ECA2030

Electric Connected Automated 2030 Consumer

EU Lighthouse project network

Industrial alliance as a facilitator to help its member to engage digital transformation
ICITI 2019,
Taipei August 27-28 2019

Piloting & industrial platform building

for electric, connected and automated drive
with ECSEL Lighthouse Initiative Mobility.E

MOBILITY.E

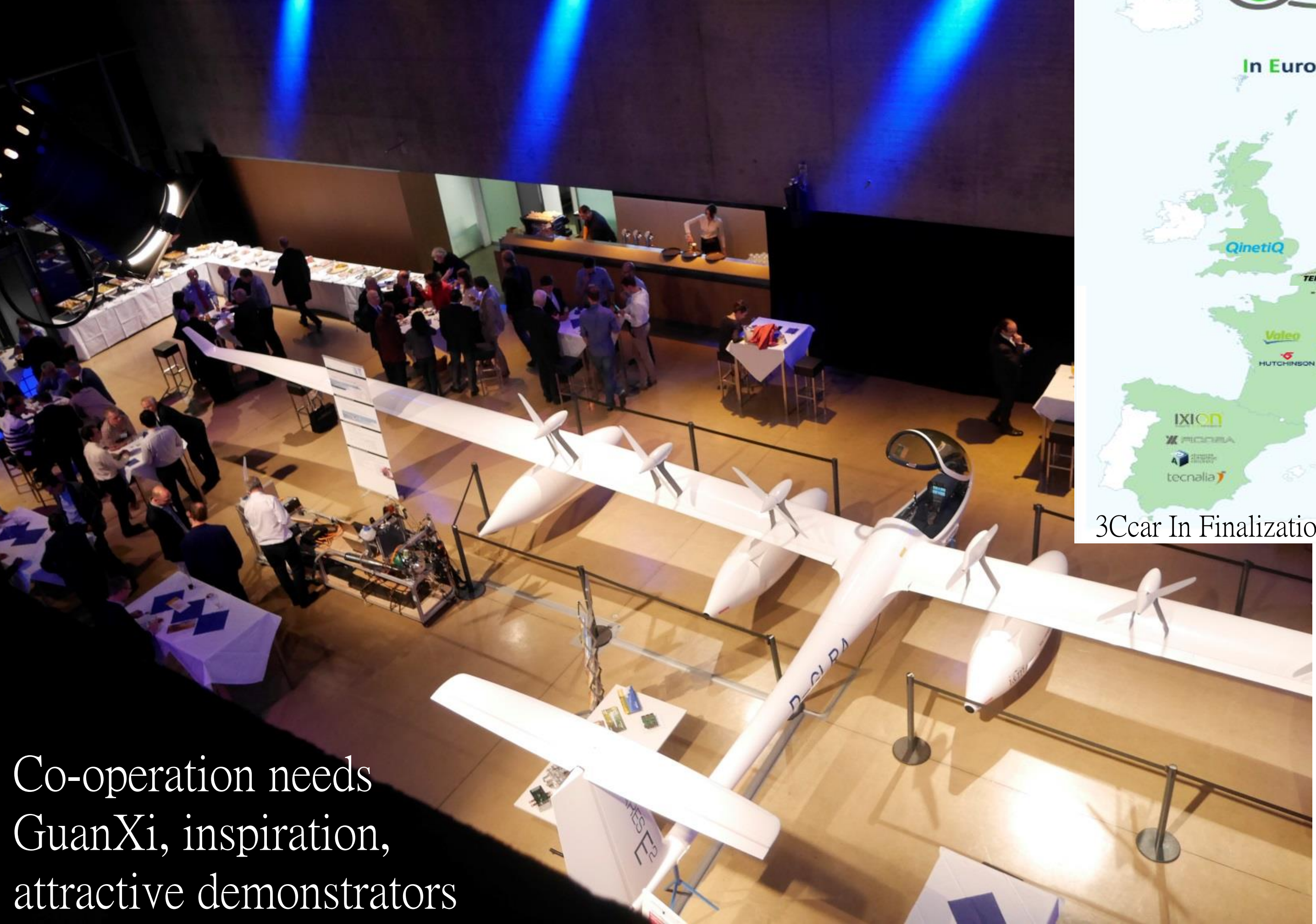
EU Lighthouse

ECSEL Joint Undertaking
Electronic Components and Systems for European Leadership

AutoDrive 3CAR Luftstrom SEMI EV eDAS ENABLE-S3 CRYSTAL DEMOBASE

V1.0

Step 1: build a collaborative, multi discipline consortium



3Ccar In Finalization

MOBILITY.E

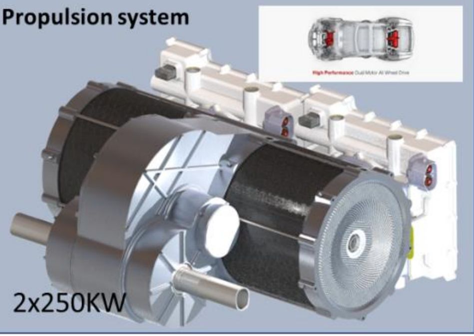
Co-operation needs GuanXi, inspiration, attractive demonstrators

Step 2: explain the Vision

Co-operation in industrial research
needs leader, attractive Technologies and
higly functional systems demonstrators

Smaller number of propulsion components - vehicle integration, maintenance, sustainable

Propulsion system



MOBILITY.E

3CAR

Step 3: explain the Vision, Mission and implementation

Example

AutoDrive

3.Year ending in 2020

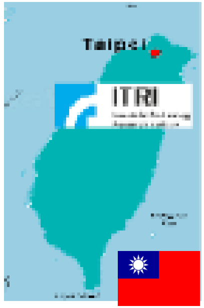
Vision

We make driving as safe as flying

Mission

by **fail-aware (health-condition-aware)**, fail-safe, and **fail-operational** electronic components, systems, and architectures for highly and fully automated driving

Partner

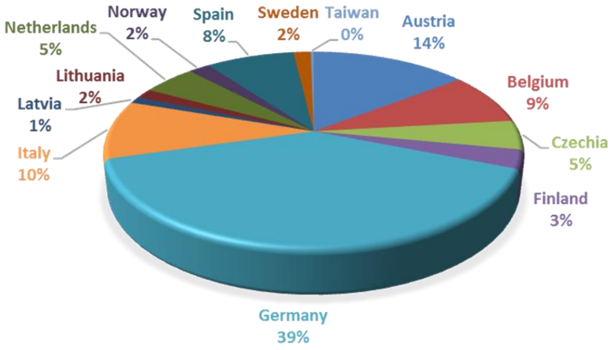


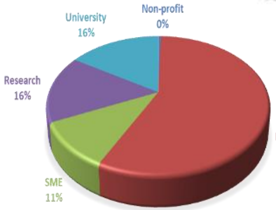
Coordinator

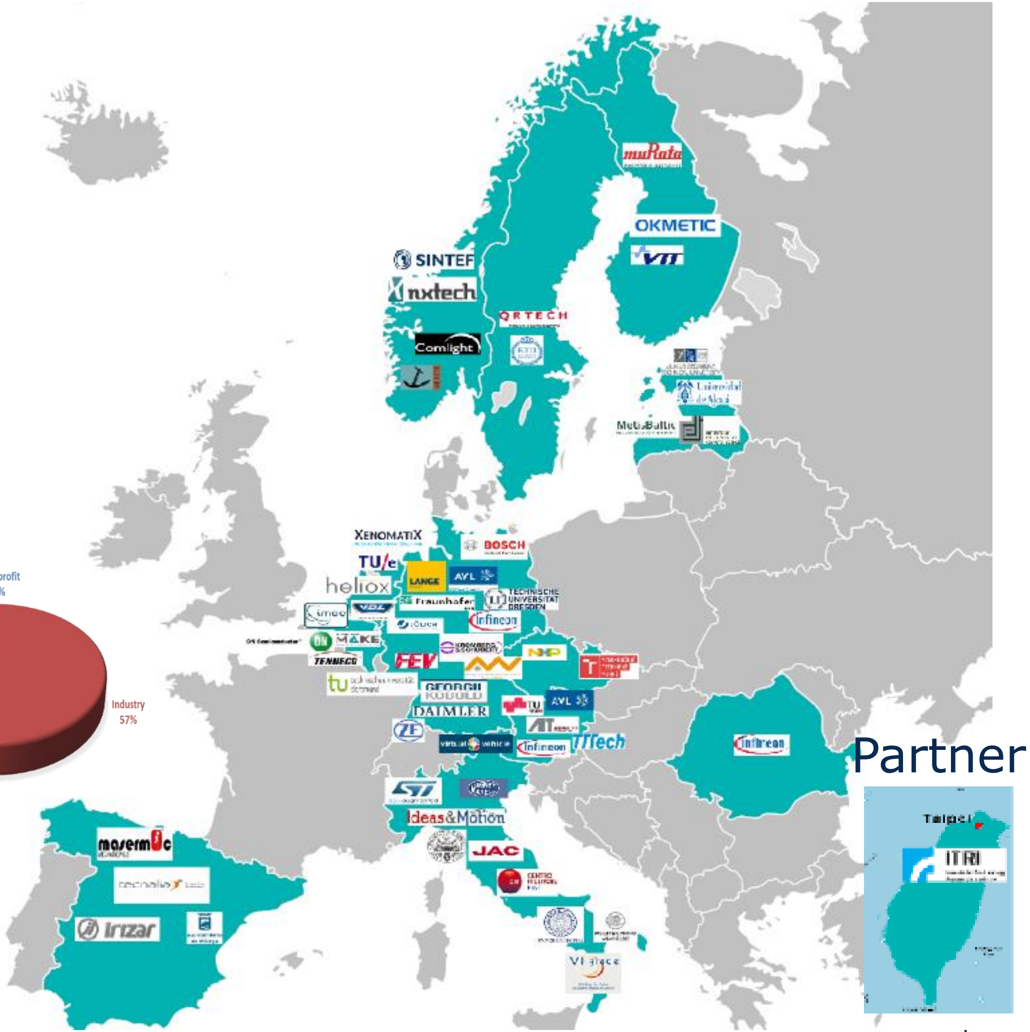
Reiner John, Infineon Technologies AG

PartnerOrganisations in AutoDrive

- **6** OEM DAIMLER, CRF, JAC, VDL, IRIZAR, LANGE
- **9** TIER 1: BOSCH, ZF, TENNECO, AVL, MM, KROSCHU, COM, XX
- **14** TIER 2 & SME
- **26** Research Partners
- **2** Test Sites at City of Málaga (ES), Renningen (DE)
- **3** Domains: Personal Transport, Public Transport & Aviation







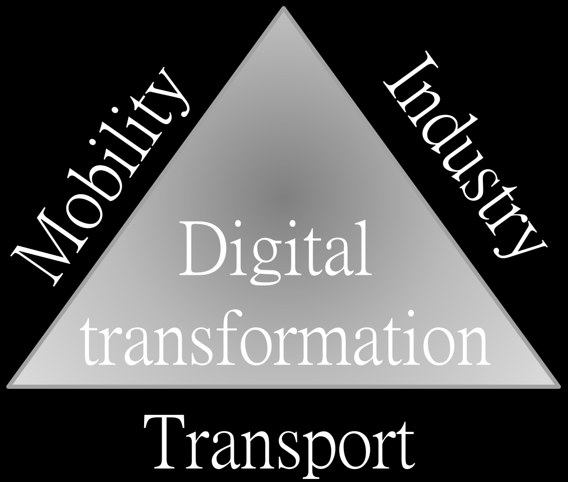
58 partners,
68 Mio € budget,
6600 PM

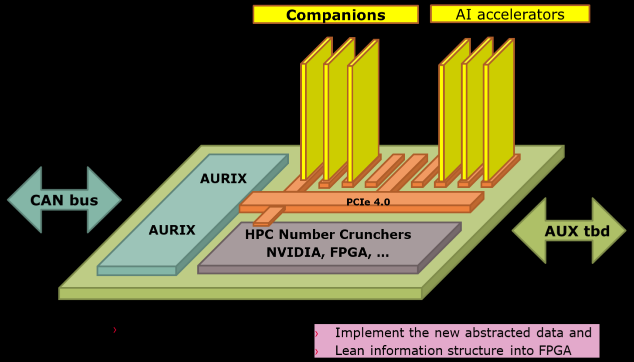
We co-operate on a large scale

Expertise among the whole value chain

Partner

Research → Tier 2 → Tier 1 → OEM





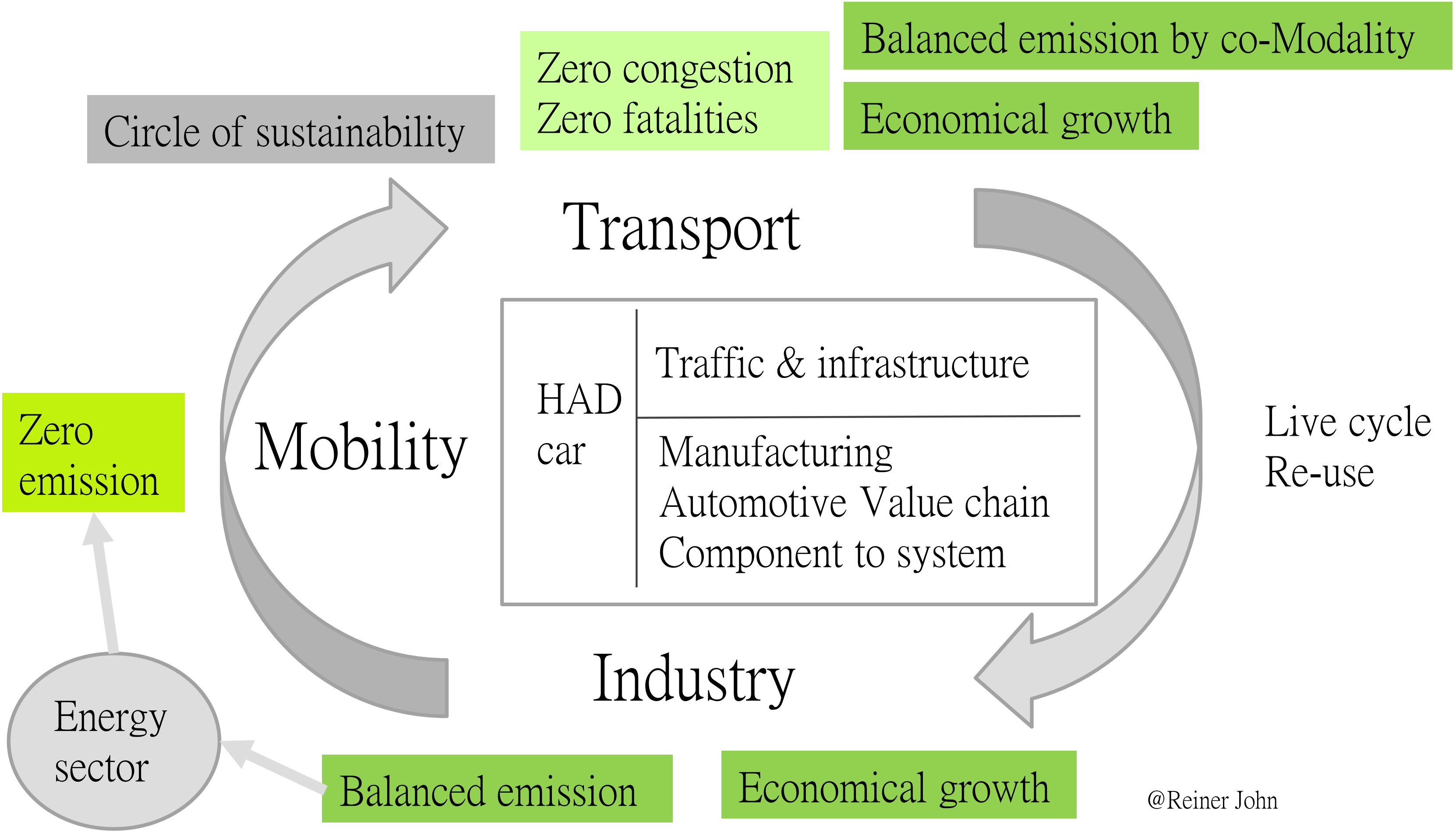
BRAIN

Open Innovation Platform for Automated Driving, Transport and Industry

Version X1.0.3

Reiner John

Step 4: Define the application and business opportunities



@Reiner John

Transistion from semi-automated to Fully automated driving

Human decision making in complex context situations

The big challenge for cognitive decision making

Human driver are capable to manage extremely difficult weather conditions based on experience, context and foreseen scenarios.

How to drive this car automatically ?

Challenges of todays and future decision systems for HAD

Opportunities for
Cognitive Decision System in
perception and propulsion for
safety and efficiency

Human brain can deal with information
of future estimations which is based on experience,
precaution, training and adaption

Heuristic conditions

The variation of the u_r ahead is very difficult to estimeate

AI Methodologies to connect the automotive value chain to enhance safety in manufacturing

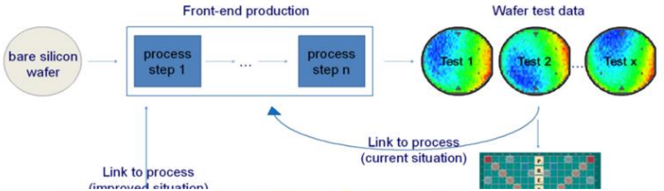
Highly reliably Semiconductor components → Integration into electronic systems → Monitoring Tracing

AI applications | Roadmaps, exploitation studies, business cases | Deployment plan

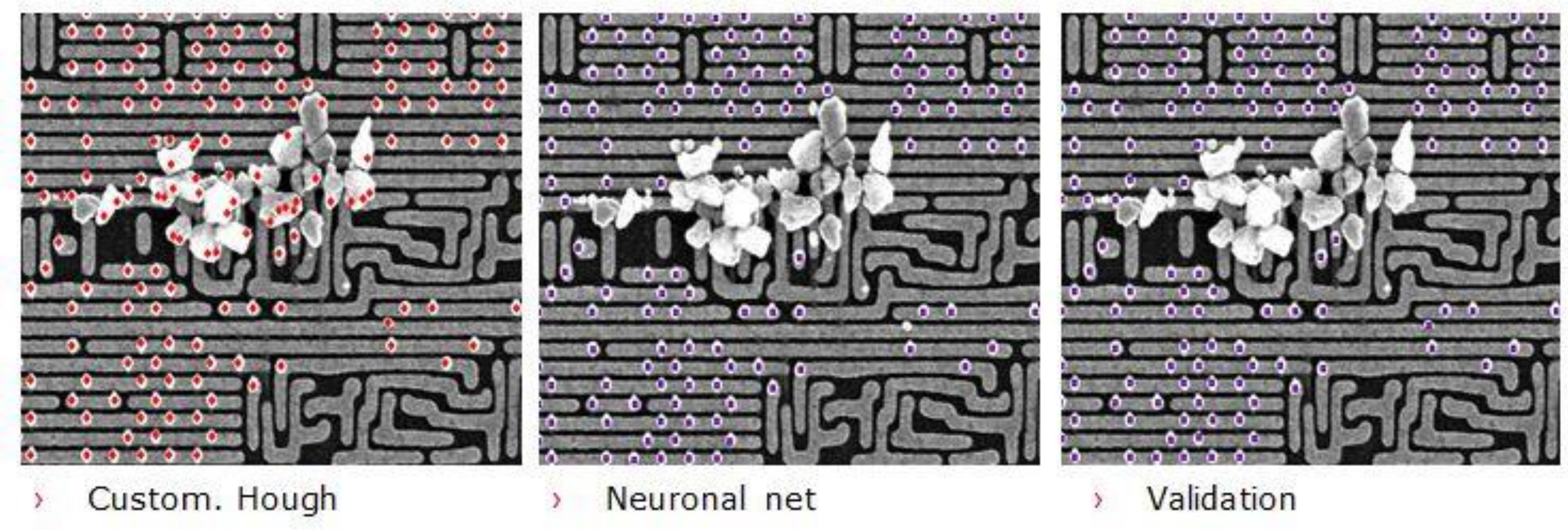
https://www.youtube.com/watch?v=sqCbYd8O8MU

Use Case: Health Factor (HF) for Process Patterns Recognition

Product health assessment using patterns in semiconductor wafer test data



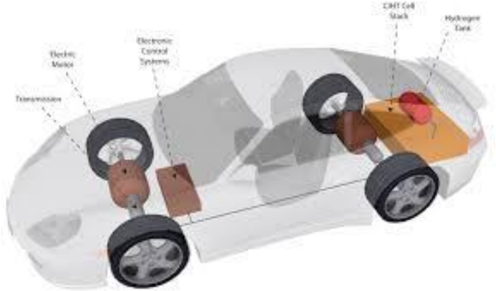
❖ Investigating and evaluating the relation



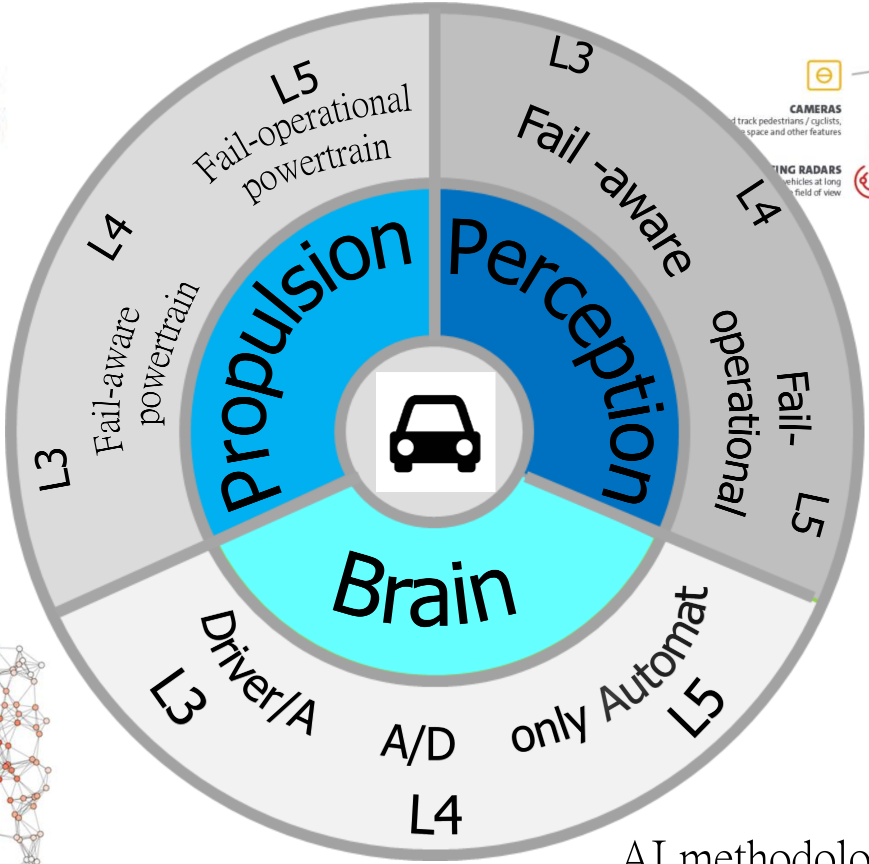
Simplified Architecture for Highly automated car (HAD)

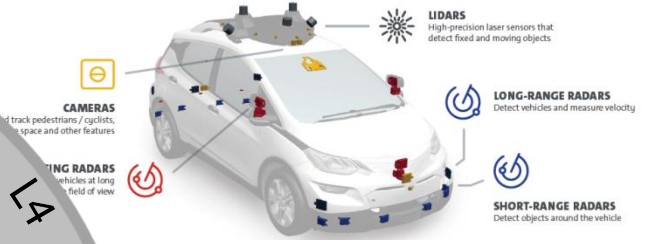
[To build cars is European strength]

The main complexity driver in automated cars (SAE level L3, L4, L5) are novel Propulsion- Perception- and automated brain sub-systems beyond today´s fail-safe level

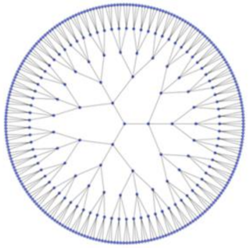


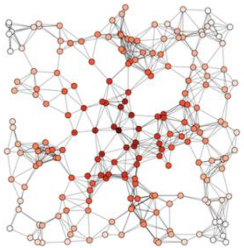
Automated cars need to make life-saving decisions – in a fraction of a second. It would be foolish if they acted upon information from only one source. The brain of the system will be the data processing unit – the number cruncher!





The L3,L4,L5 needs work on the redundancy principle.: Different signals are compared and only when data is consistent, the car will act upon it. For example, a front facing light based sensor (LiDAR) combined with a camera could tell the vehicle not only that there is something in front of it but that it is a pedestrian and the emergency braking should be actuated immediately.





AI methodologies to address complexity

Propulsion

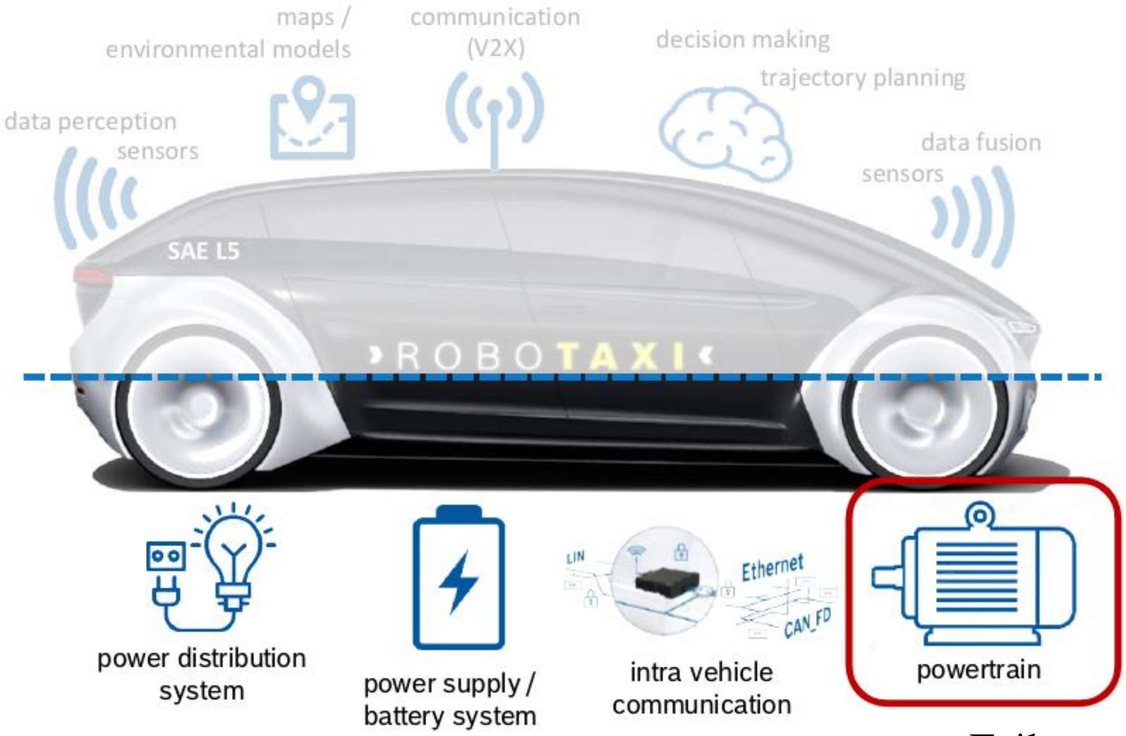
Overview: Requirements for Fully Automated Cars

Introduction – What is in, what not?

Fail operational

Europe climate

South California

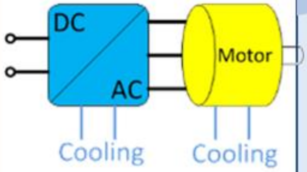


Fail operatic

First generation el. Powertrains

No integration or built-on

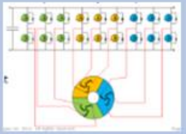
E3Car



2008

Nanoelectronic Component Integration
Electro-Mechanical Integration
Electronic System Integration

Complexity

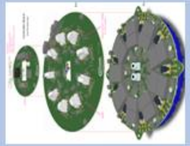


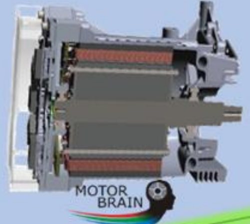
Motorbrain

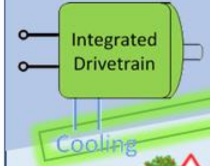
Axial integration

60 kW pk

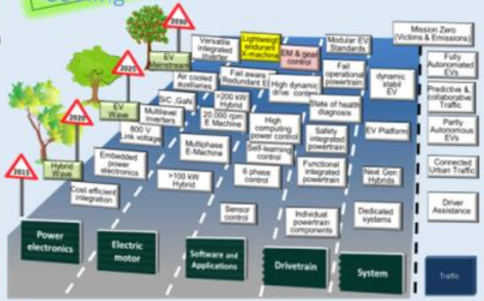
- Easy integration
  - → Lower currents
  - → Smaller modules
  - → Better EMI
  - → Faster switching
  - → Higher efficiency
  - → Better scalability

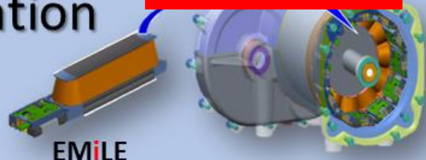






Multiphase

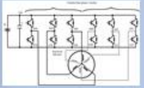


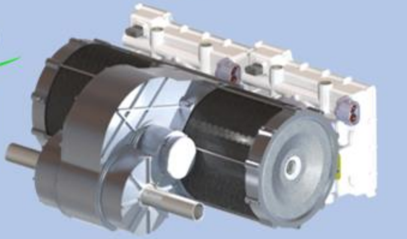


EMiLE

Full tooth integration

Functional Integration





3Ccar

Gearbox, Inverter, Machine

- Signal conditioning for sensors
- Predictive Control
- System health Prediction for power components and sensors
- Fail awareness of propulsion system
- Predictive maintenance

distributed windings.

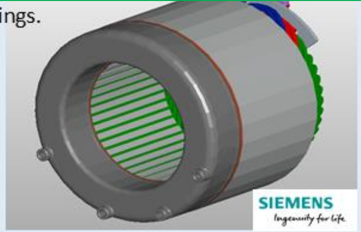
Hairpins

125 kW

eDAS

Oil injection on end-windings

125 kW

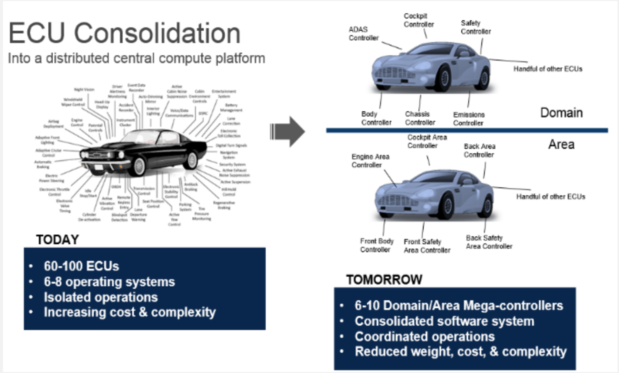


AI

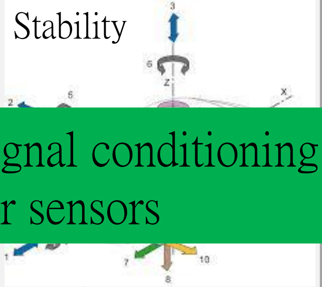
2018

Thermal-Electrical Integration

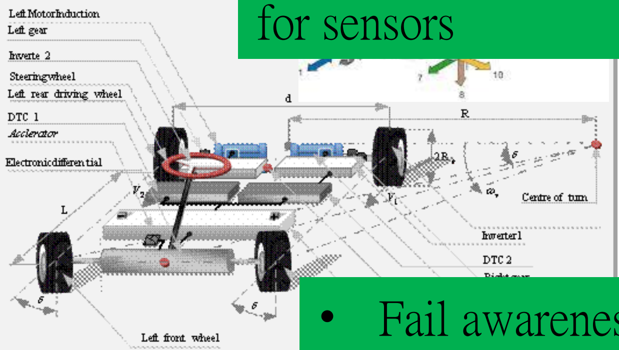
AI for Controlled Complexity in Propulsion Systems



Domain control -> higher Control / computing power -> certified and safe and available control platform



Signal conditioning for sensors



E/E Architecture Evolution

Electro-mechanical integration

- E-Motor
- Brake
- Damp
- Steer
- Gear/

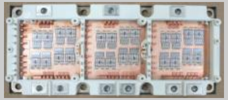
Electronic S

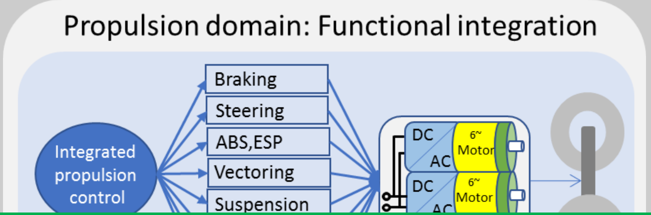
AI in Control by accelerators

Sensors

Multicor

PowerModule



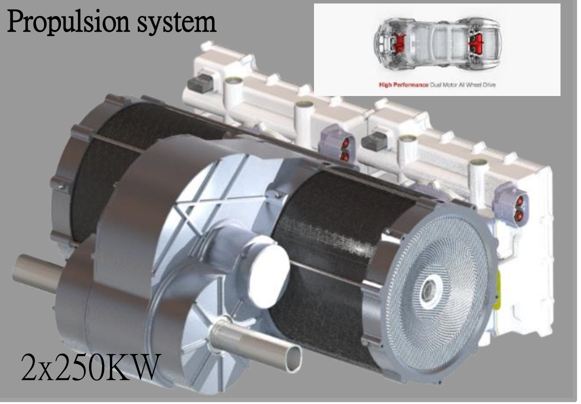


- Fail awareness of propulsion system
- Predictive maintenance

Propulsion domain

System health Prediction for power components and sensors

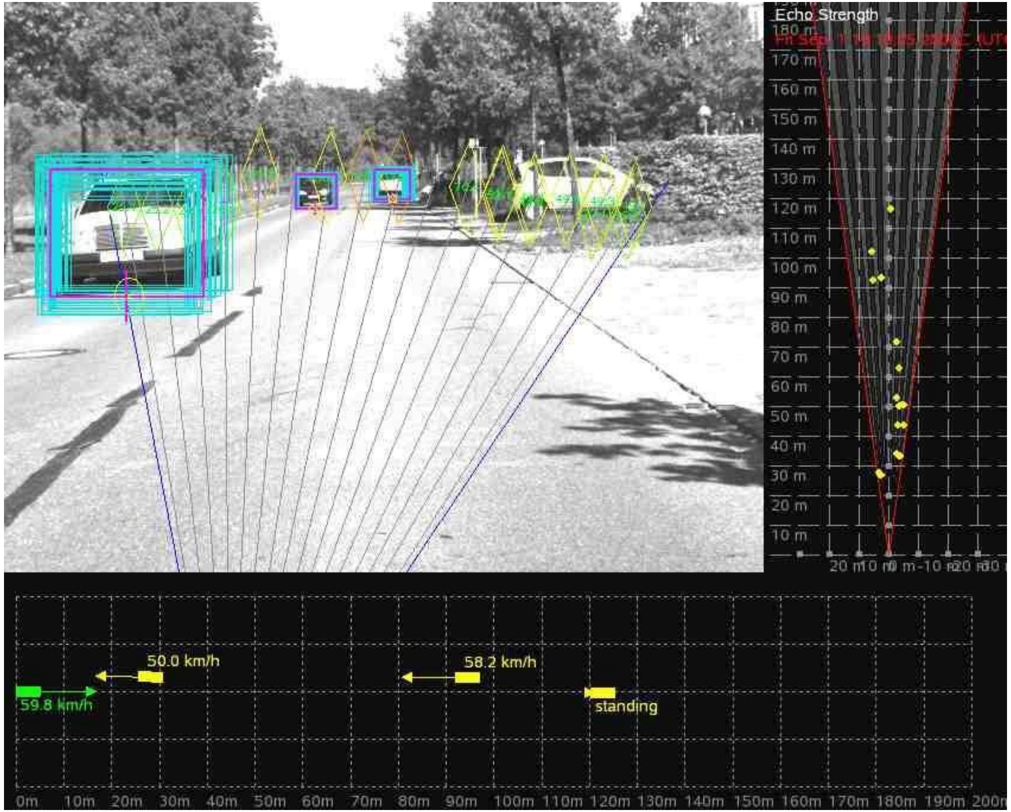
Propulsion system



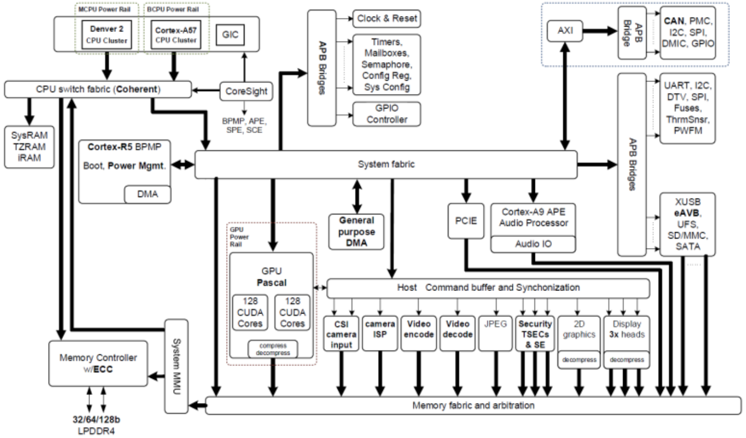
2x250KW

Perception

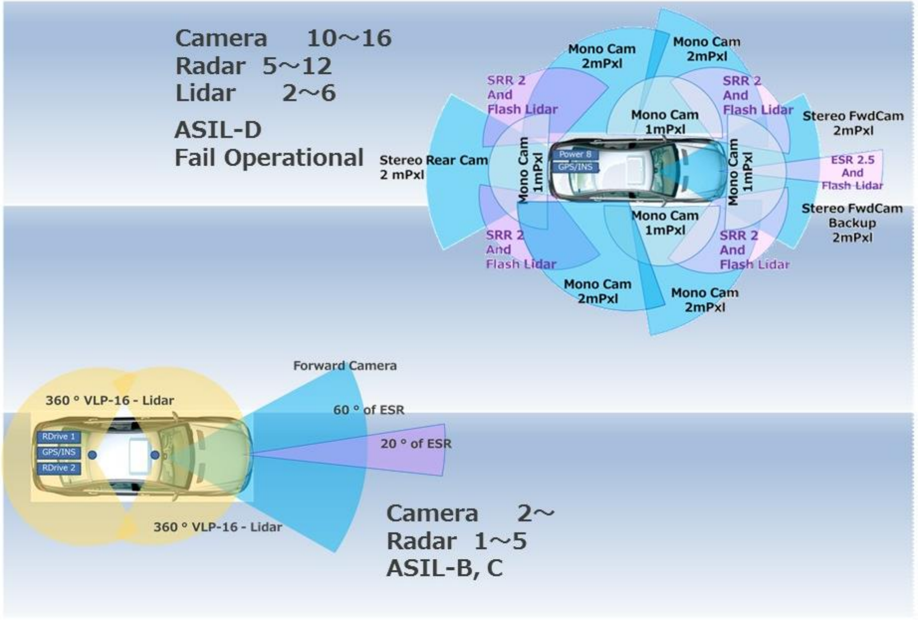
Perception function with Lidar



Perception realisation



LEVEL 2-> LEVEL 4 ->LEVEL 5



L4
>25 Sensors + Control Unit (incl. AI) and Driver Monitoring

- 4 Corner Radars
- Stereo Vision
- Mid Range Radar
- Far Infrared Camera
- ADAS ECU
- Mono-Vision Rear
- V2X
- LiDAR
- HD Map
- E-Horizon
- Driver Monitoring System
- Rear/Surround View

>40,000 DMIPS >25 TOPS
512 MB – 3 GB RAM 200W

L5
28-32 Sensors + Control Unit (incl. AI) and Driver Monitoring

- Stereo-Vison, Long Range Radar
- 4 Corner Radars, Satellites
- LiDAR Front, Mono-Vision Rear
- Driver and / or Passenger Monitoring System
- HD Map
- V2X
- Surround View
- Far Infrared Camera
- Mid-Range Side Sensors
- AD ECU

250,000 – 900,000 DMIPS
>300 TOPS 32 GB RAM 600W

Software + OS

L4 – More than 55 Features/functions

- AUTOSAR + Adaptive AUTOSAR
- POSIX Operating System

L5 – More than 60 Features/functions

- Adaptive AUTOSAR
- POSIX Operating System

Safety concept Fail-safe Fail-operational

L4. System has longitudinal and lateral control in a specific use case. Recognize the performance limits and requests driver to resume control with enough time margin
L5. System can cope with all situations automatically during the entire journey. Driver does not monitor the system.

E/E architecture

L4

- Central cross domain ECUs
- Zone oriented architecture and vehicle control computer

L5

- Zone oriented architecture and vehicle control computer

LEVEL 2-> LEVEL 4 ->LEVEL 5

Level 3

Sensors – L3	#
Ultrasound	8
RADAR (LRR)	2
RADAR (SRR)	4
Camera (LR)	2
Camera (Sur)	4
Camera (Stereo)	1
Microbolometer	1
LiDAR	1
Dead reckoning	1
Total	**~24-26**

Awareness for Take Over

2018

Level 4

Sensors – L4	#
Ultrasound	8
RADAR (LRR)	2
RADAR (SRR)	4
Camera (Stereo/Trifocal)	2/3
Camera (Sur)	4
Camera (Stereo)	1
Microbolometer	1
LiDAR	2/4
Dead reckoning	1
Total	**~25- 28**

No Driver Interaction

2020

Level 5

Sensors – L5	#
Ultrasound	8-10
RADAR (LRR)	2
RADAR (SRR)	4
Camera (LR)	2/3
Camera (Sur)	4
Camera (Stereo)	2
Microbolometer	1/2
LiDAR	4
Dead reckoning	1
Total	**~28- 32**

No Driver

>2025

Brain

USE CASES AND BUSINESS OPPORTUNITIES

- Shuttles and taxis might operate at low speeds in central business districts, corporate campuses, university campuses, military bases, retirement communities, resorts, shopping centres, airports, and other semi closed environments as well as for first and last-mile transit applications.
- Delivery systems might conceivably use pathways rather than or in addition to roadways.
- Physical infrastructure might include vehicle-to-vehicle and vehicle-to-infrastructure communications equipment, ground-based units for global navigation systems, dedicated facilities comparable to bus and bicycle lanes, on-street parking restrictions, and specific roadway or pavement modifications. Digital infrastructure might include the maintenance of highly detailed roadway maps and pertinent traffic operations data.
- Cyber vehicles self-driving “taxi” or delivery van in mixed traffic
- Automated bus/PRT (Personal Rapid Transit) in mixed traffic
- Cyber vehicles / delivery vehicles. Last mile use, and Automated bus/PRT in dedicated lane
- Cyber vehicles/ delivery vehicles
- Last mile use, low speed context and Automated bus/PRT: segregated lane

L4 HIGH AUTOMATION – L5 FULL AUTOMATION

- L4
  - Piloted highway driving
  - Geo-fenced city pilot
  - Autonomous valet parking
  - Mobility on demand/vehicle on demand
  - Full automation using driver for extended availability
- L5
  - Auto pilot

Immanual Kant
1724 - 1804

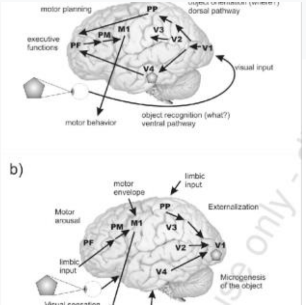
All our knowledge
- begins with the senses,
- proceeds then to the understanding,
- and ends with reason

There is nothing higher than reason.

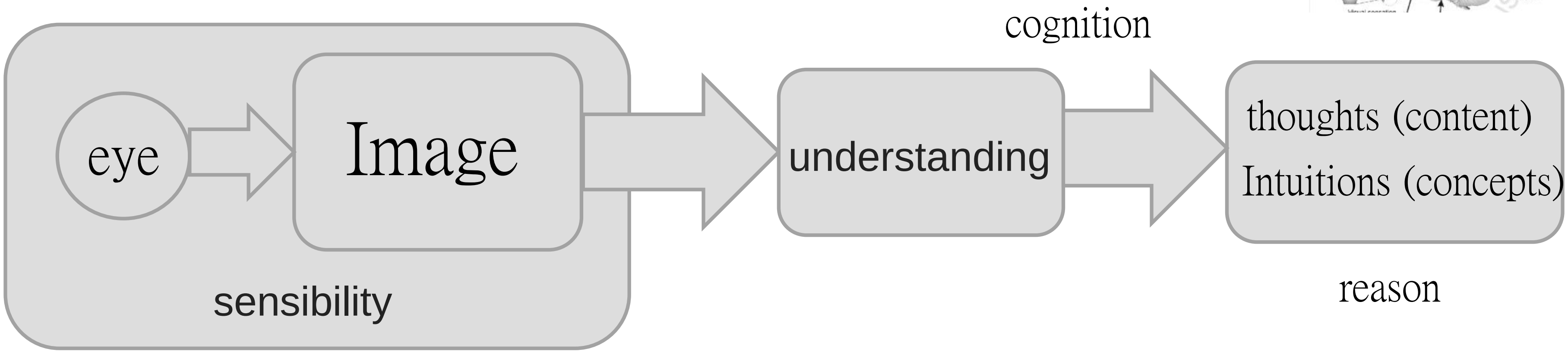
Reason is the capacity of consciously making sense of things, establishing and verifying and falsification facts, applying logic, and adapting or justifying practices, institutions, and beliefs based on new or existing information.

Kant: technical Implementation looks like that

1. Every cognition consists of sensibility and understanding,
2. sensibility relies on the mind, and the mind relies on our five senses.
3. Therefore: thoughts without content are empty.
4. Intuitions without concepts are blind.



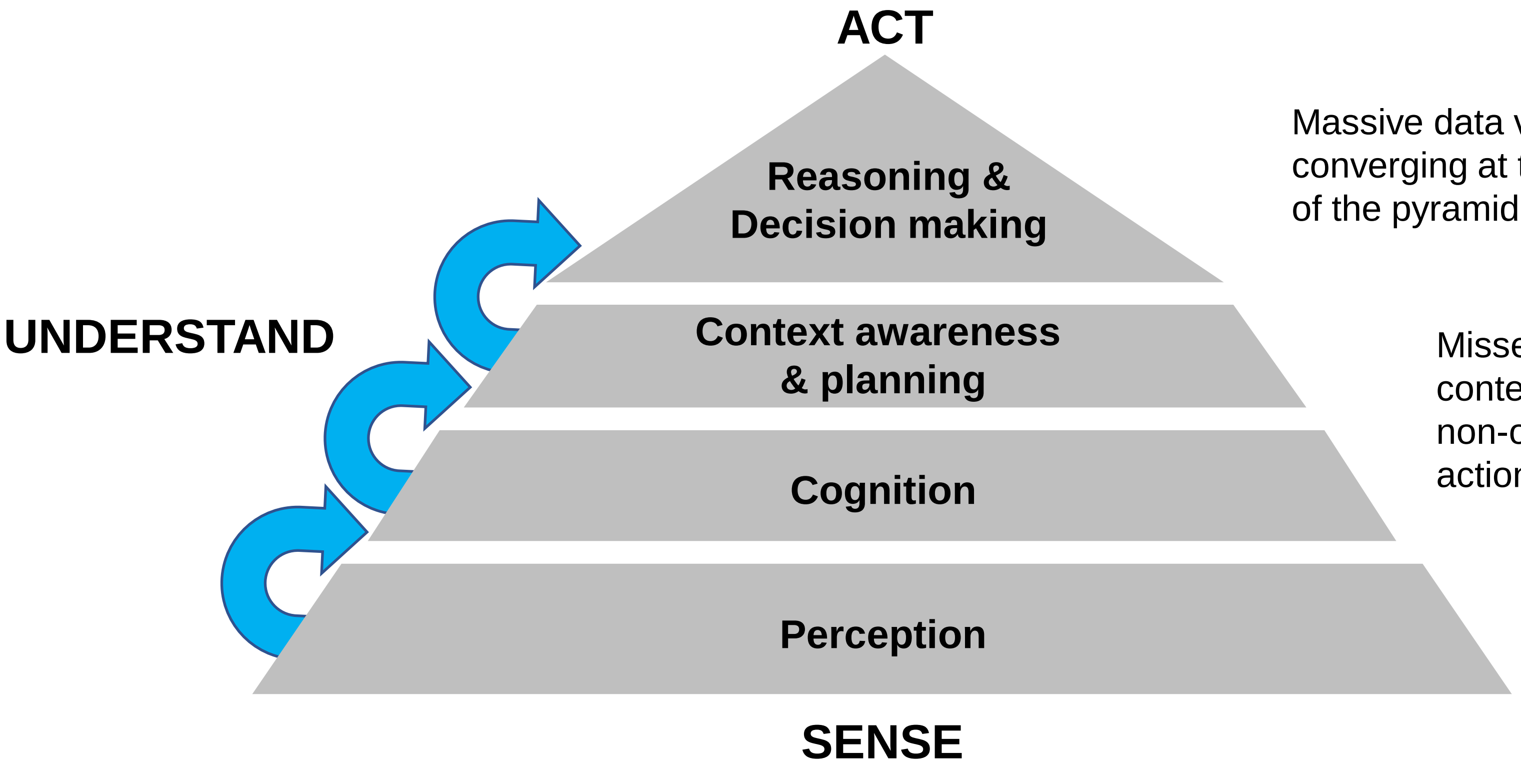
Todays flow Visiual cortex → Brain → Mind



Concept innovation thrust

Closing the loop to enable Cognitive decision decision making in automated systems

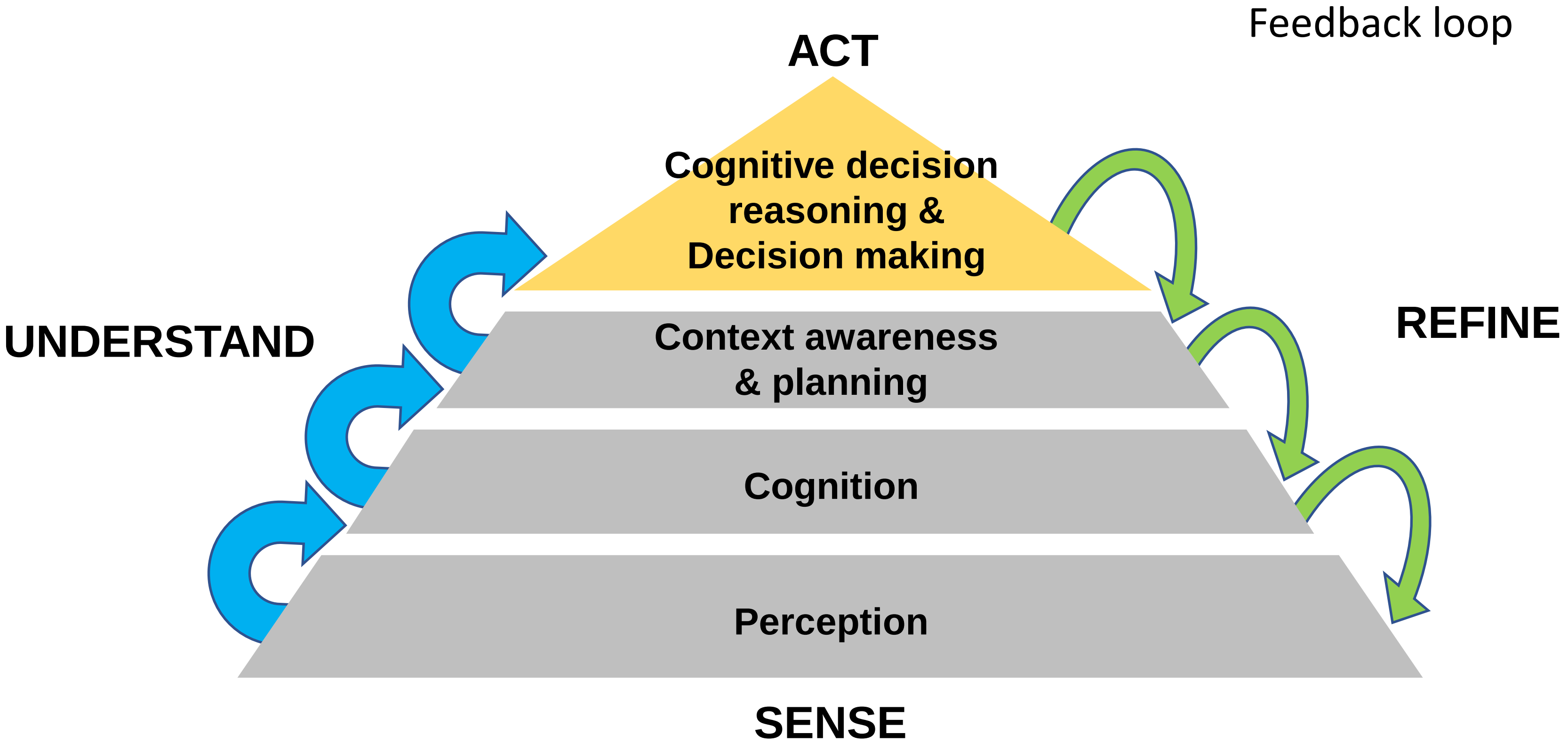
Now: Automation based on causal reasoning – sense-understand-plan-act



Massive data volumes converging at the top-end of the pyramid

Missed cues, lost contextual aids, and non-obvious possible actions

Future: **Automation-based on human-like Cognitive decision reasoning**
Sense – understand – plan – refine perception for intended action – refine plan - act



Semiconductor innovation thrust

Building an efficient, highly-integrated open innovation platform for cognition in any application domain

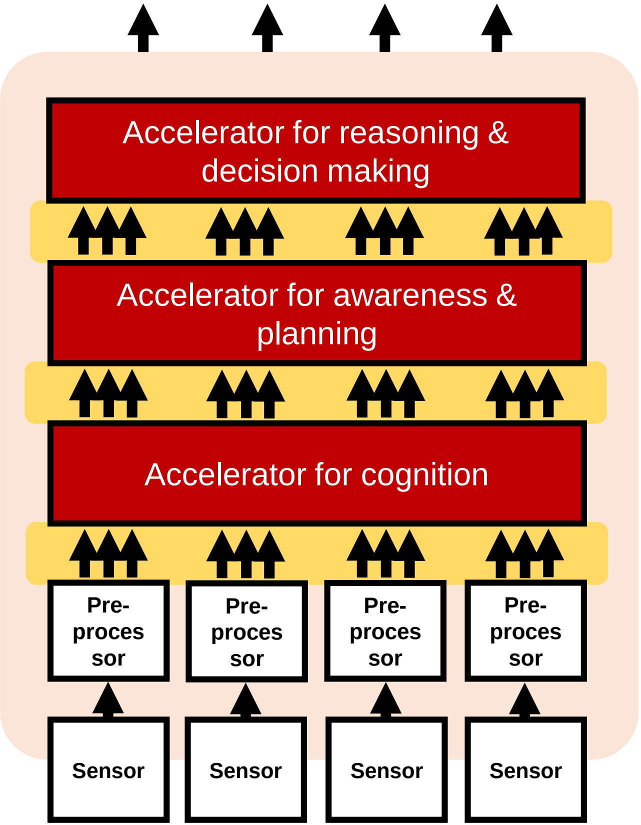
Bring the complete semiconductor value chain to developing for the automation industry

State of the art

Domain-specific automated actions

Vendor specific application interface

Implementation-specific interface format



Vendor specific platforms

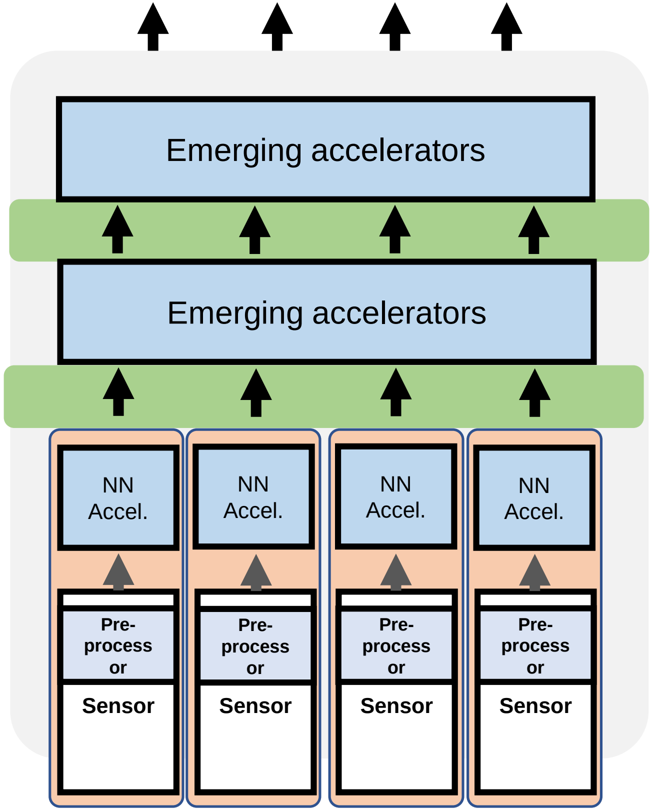
Inefficient compute based on conventional processing technologies

Massive volumes of redundant data

Building sensors like we used to build processors in the 1990s (faster is better)

Innovation

Domain-agnostic automation



Standard interface for platform functions

Standard interfaces between layers

Tight integration

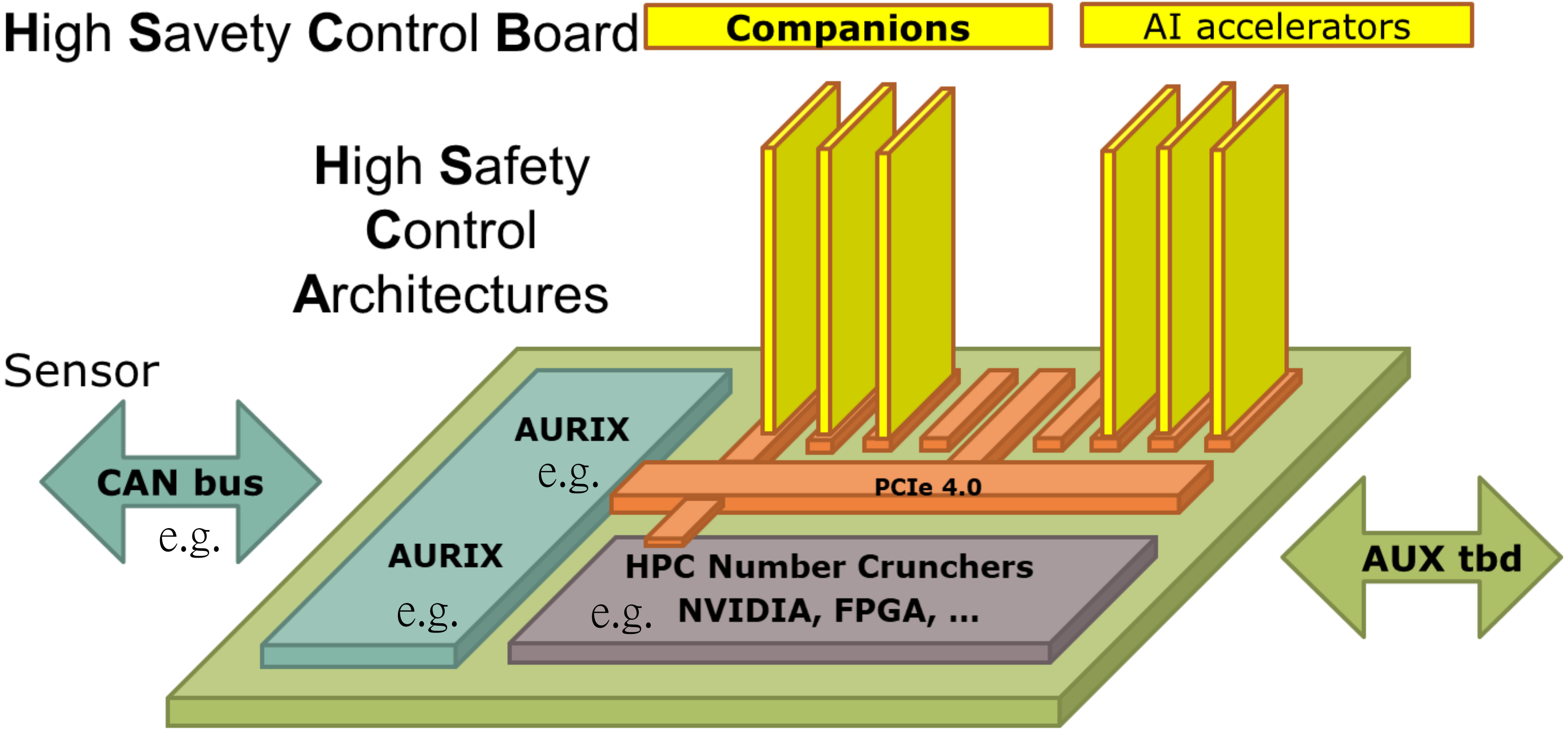
Open innovation platform

Highly-efficient compute based on emerging technologies (analog, spiking, compute-in-memory)

Massive data reduction

New ways of using sensors: Focus on *refinement* instead of *as fast as possible*

Open Innovation Platform in cooperation with Taiwan Partners



- Simple view

Implement scalable Performance for highly automated driving and safety critical processes in industry

Brain

Going ahead

https://brain-cloud.automotive.oth-aw.de/apps/gallery/#BRAIN