects

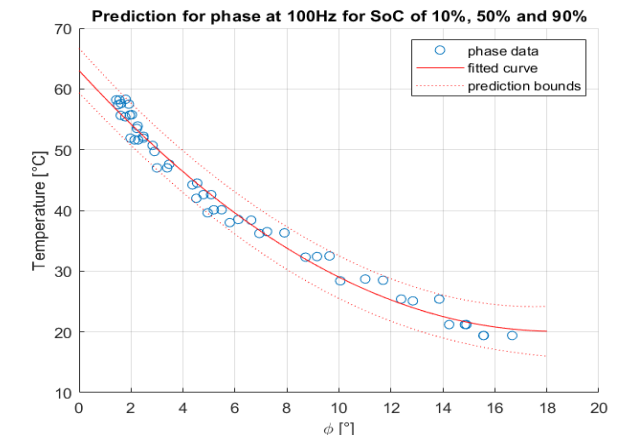
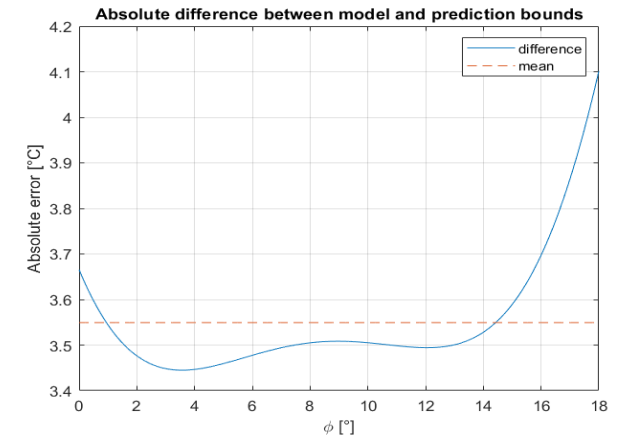
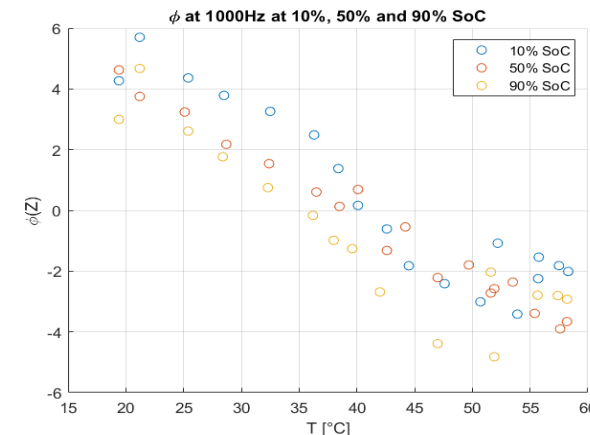
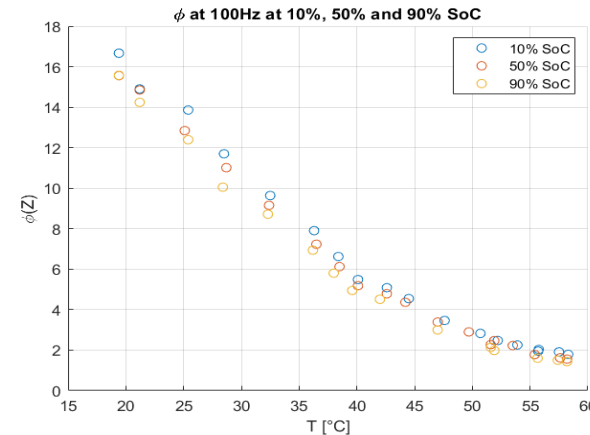
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Thermal runaway prediction

EIS + Sensor fusion to predict thermal runaway events

- Continuation of the EIS project
- EIS to measure internal cell temperature
- Sensing gasses
 - CH₄
 - H₂
 - VCO
- Electrical information
 - Cell voltage



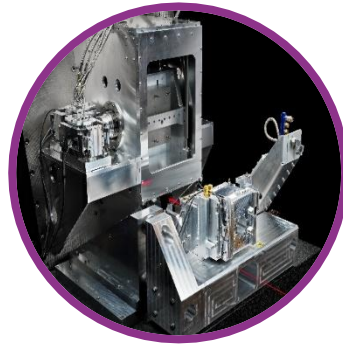
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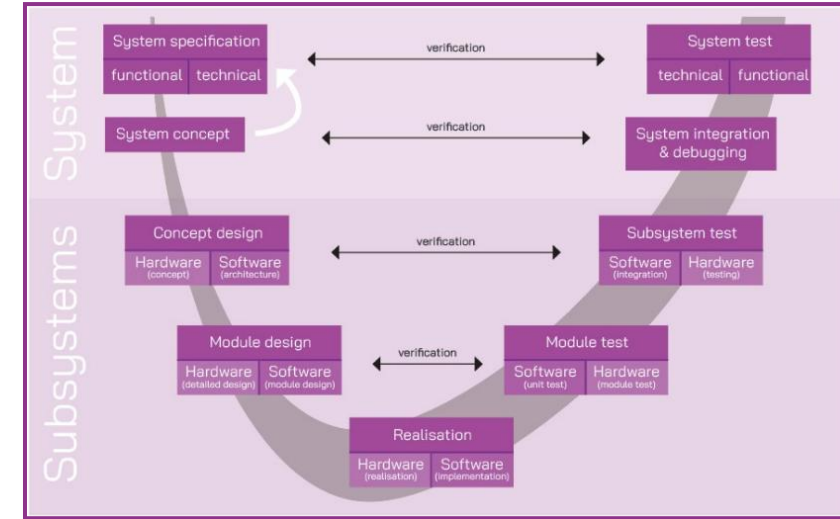
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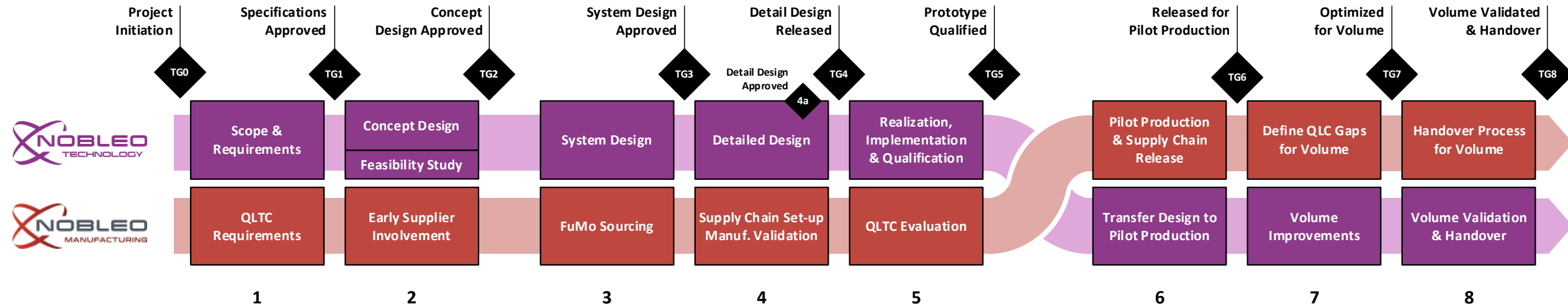
Nobleo Technology

Stage gated product development flow

- Alternatively: Agile / **Adopt customer WoW & Processes**
- Supported by Bi-Weekly Traffic Light Reporting to customer's stakeholders



Proof-of-Concepts & Functional Models (FuMos)



Mechatronic Systems

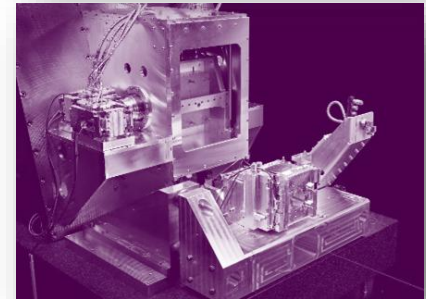
Creating motion systems for high precision & performance

We support our clients through

- **Mechatronic Solutions**
Design, Development and Engineering services
- **High-Tech Equipment & Test Tooling**
From 1st Concepts up to on-site Commissioning
- **Design House+**
Tailored Supply Chain Solutions
Industrialized, turn-key ready at supplier of customer's selection
- **Your development partner were**
All Foreground IPR remains with customer
No customer lock-in is created

Areas of expertise

- **Advanced Mechatronics**
By System Engineering multi-disciplinary competences are turned into optimized designs
- **Precision Engineering**
Applying mechanical design know-how for sub-micron accuracy at high throughputs
- **System Dynamics**
Experts in modelling, simulating and experimental verifications of complex systems
- **Servo Controller Designs**
Control theory, sensing and actuation know-how applied to optimize system performance



What we do

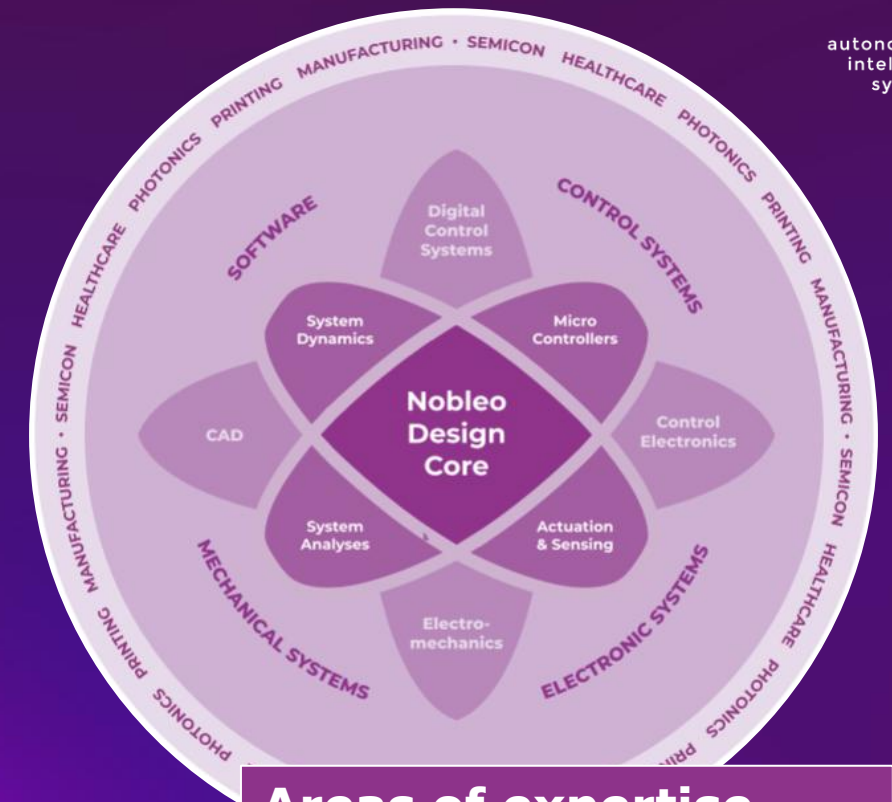
We support our clients through

- **Mechatronic System Development**
 - Uniting multi-disciplinary competences for optimized designs
 - Applying mechanical design know-how for sub-micron accuracy at high throughputs
 - Experts in modeling, simulation and experimental verification of complex systems
 - Control theory, sensing and actuation know-how applied to optimize system performance
- **High-Tech Equipment & Test Tooling**
 - Development from Concept to on-site system commissioning

Design House+

End-to-End ownership

- **Supply Chain Management**
- **NPI at customer tailored supply chain**
- **From Concept up to Industrialized Turn-Key**



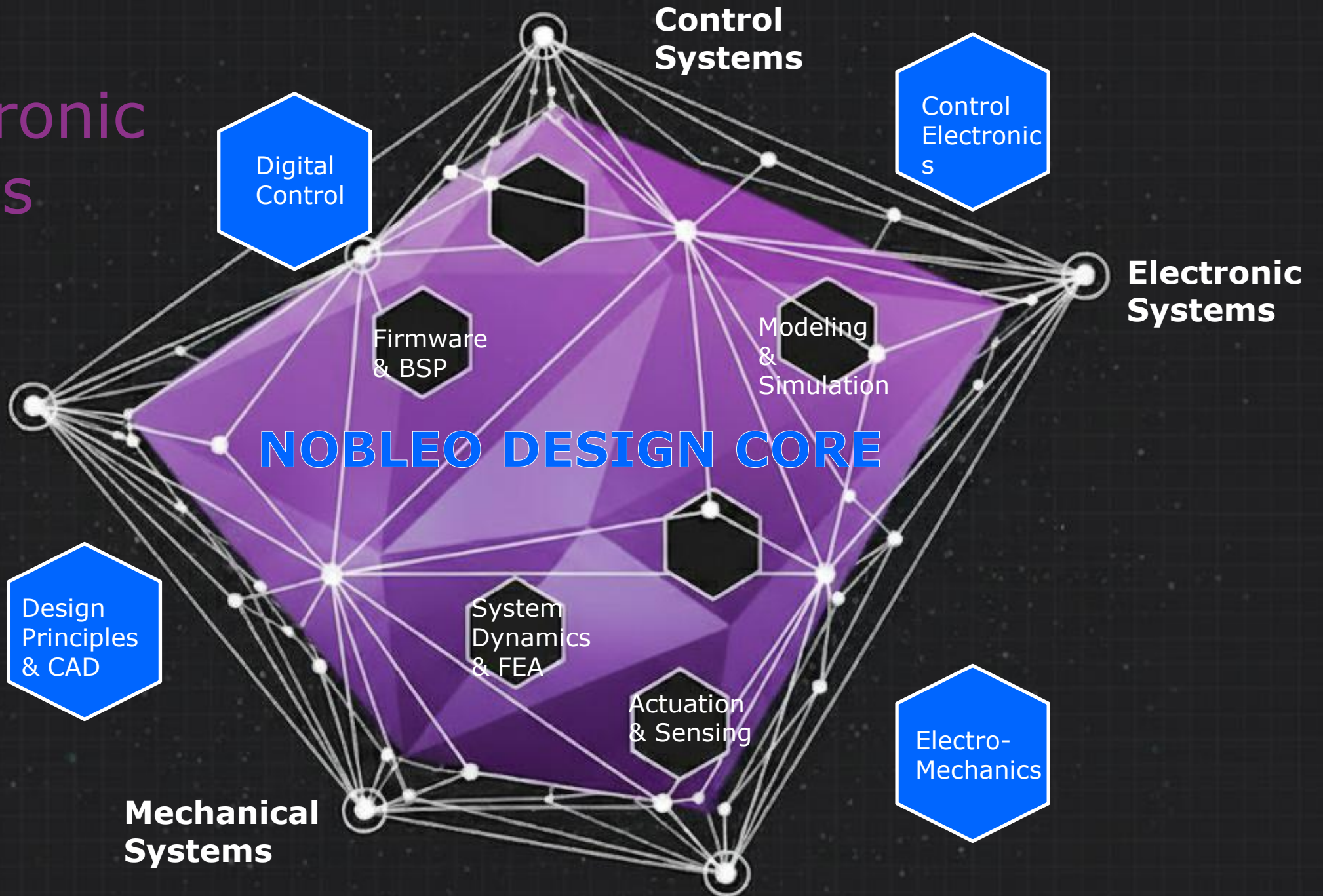
Areas of expertise

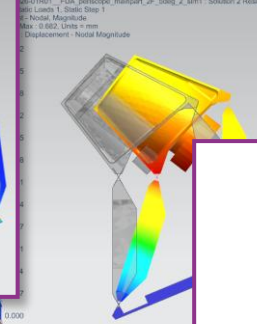
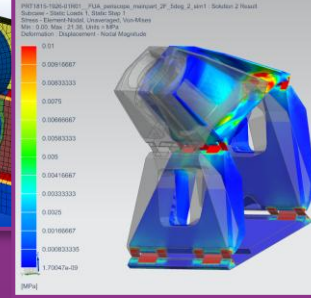
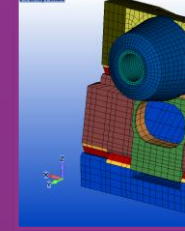
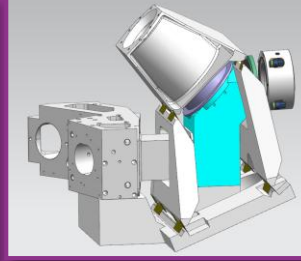
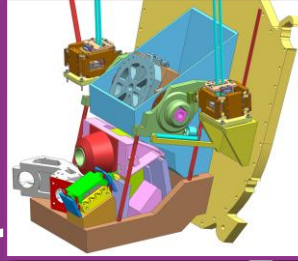
- **System Engineering**
- **Dynamics & Control**
- **Precision Engineering**
- **Finite Element Modeling**
- **Embedded Software**
- **Electronics Design**
- **NPI & Industrialization**

Mechatronic Systems

How?

Embedded Software

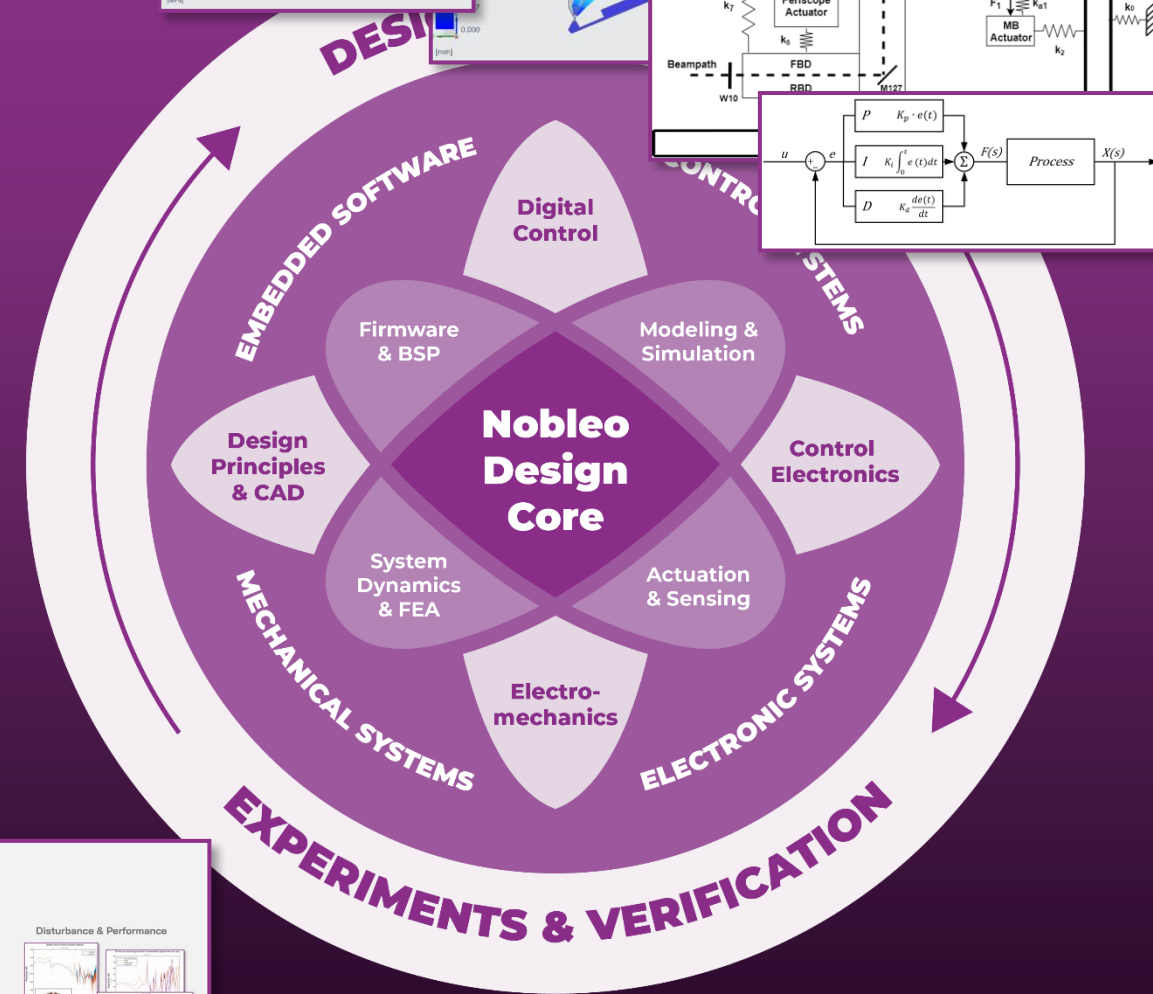
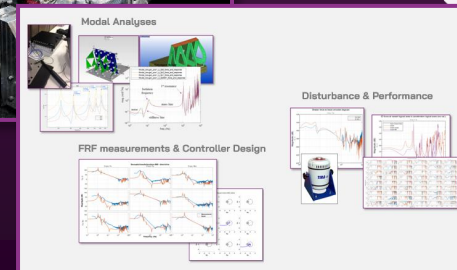
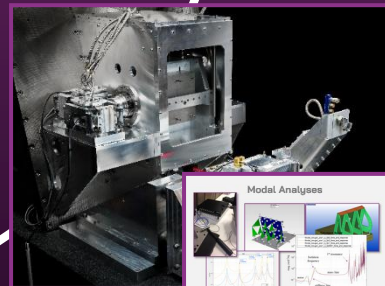




• Expertise & Toolchain

→ Fast iterations

→ Pragmatic and effective approach



Nobleo Design Core

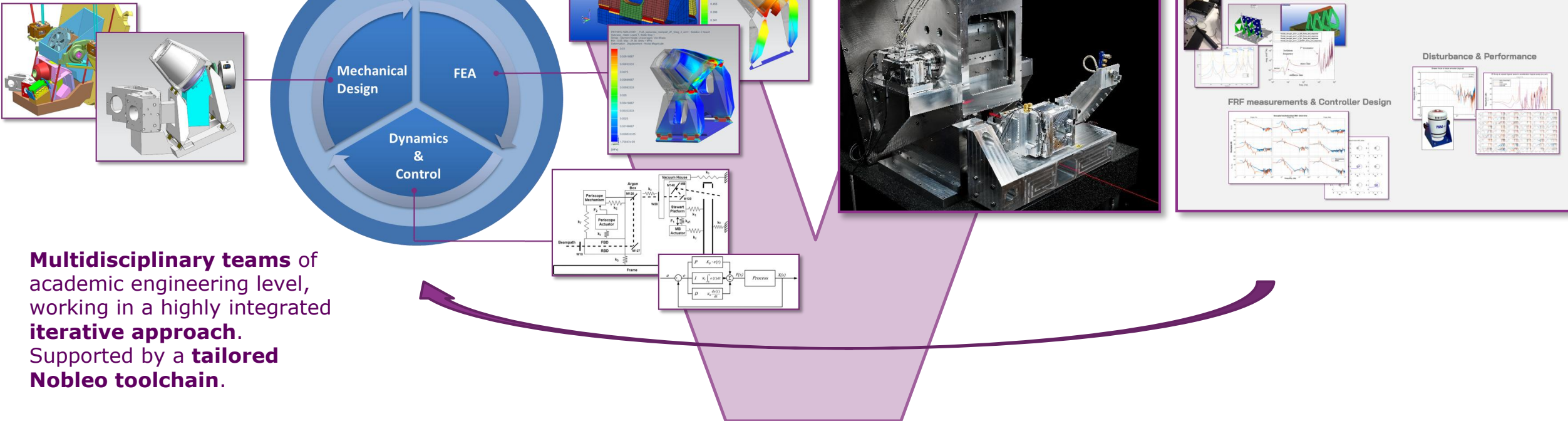
Our customers' challenges are dealt with in a **pragmatic & effective approach**

Build **Proof of Concepts / Functional Models / Prototypes**

Design & Modeling

Experiments & Testing

+



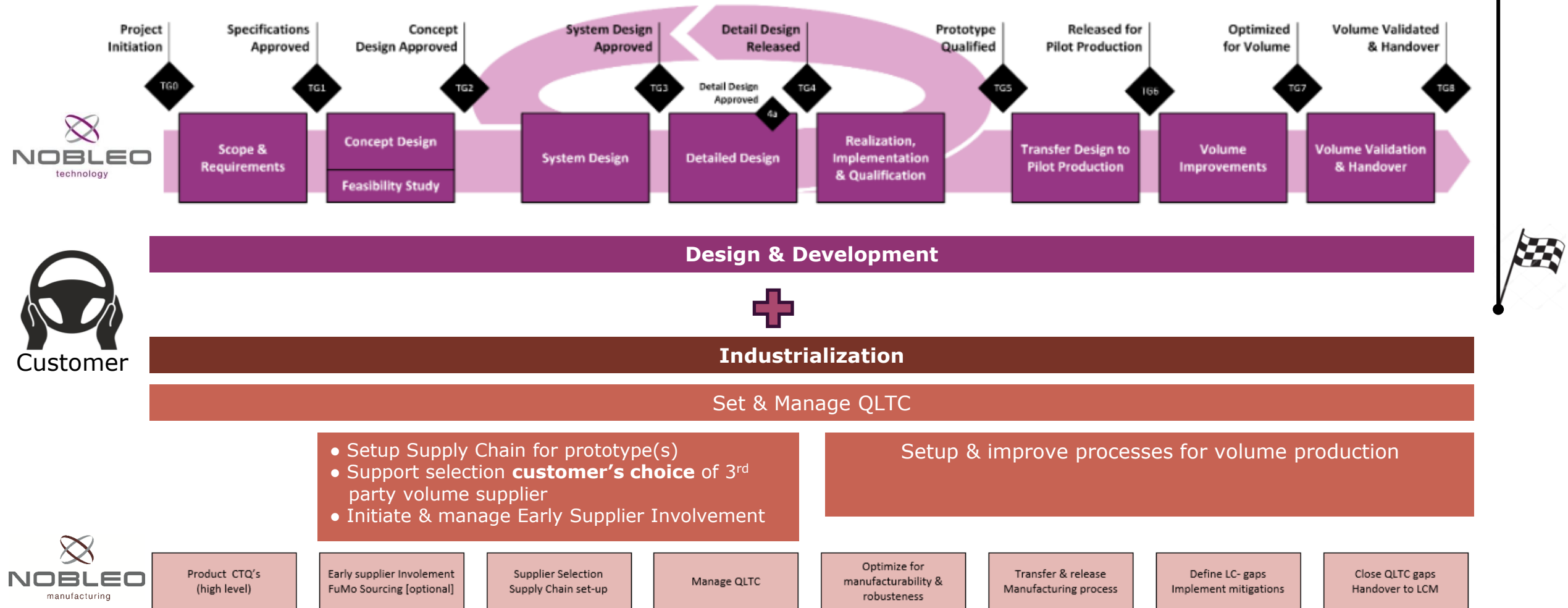
Test, **Verify & Learn** for improved designs

Design House+

End-to-End ownership

- Supply Chain Management
- NPI at customer tailored supply chain
- From Concept up to Industrialized Turn-Key

Turn-Key ready without
"Customer Lock-In"



Systems

In-house cleanroom

To support our development activities the Nobleo lab is equipped with:

- ISO Class 7 hard-wall cleanroom
- ISO Class 7 soft-wall cleanroom
- ISO Class 5 integrated cross-flow unit



Mechatronic Systems

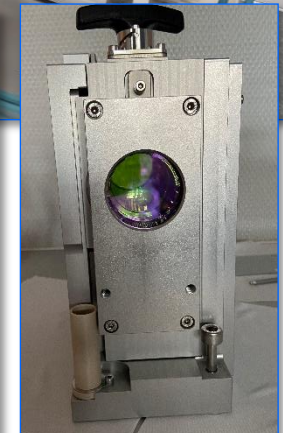
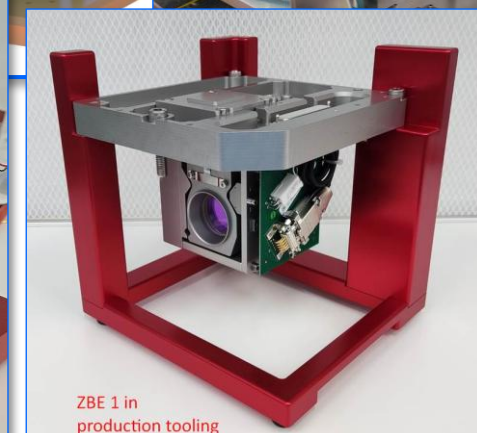
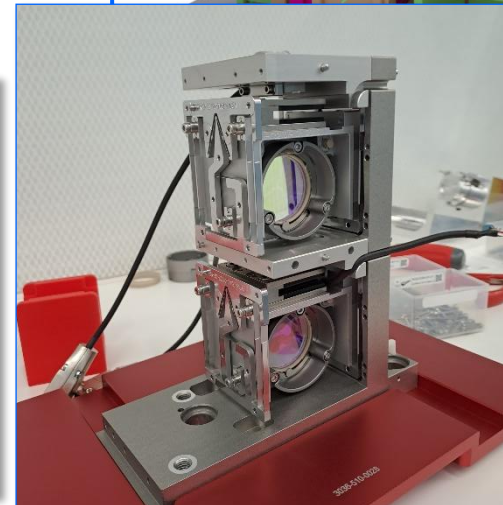
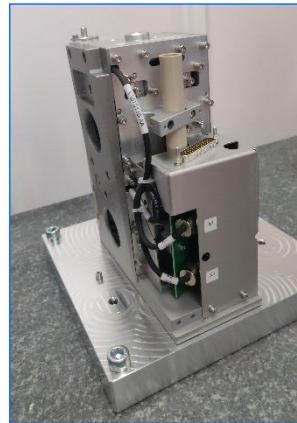
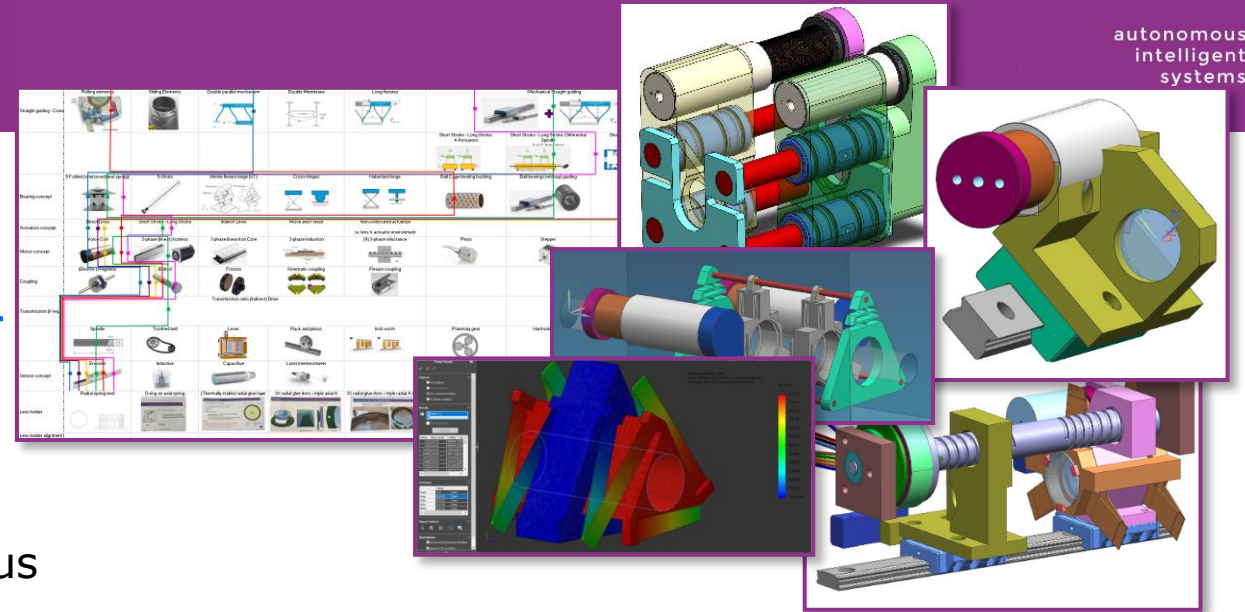
Portfolio, some example cases; High-Tech Equipment & Test Tooling

Systems

Zoom Beam Expanders & Focus Actuator

Design & development of a Mechanical/Dynamical Concept for Zoom Beam Expander modules and Focus Actuator module.

- Feasibility Study
- Concept developments
- Design choice trade-offs
- Development; concept & detailed design
- Design Q-Tool & Qualification
- NPI

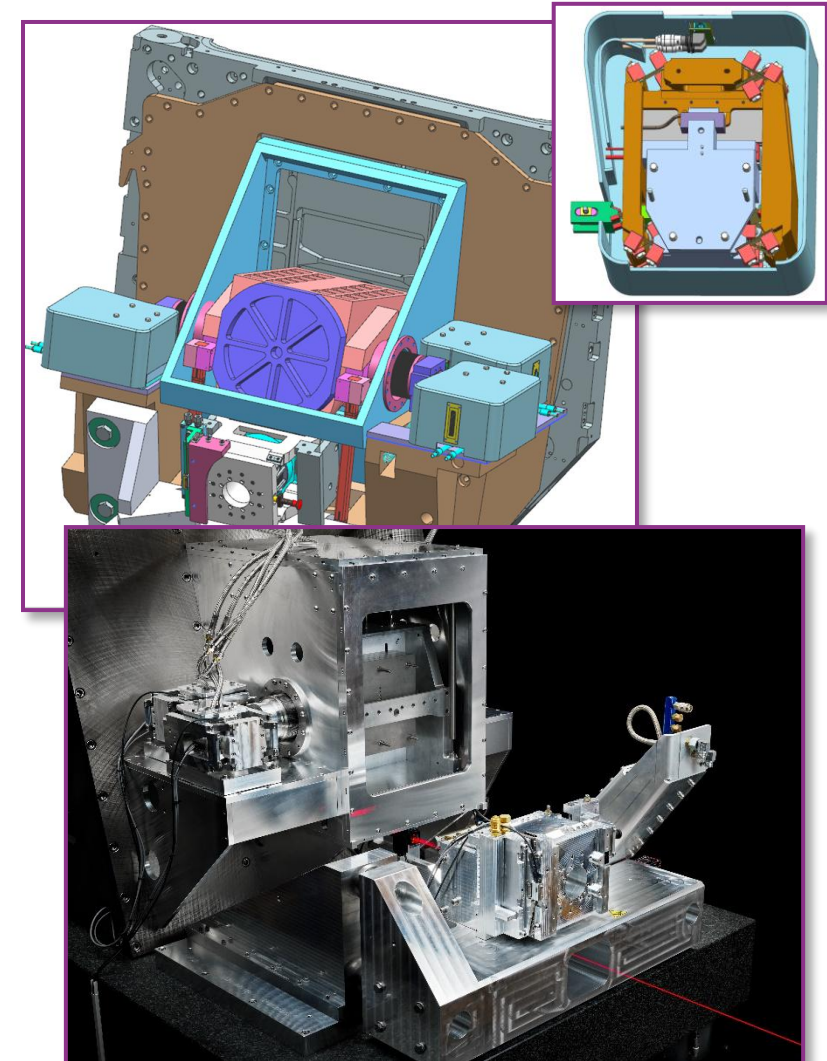


Systems

Focus Unit

Mechanical & Dynamical Concept design of a Focus Unit,
detailed design + TPD of the Focus Unit Actuators

- 0.7 μ m accuracy with applicable disturbance spectra & focus ranges
- RAMS /MTTR, e.g. Actuator module swap
- Concept & detailed design, TPD, realization, Design Qualification Tooling, qualification & initiation of NPI



Systems

Rotating collet

Rotating collet upgrade kit for die transfer machine

- 18kUph (>3M/wk), 5 parts/s
- Added rotational DoF at end effector
- Highly dynamic environment (>120G accelerations)
- 6.5 grams mass budget
- 67 ms for 180 degrees rotation (start-stop motions)
- <50mu repeatability: backlash free bearing design
- Closed loop feedback without encoder, using motor commutation hall sensors

