

SZEnergy Team

**Key to the success of student
competition teams in Győr**



Established in 2005

1

The first student team of Széchenyi István University

2

Activity: Development of energy efficient electric race cars

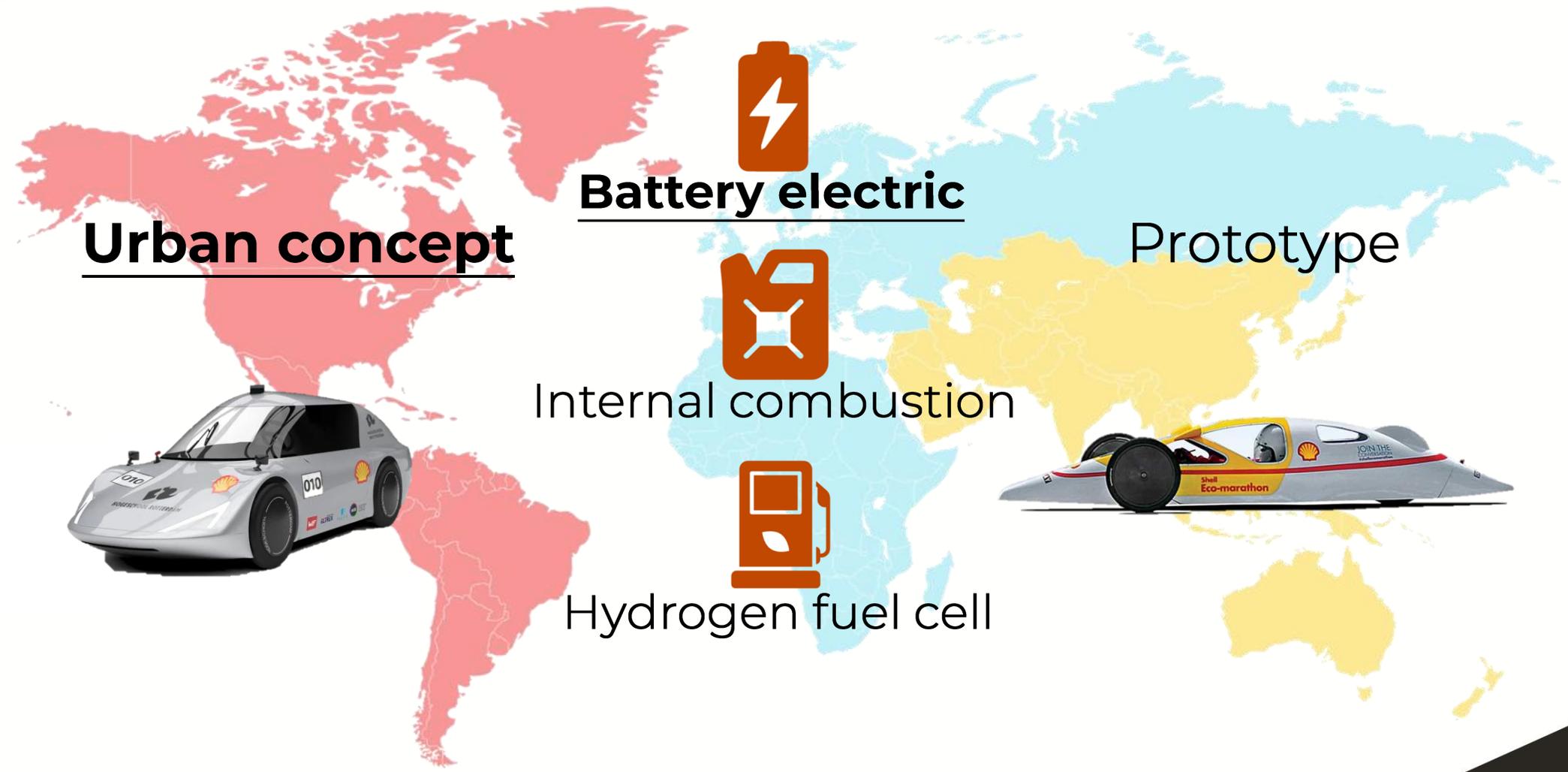
3

Participating in Shell Eco-marathon since 2008

4

In the past 4 years, we managed to set new records each year (327 km/kWh)

5



Urban concept



Battery electric



Internal combustion



Hydrogen fuel cell

Prototype





Shell
Eco-marathon®



Poland, Kamien Slaski
Silesia Ring



June 10-16.

Urban concept – Battery electric

Autonomous Urban Concept



Technical inspection



1. attempt



2. attempt



6. attempt



Best result



Self driving



Obstacle avoidance



Parking manouvre



Business presentation



Best result



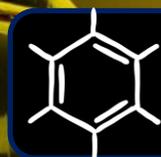
Dead heat



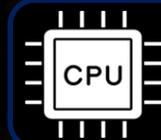
327 km/kWh



Mass: 95 kg



Carbon composite chassis



Self developed
vehicle electronics



Autonomous capabilities

SZEmission



Mechanical
department



15 members

Electrical
department



7 members

Autonomous
Vehicles
department



13 members

Marketing &
Management
department



5 members

Mechanical department 

Design

3D printing

Manufacturing

Assembly

Electrical department 

Circuit design

Embedded software development

PCB assembly, testing

Vehicle electronical system design and integration

Autonomous Vehicles department 

Self driving

Obstacle avoidance

Trajectory planning

Environment detection

Marketing & Management department 

Graphics design

Sponsorship

Social media management

Event organization

STEM Student Excellence programs at Széchenyi István University

- SZEnergy – Shell Eco-marathon
- Arrabona Racing Team – Formula Student
- SZEngine – Motor Development team – Formula Student
- SZESAT- Satelite and Infocommunacation
- SZENAVIS - Concrete Canoe Construction Team

SZEnergy as Student Excellence program

- **University Mentors from R&D territories**
- **Closer interaction with students**
- **Better individual development**
- **Real teamwork beyond course-based groups**
- **Community experience**
- **Students stay in program for 2–3 years on average**

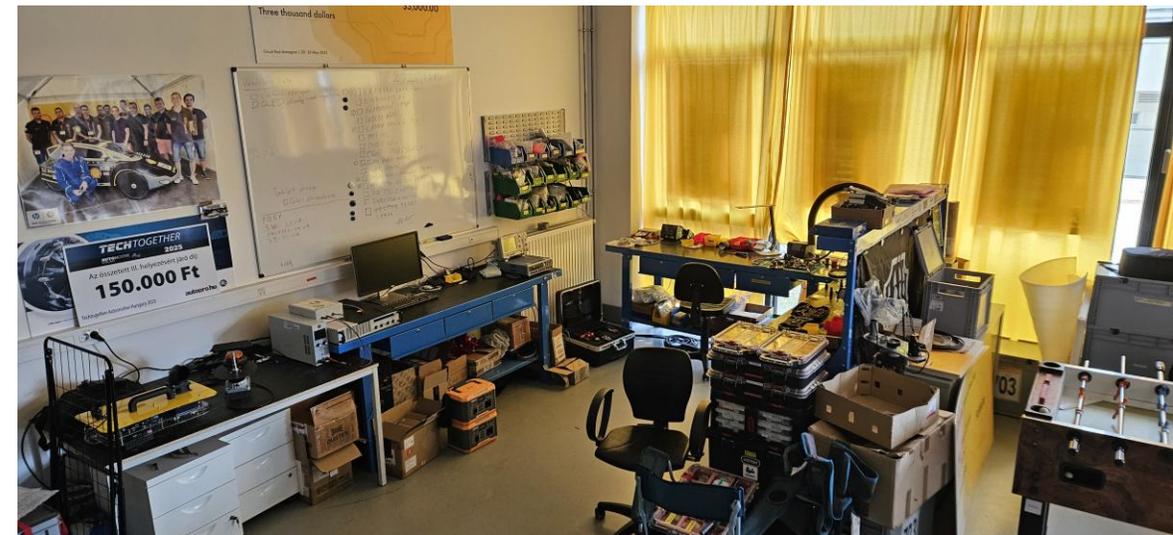


SZEnergy University Background

- **Mentors from Vehicle Industry Research Center**
- **Have access for Department Laboratories**
- **The team operates as an independent legal entity (nonprofit association)**
 - **Enables fundraising**
 - **Provides students with practical experience in company operations**
 - **Teaches cost planning**
 - **Introduces taxation knowledge**
 - **Involves students in sponsorship agreements**
- **Genuine multidisciplinary collaboration – not limited to a single professional group**

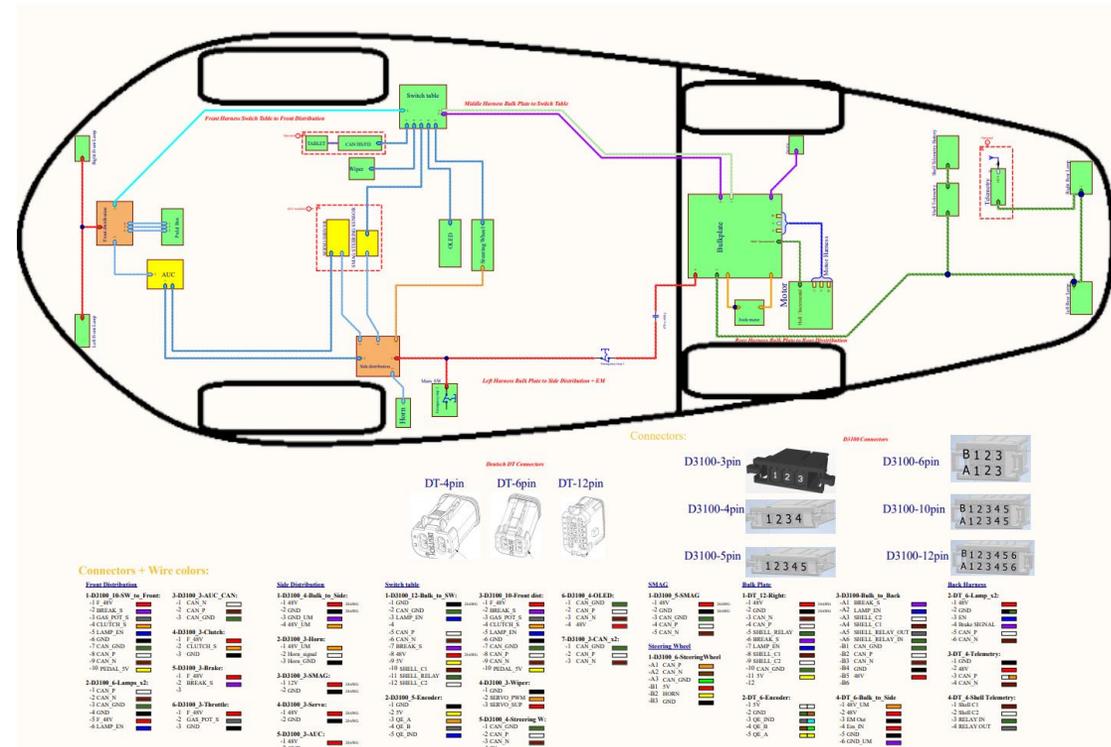
Infrastructural background

- Available and open laboratory 24 / 7
- Special designing softwares for suspension, gears etc.
- Department laboratories
- Self-controlled student laboratory equipped with devices from university, research center and sponsors

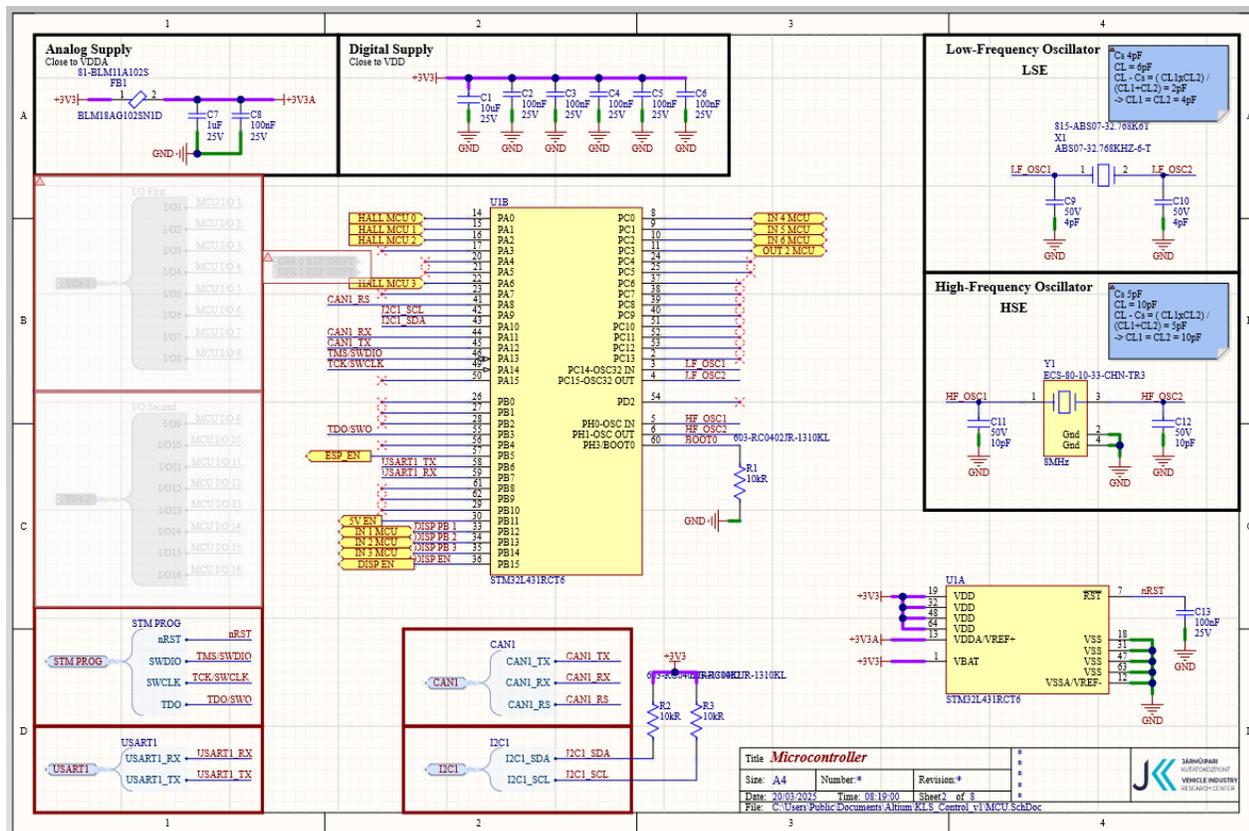


Self-developed electrical system

- Battery management system
- Motor controller
- System harness
- Hardware and software development of subsystems

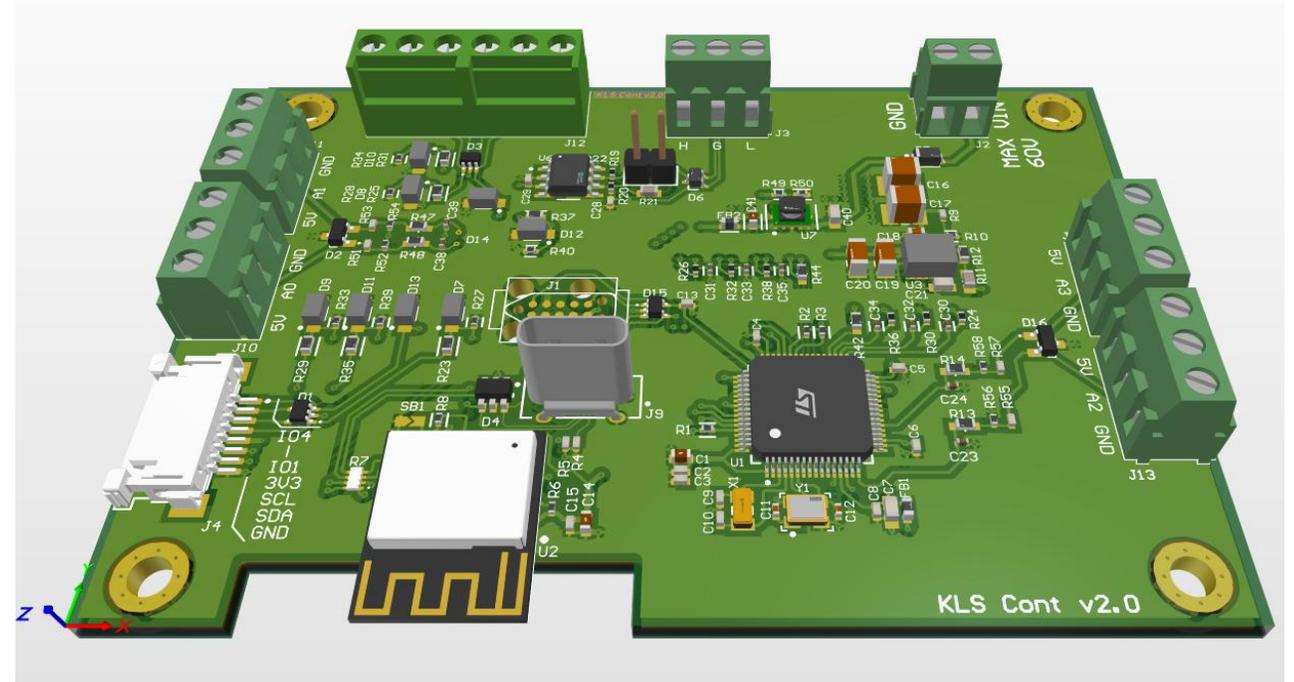
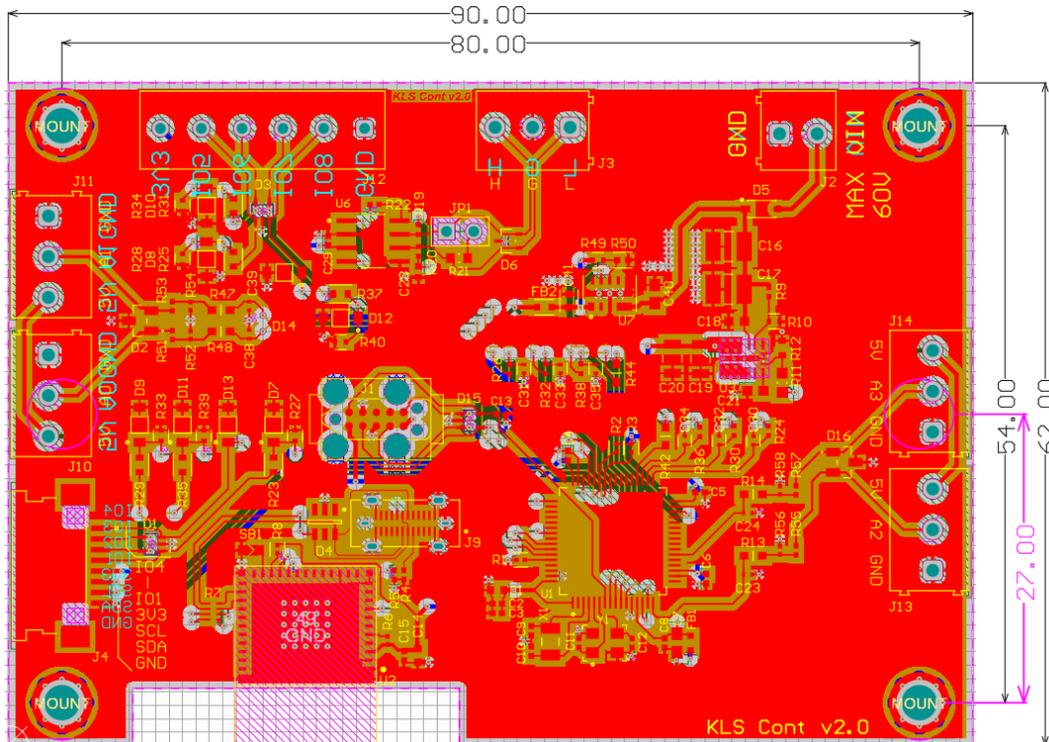


PCB design I.

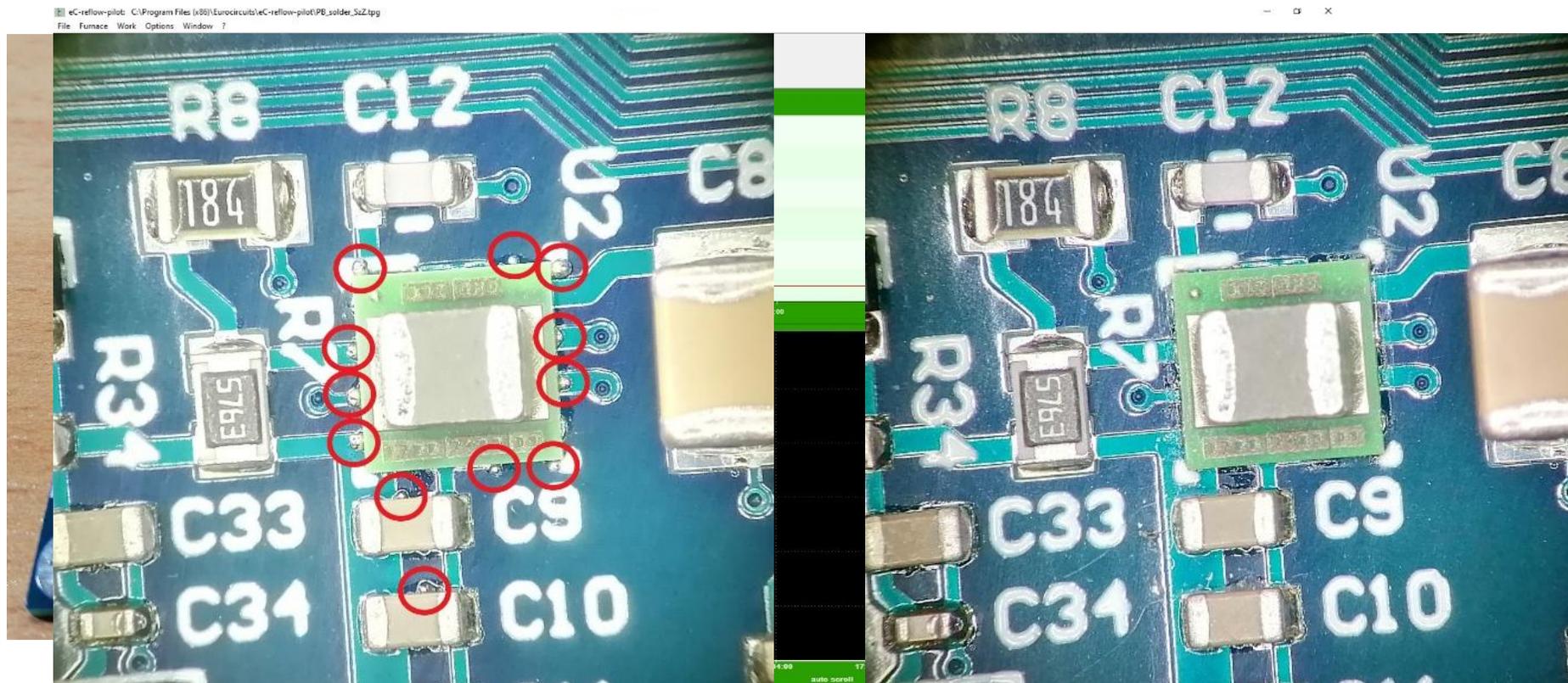


From requirements, through schematic drawings and PCB layout to physically assembled units

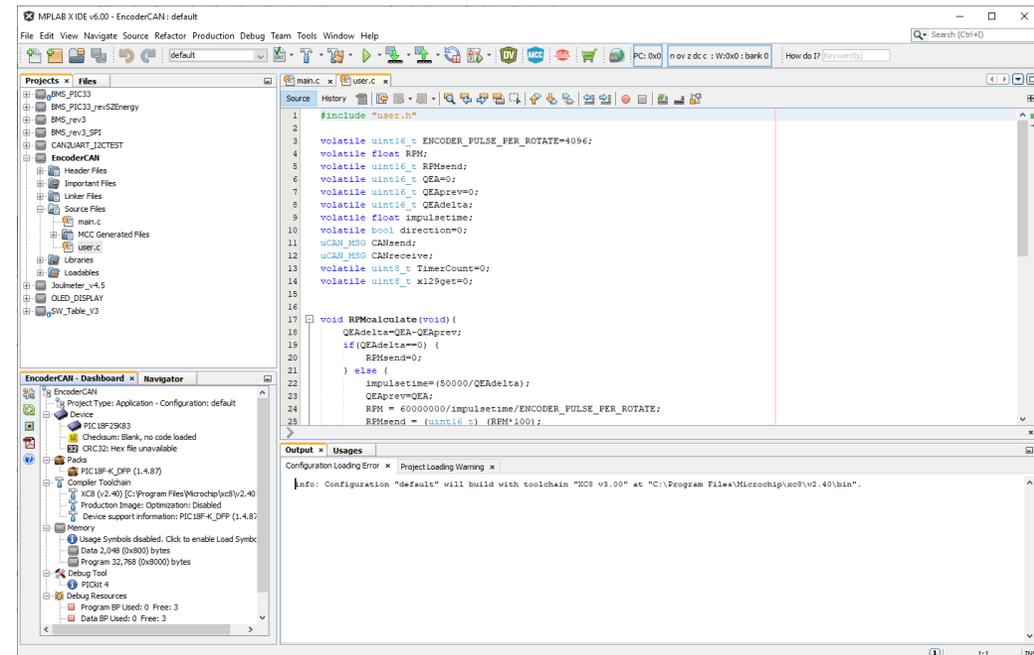
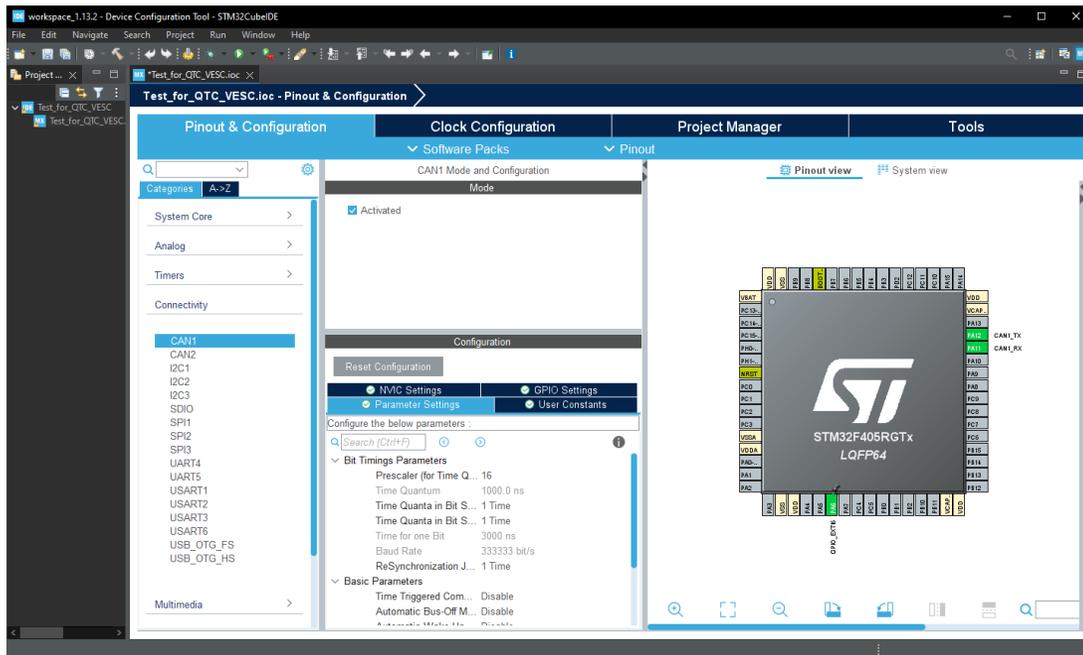
PCB design II.



PCB assembly

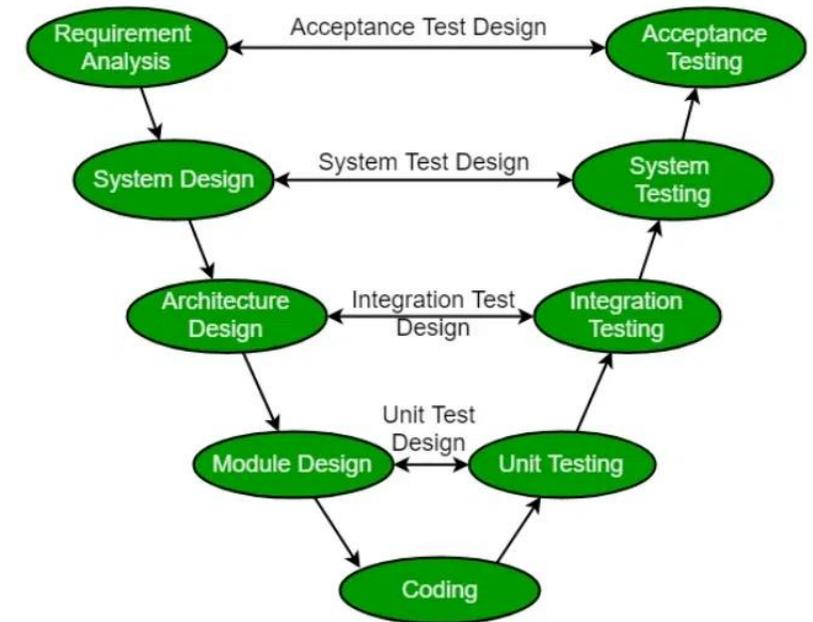


Embedded software development



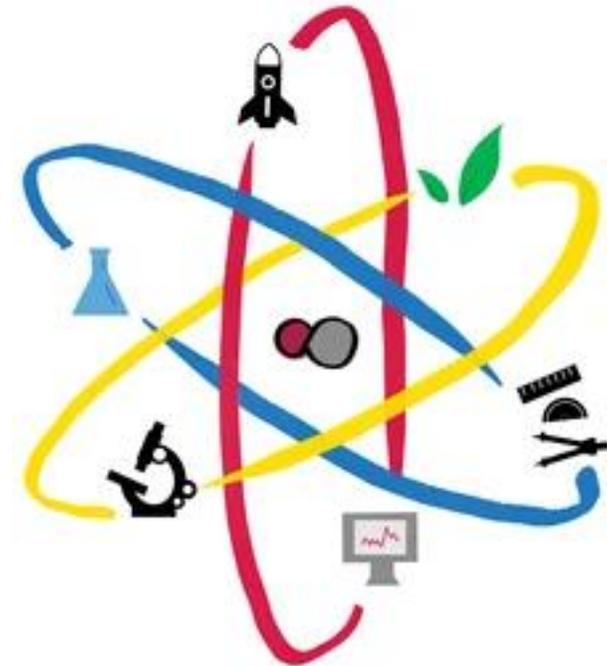
Project tasks in the Team

- V-shaped development tree
 - Adaptation from software development to racing vehicles
- Practical element implemented
 - No one has a task for the drawer only
 - We must aim for the sense of accomplishment at the end



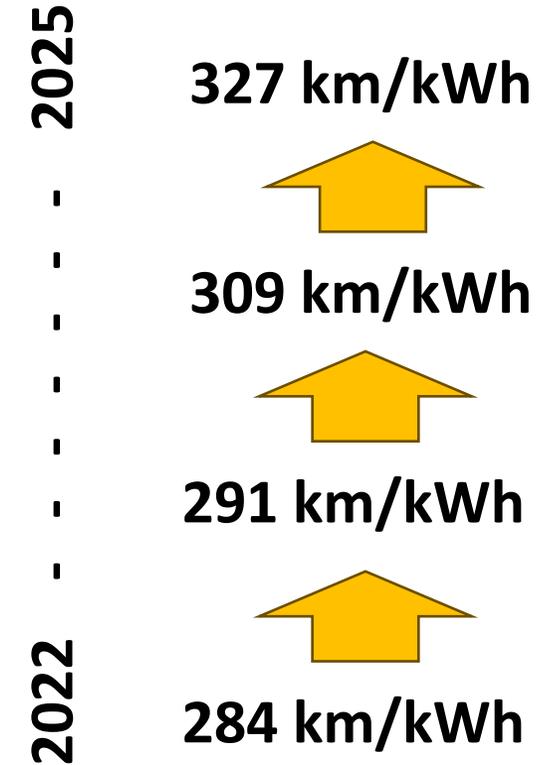
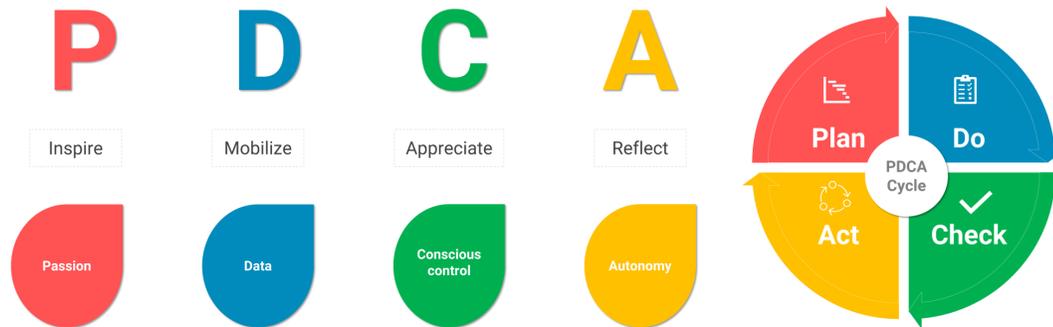
Differences to Project based Subjects

- **Working as small company**
- **One race each year, which elevates the risks and rewards**
 - Higher responsibility needed
- **Multidisciplinary environment**
 - Engineering
 - Marketing
 - Financial
 - Business



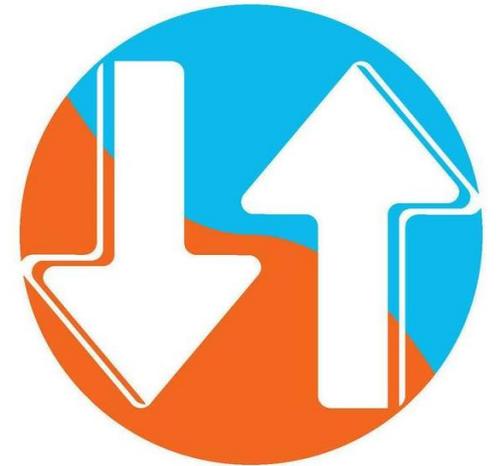
How to stay successful and grow?

- **Quality management**
 - **PDCA**
 - **Unique point: Know-How stays in the house**
 - **Strong mentor base**



Current problems we face

- **Lower self-reliance**
- **Students don't like risks and responsibilities**
 - We have to push them out of their comfort zone
- **Easy to reach, but hard to catch students**
 - Social media is helping and destroying in the same time
 - High labor market demand



Thank you for your attention!



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your attention!



SZÉCHENYI
EGYETEM
UNIVERSITY OF GYŐR

MOTORSPORT
SZÉCHENYI UNIVERSITY



JÁRMŰIPARI
KUTATÓKÖZPONT
VEHICLE INDUSTRY
RESEARCH CENTER



Audi
Hungaria

BOSCH



ALPROSYS

REVO-TEC
GÉPIPARI KFT.



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Zenit-Auto Rent



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BIOTEK
RÖGZÍTÉS TECHNIKA

ferroton

POWER
BELT

LV METAL

Ferromark
alapítva 1998

WILLISITS
engineering

CSABALA
KFT.

mw csapagy.hu

SÁHÓ
műhely
fogszedés - megújítás - csapagya

RABOMATIK

VEVŐKÖZPONT
ahol a szakértelem kereskedik

MESTEREK
BOLTJA

Composite
PROJEKT

Seco

SZTAKI

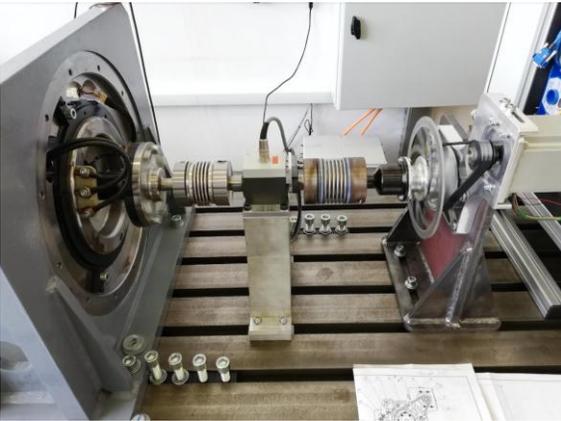
INFORMATIKA
TANSZÉK

Automatizálási
& Mechatronikai
Tanszék

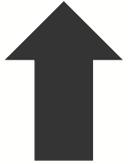
KÖZÜLETI
VÁSÚTI
JÁRMŰVEK
TANSZÉK

UNIVERSITAS-GYŐR
NONPROFIT Kft.

Vehicle model based optimization



**Drivetrain
model**



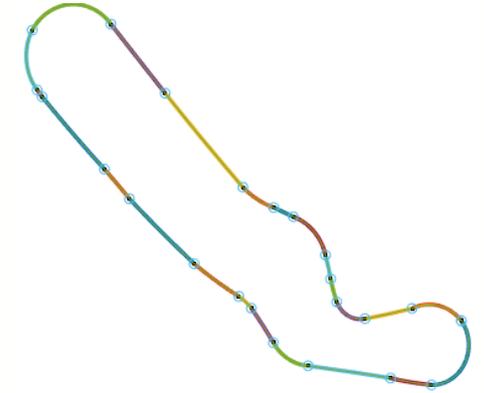
Motorbench
measurements



**Resistance
model**



Rolling & Dynamic
measurements



**Track
model**

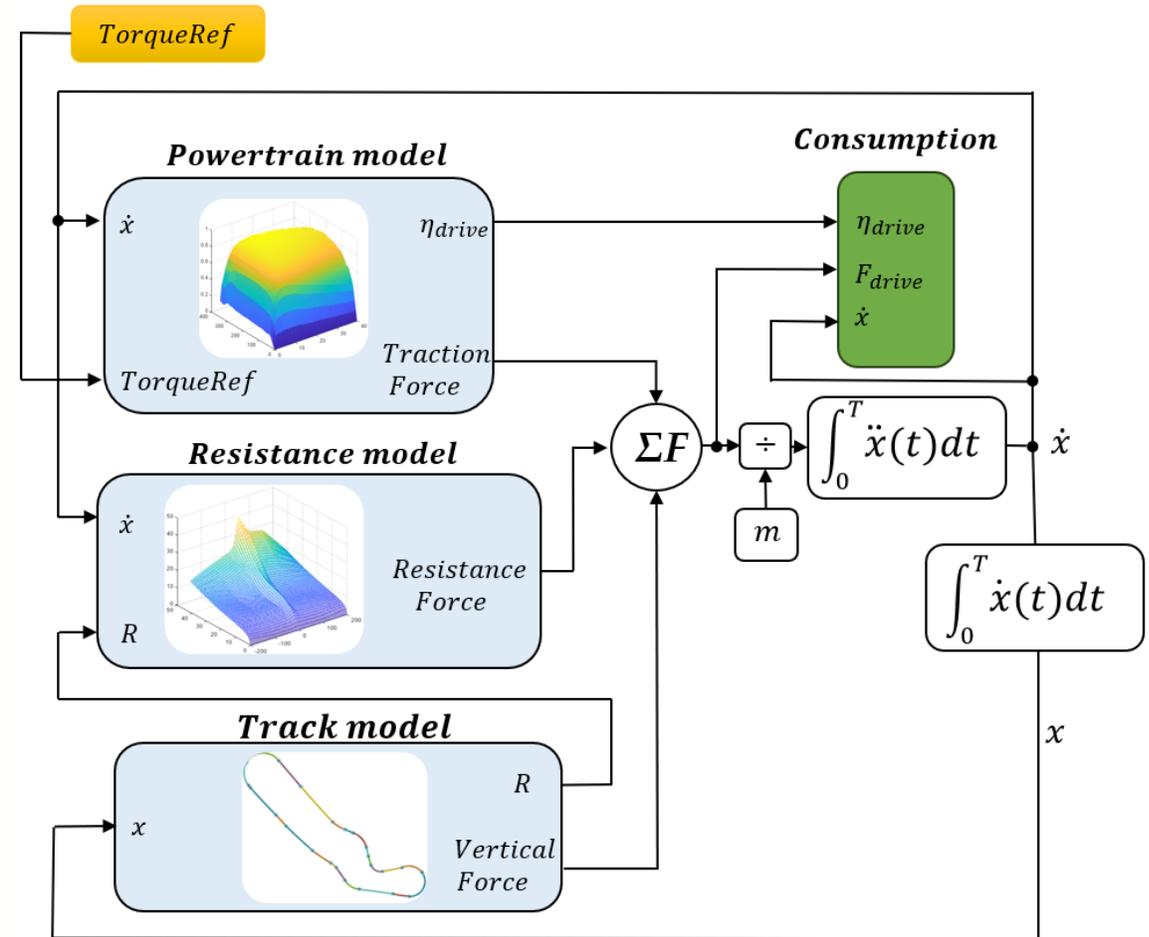


GPS based
measurement



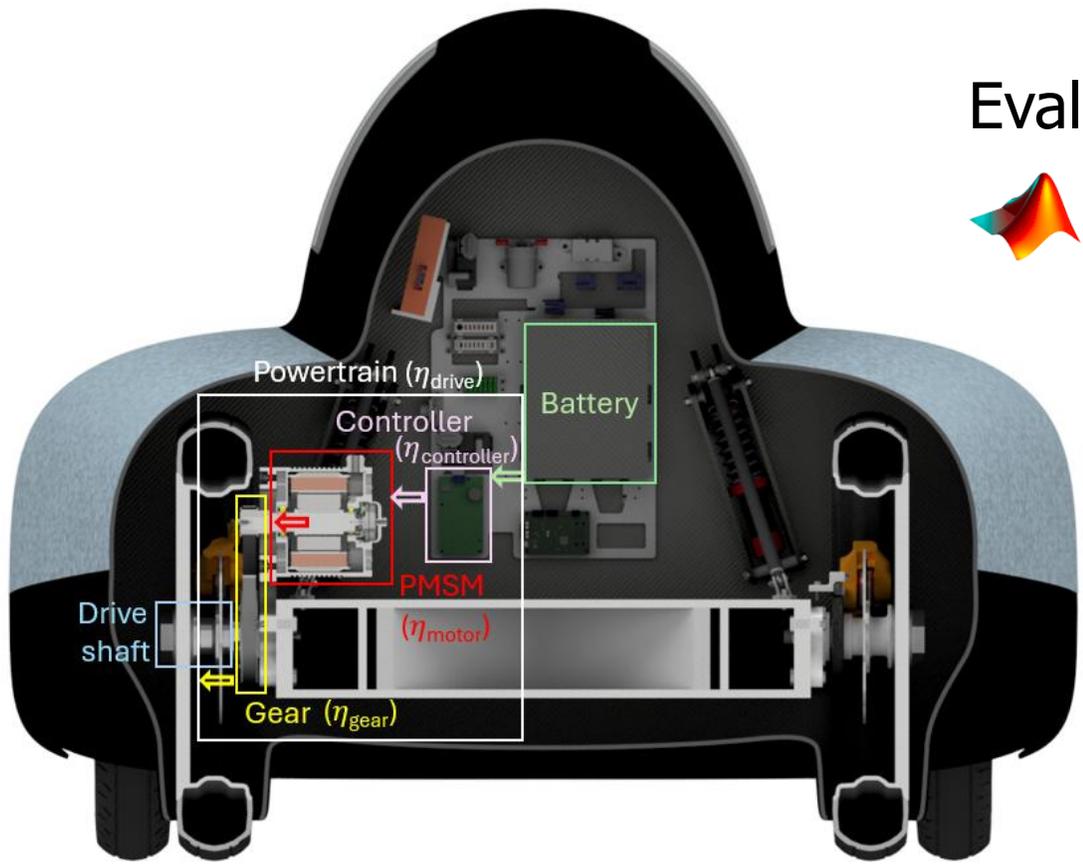
Nonlinear vehicle model

- Measurement-based „tank-to-distance” version
- Longitudinal dynamic model
- Sub-models are determined:
 - Powertrain Model
 - Resistance Model
 - Track model

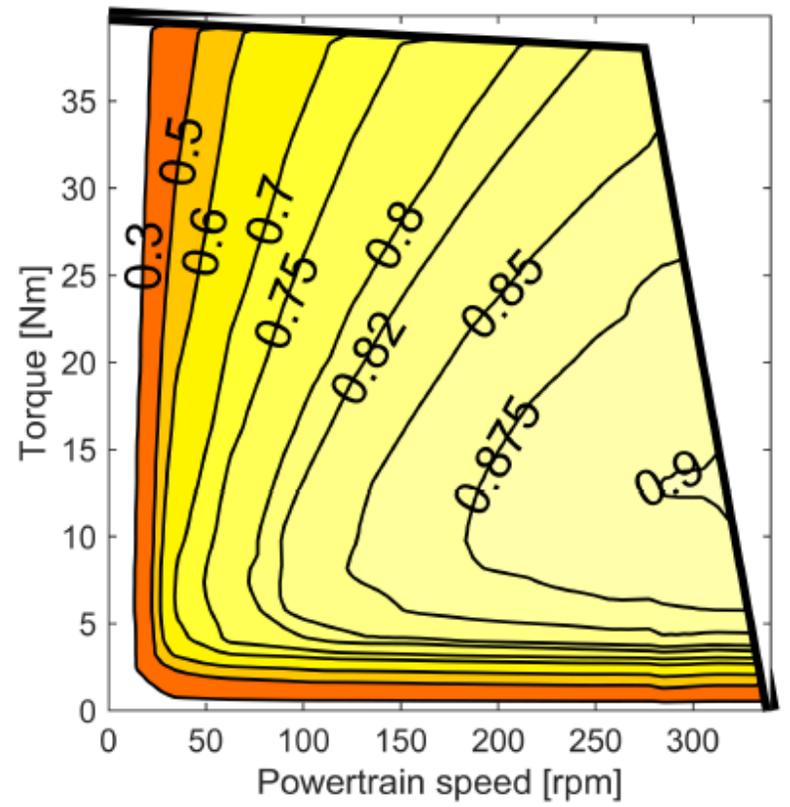


Schematic structure of the nonlinear vehicle model

Powertrain model

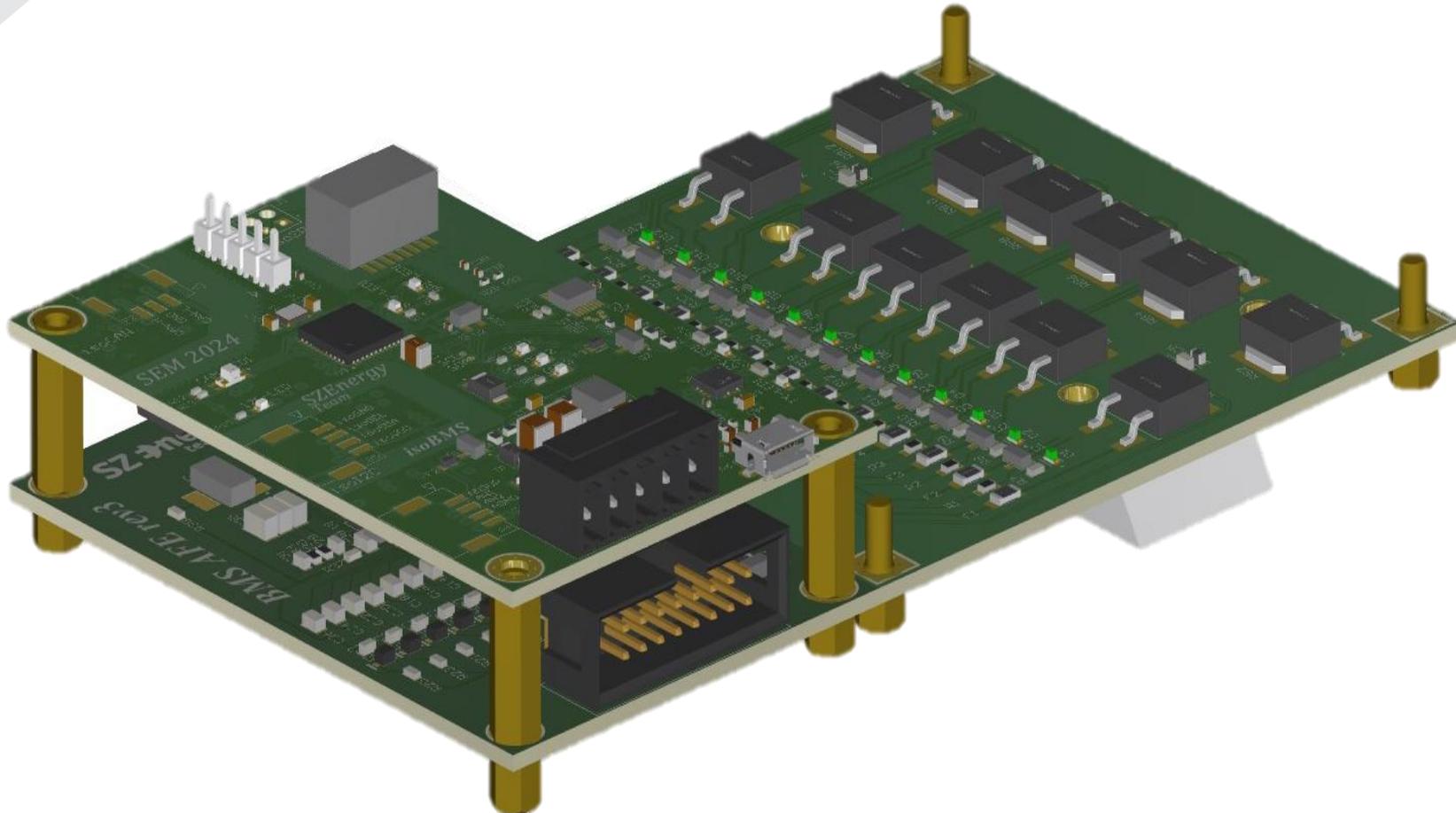


Evaluation in



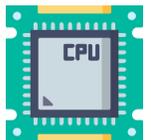
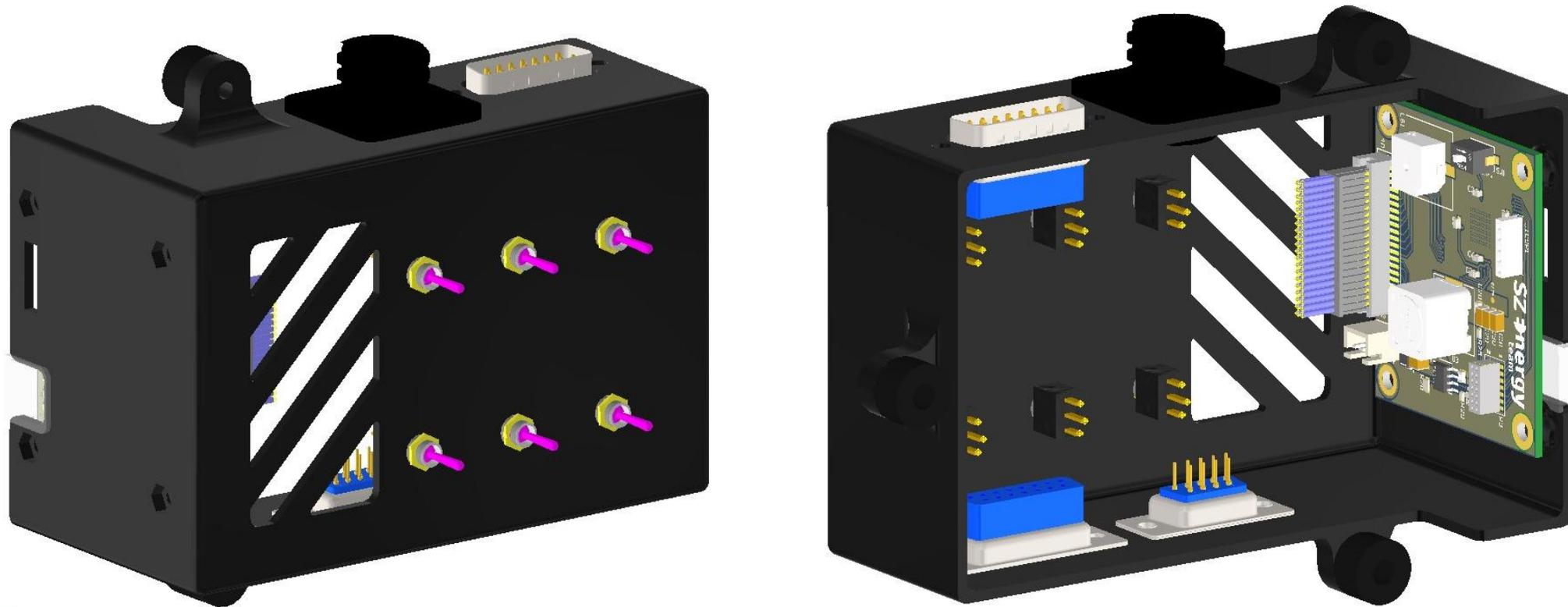
$$\eta_{drive} = \eta_{motor} \eta_{controller} \eta_{gear} = \frac{P_{mech}}{P_{electric}}$$

Battery Management System

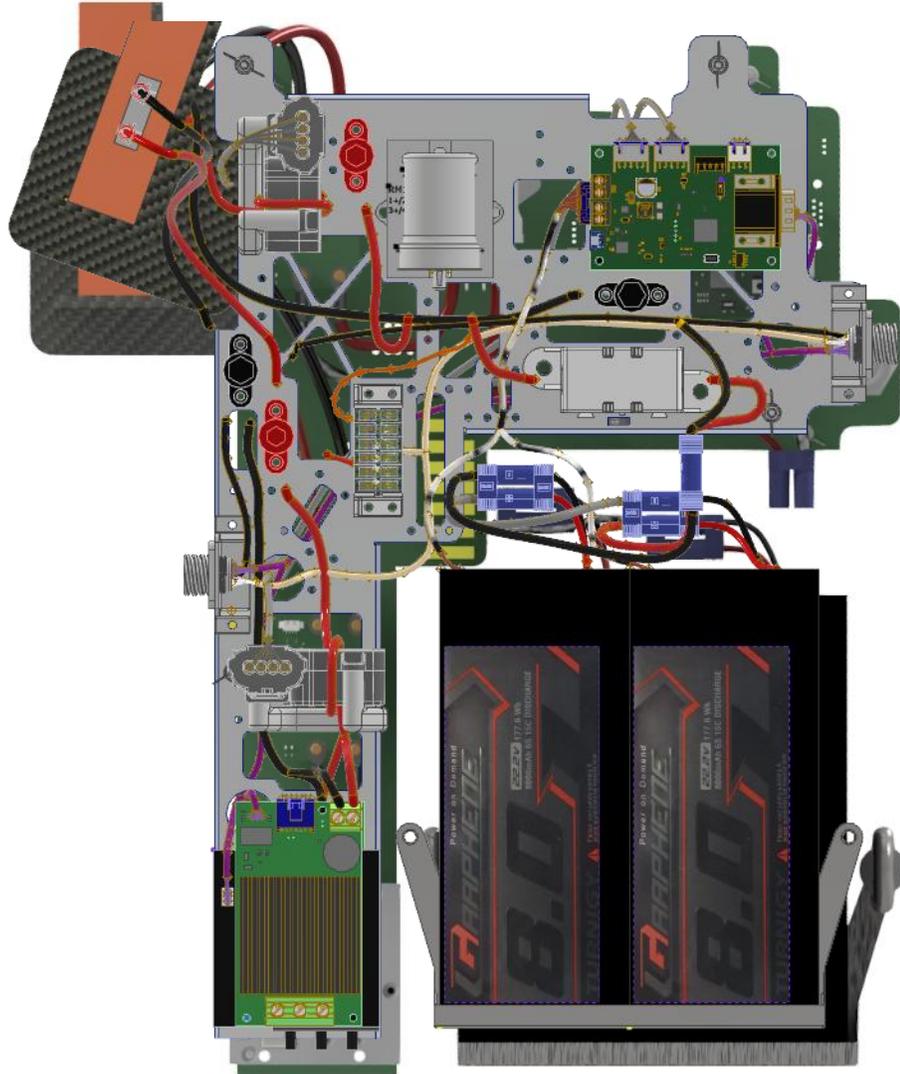


- **Isolated communication:**
 - **CAN, SPI, I2C**
- **Modularity**
 - **Balancing**

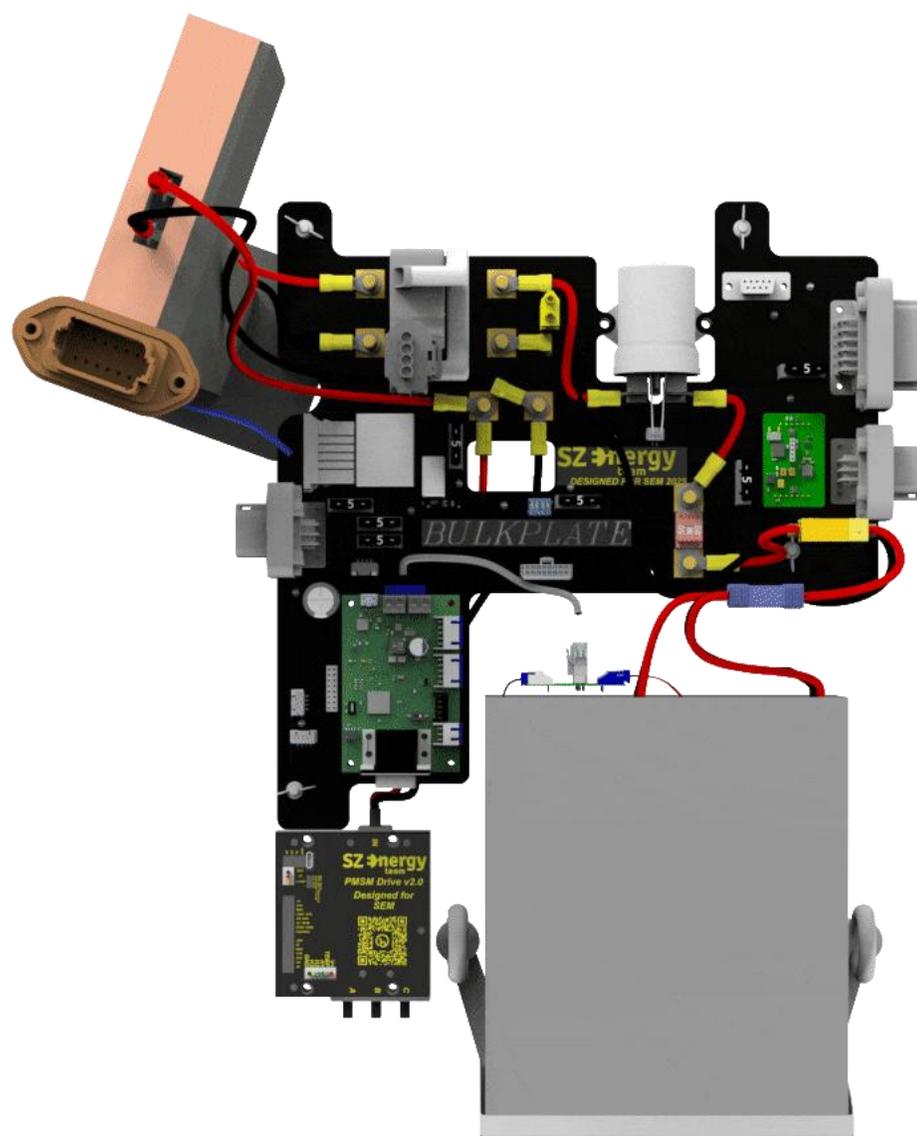
Electronics



Electronics service plate



- Completely assembled on a PCB
- Communication running on the inner layers
- Integrated motorcontroller and BMS



Autonom developments



Parking

- To increase robustness
- Fusion of Visual & Lidar information



Autonom capabilities

