Engineering Trends

1st Training in Bahia Blanca, ARG

12-14th of November 2018
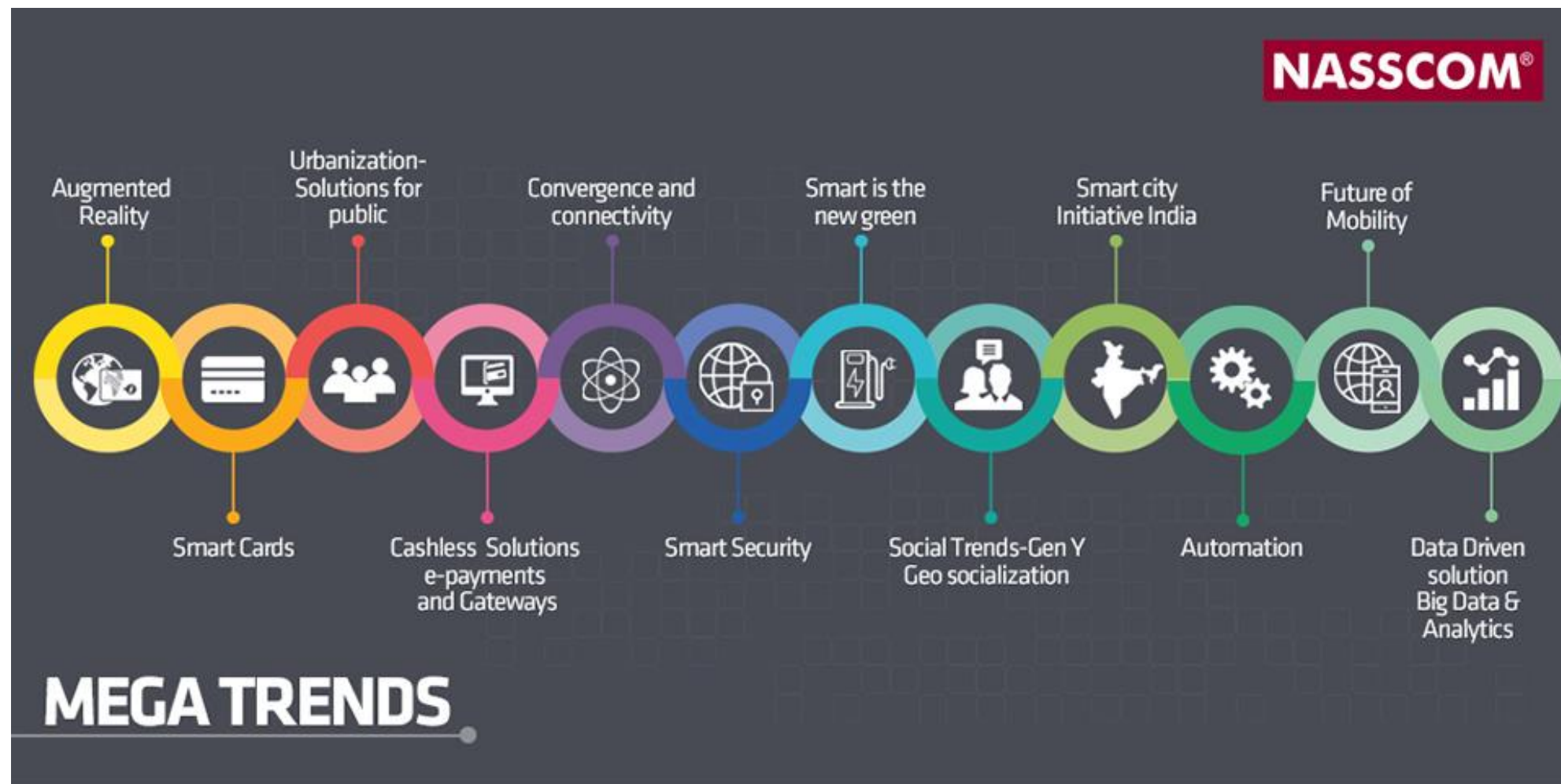
Global Megatrends

Global Megatrends

- Trends exist in all areas of life: economics, politics, science, technology, culture, not only in engineering

- Interesting for Engineering: automation, future of mobility, big data & analytics

- All trends are connected and all trends are presented on the same level here, they are equal to each other when it comes to importance

- Urbanization, more people live in cities, connectivity, changed needs, silver society, (data) safety, ecology/environmental awareness – all have also impact on engineering trends

- Innovation should be based on trends to fulfil technological standards, economic necessity, meet customers desires and meet legal requirements

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Definitions

- Difference between automatization and autonomization

    automatic: what programmers developed, defined behavior, without human intervention

    autonomous: decisions in individual situations, independent reactions to changing environment

Definitions

- Industry 4.0

  digital linkage of humans, machines and products, digitalization of industrial production

- Internet of things

  connected, communicating products and devices, collect data, internet and cloud based communication with devices

- Both together = Industrial internet of things (smart factories, industrial robots)

Definitions

Further facts on the Internet of Things

- making things smarter

- in 2020, 50 billion devices will be connected to the world wide web

- Many of the connected things will be sensors, which can now be produced on a lower cost-level, creating new levels of network connectivity between machines and people

- Used for better performance or further intelligent services

- Connection of real and virtual world

Car Connectivity

Car connectivity

Car connectivity

The picture before shows that really everything is (or will be) connected to the internet, not only cars or industrial things (machines, robots,…) but also a lot of other every day objects, private as well as public ones

Car connectivity
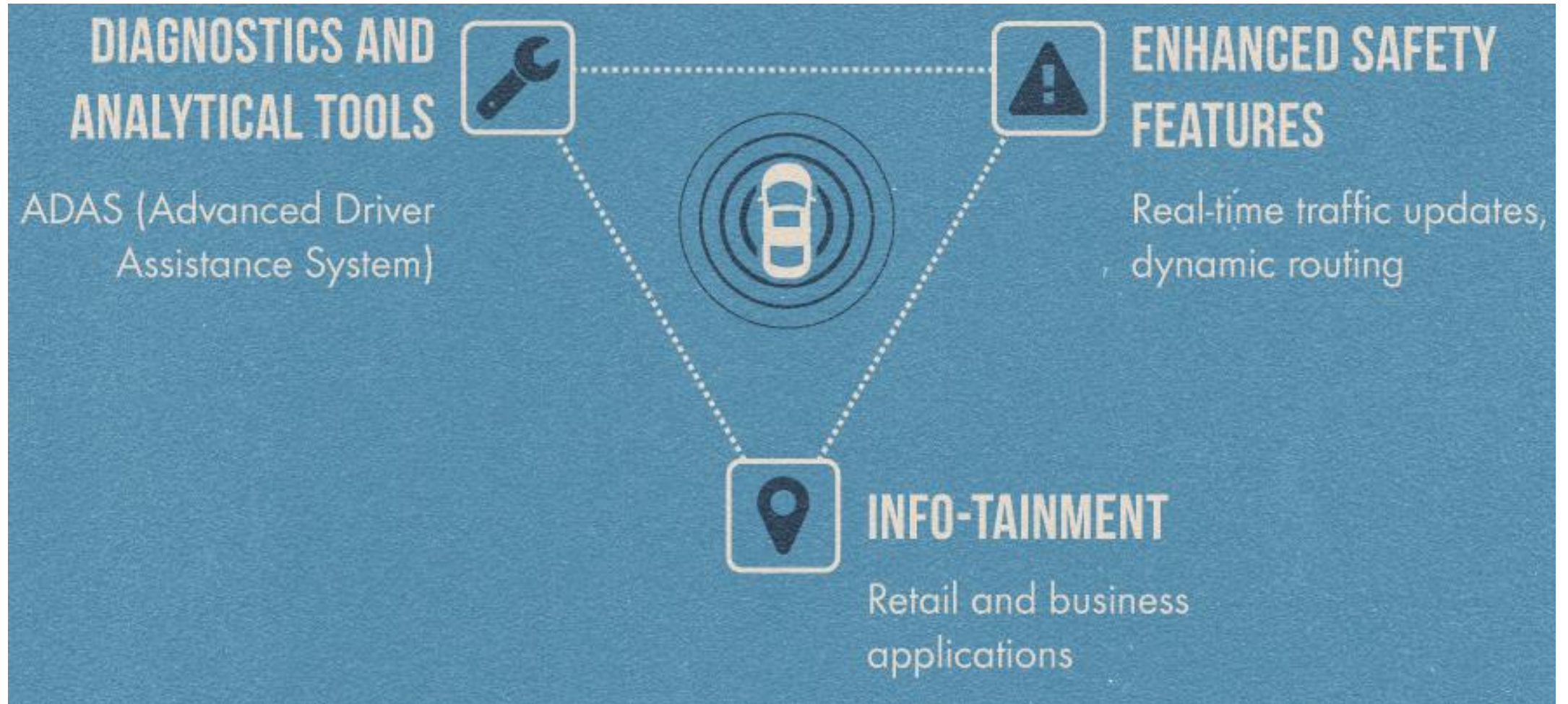

The three components of the IoT

Car connectivity

- Technology has developed over time, becoming smaller and simpler to implement

- Integrated sensors, hardware modules, data transmitters, control units to track performance, health and damage factors (in real time!!)

- Car equipped with internet access, WLAN, share internet access with other devices, inside and outside the vehicle

Car connectivity

Car connectivity

The picture before shows the three components that engineers have to deal with, the necessary factors of a connected car

Conditions for speaking about car connectivity: interconnectedness, assistance and safety systems, operating and display concepts, focus on personal experience

Car connectivity

MEANING FOR USERS

- Personalised driver and passenger experience, interacting with a product, experienced-focus

- Smart cars in cities: self-report of accidents, navigate to parking lots (or even drop us off and go there by themselves)

- Data: manufacturers learn about users behaviour and preferences, drivers learn about own driving and how to use their vehicle most optimal
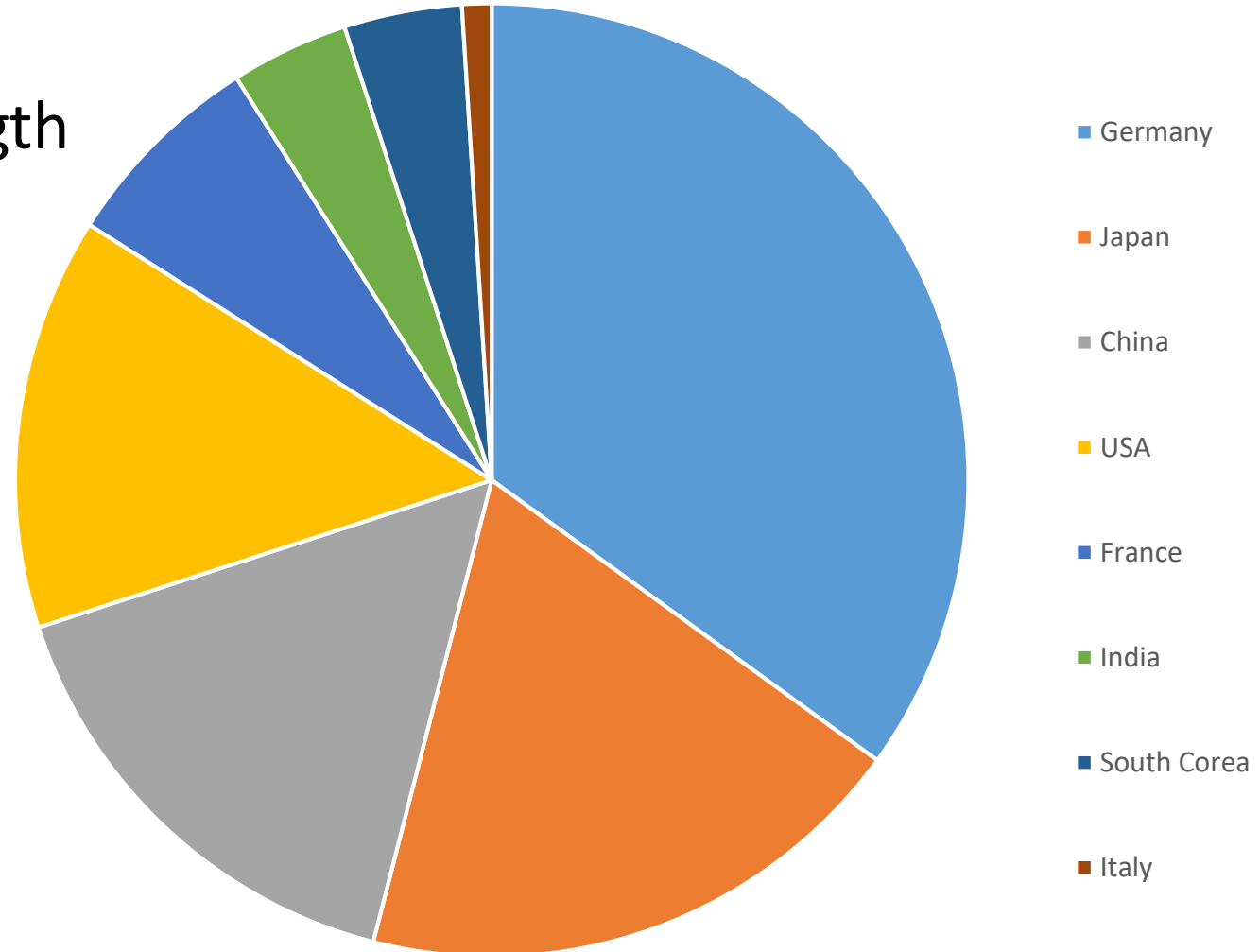
Car connectivity

CCIS (connected car innovation study)

- 19 manufacturers, 8 countries
- Connected cars innovations:

  interconnectedness, assistance and safety systems, operating and display concepts
- CC innovations hold 53.6% of all innovations of the manufacturers (2010: 29%)
- In 2017 543 connected car innovations
- CC innovations as important as innovations of drive and automotive technology

Car connectivity

CC Innovative strength

Legend:
- Germany
- Japan
- China
- USA
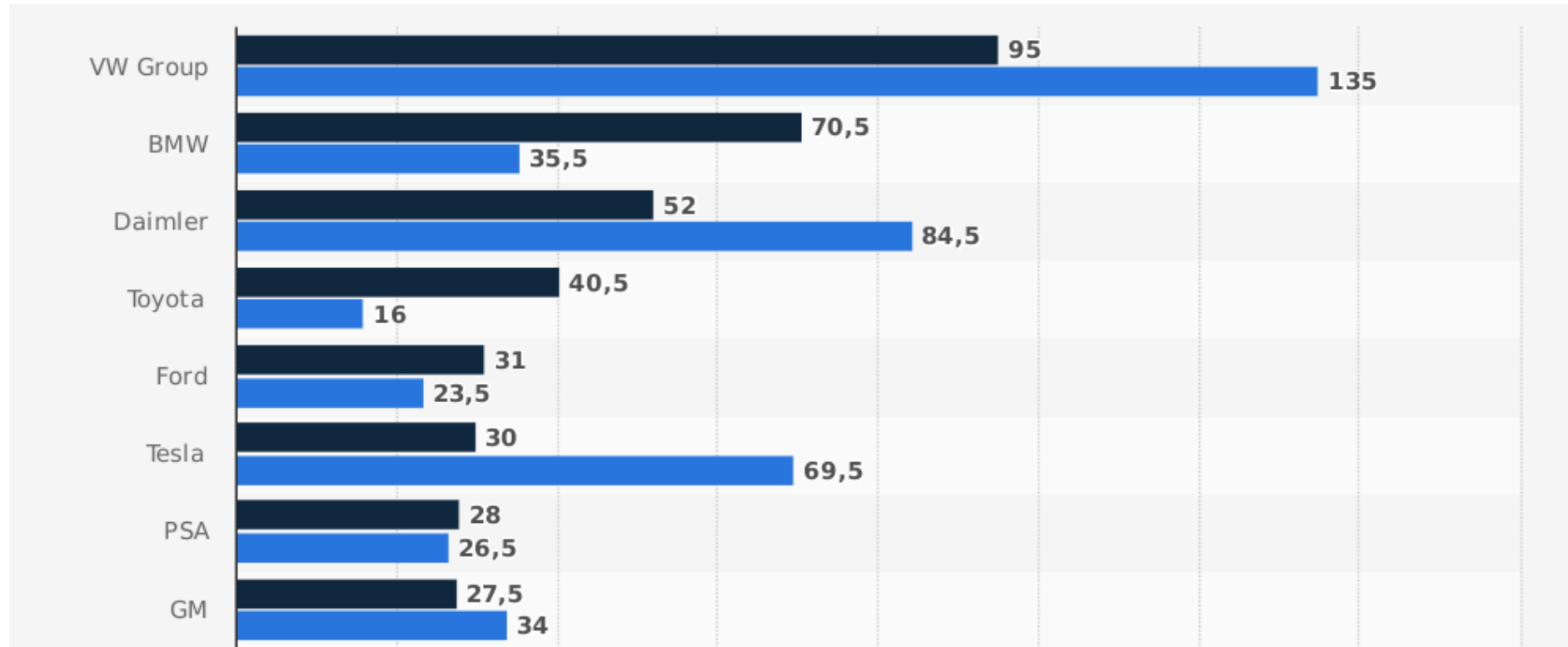- France
- India
- South Corea
- Italy

Car connectivity

The picture before shows index values of automobile manufacturers in the area of connected cars, sorted by countries of origin in 2017 (results of the CCIS)

Car connectivity

	Black bar	Blue bar
VW Group	95	135
BMW	70,5	35,5
Daimler	52	84,5
Toyota	40,5	16
Ford	31	23,5
Tesla	30	69,5
PSA	28	26,5
GM	27,5	34

Car connectivity

The picture before shows index values of automobile manufacturers in the area of connected cars, sorted by the companies in 2017 (results of the CCIS)

Car connectivity

DISCUSSION

Risks?

Threats?

Car connectivity

WHAT IS NECESSARY

- Software availability, building apps for connected cars

- Universal application programming interface (API) is must, decouple technology and software within the car from services it can offer, brand or model not important anymore, developer communities

- Trend of coopetition (cooperation of competitors, increasing number of cooperating companies in the last few years, also a trend!!)

Car connectivity - Discussion

RISKS AND THREATS

- Amounts of data

- So much data, Legislation and security!

- Personal data used by companies, government and institutions, could be done without our knowledge, privacy!!, which applicant to chose

- Security concerns of public must be prioritized!

- Number of hackers grow at the same rate as the number of possibly connectable items, potential security risk!

- Increasing entry points/opportunities for criminals

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NEEDS

   ➔ computer scientist and engineers (electrical, mechanical)

- <u>Computer scientist:</u> operation of microcontrollers, interaction of sensors, algorithms and actors (in real-time!!)

- <u>Engineer:</u> develop regarding to functionality, changes of the vehicle (drive concept and design!)

- They have to work together! "How to team work" must be teached as well, not only "deep engineering knowledge"

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THE DEPARTMENTS

- Electrical engineering and information technology

- Mechanical and process engineering

(Also economics, architecture and design, social and cultural sciences and media)

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ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGY

- Chose focus:

  automation technology

  electric energy technology

  microelectronics

  information technology

  communications engineering

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- Choice of focus is for Bachelor AND Master studies to get more specific knowledge/expertise, meeting the students interests

- The methods of how to lean teamwork and the methodologies how the studies are executed in Düsseldorf is topic of the next ASCENT meeting in Mexico

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COURSES

Electrical machines

Electrical power supply

Power electronics & drive control

Microelectronic sensors

Project: Automation (MA)

Practical project in sixth semester with bachelor thesis

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MECHANICAL AND PROCESS ENGINEERING

- Chose field of study:

  energy and environmental technology (how to use energy in an efficient and sustainable way, how to save resources,...)

  product development

  production technology

 simulation and experimental technology

Data Management

Data management

- Four characteristics of self driving cars:

    scanning the environment with the help of sensors

    navigation without human invention

    communication with other traffic

    make safety relevant decisions

- Also great chance for elderly and disabled people and for a "pay per use" concept!

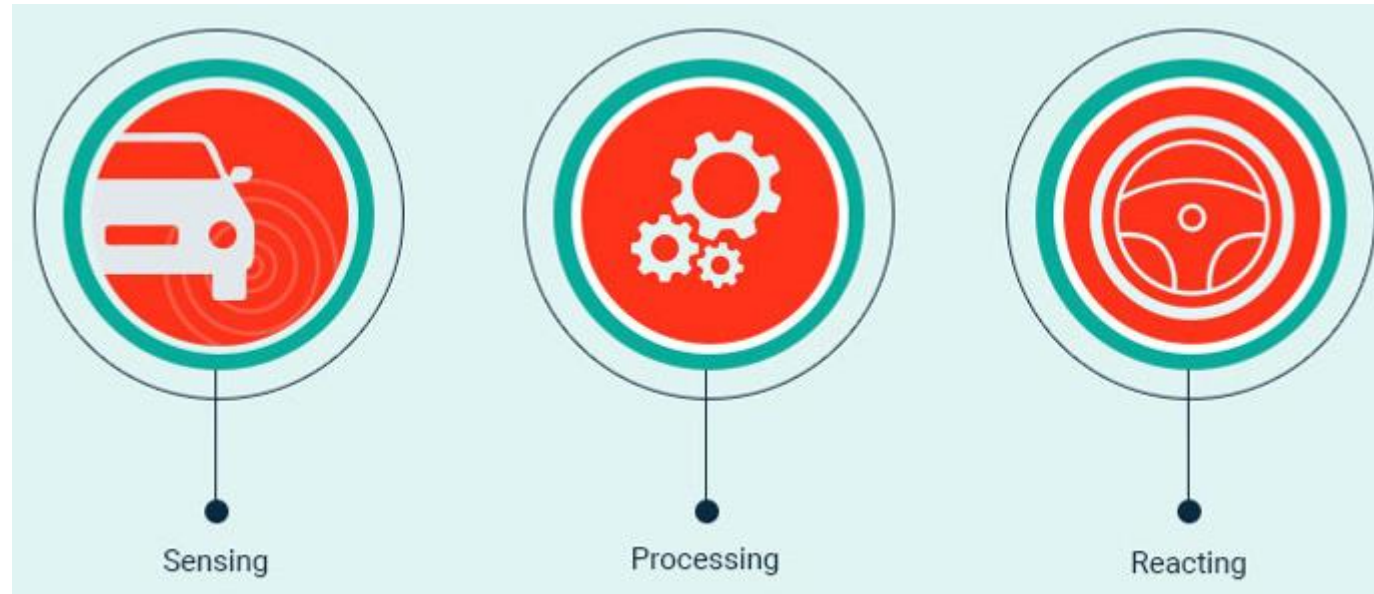# Data management

Level of automation
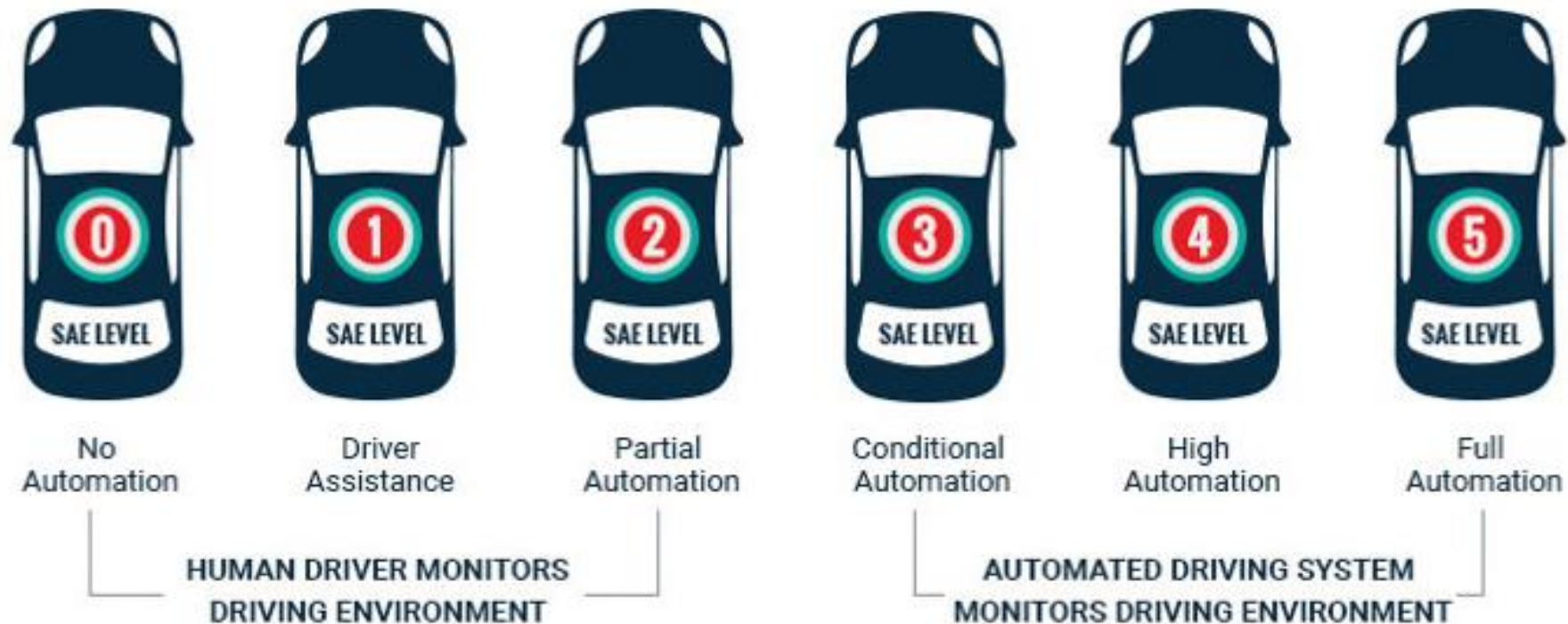
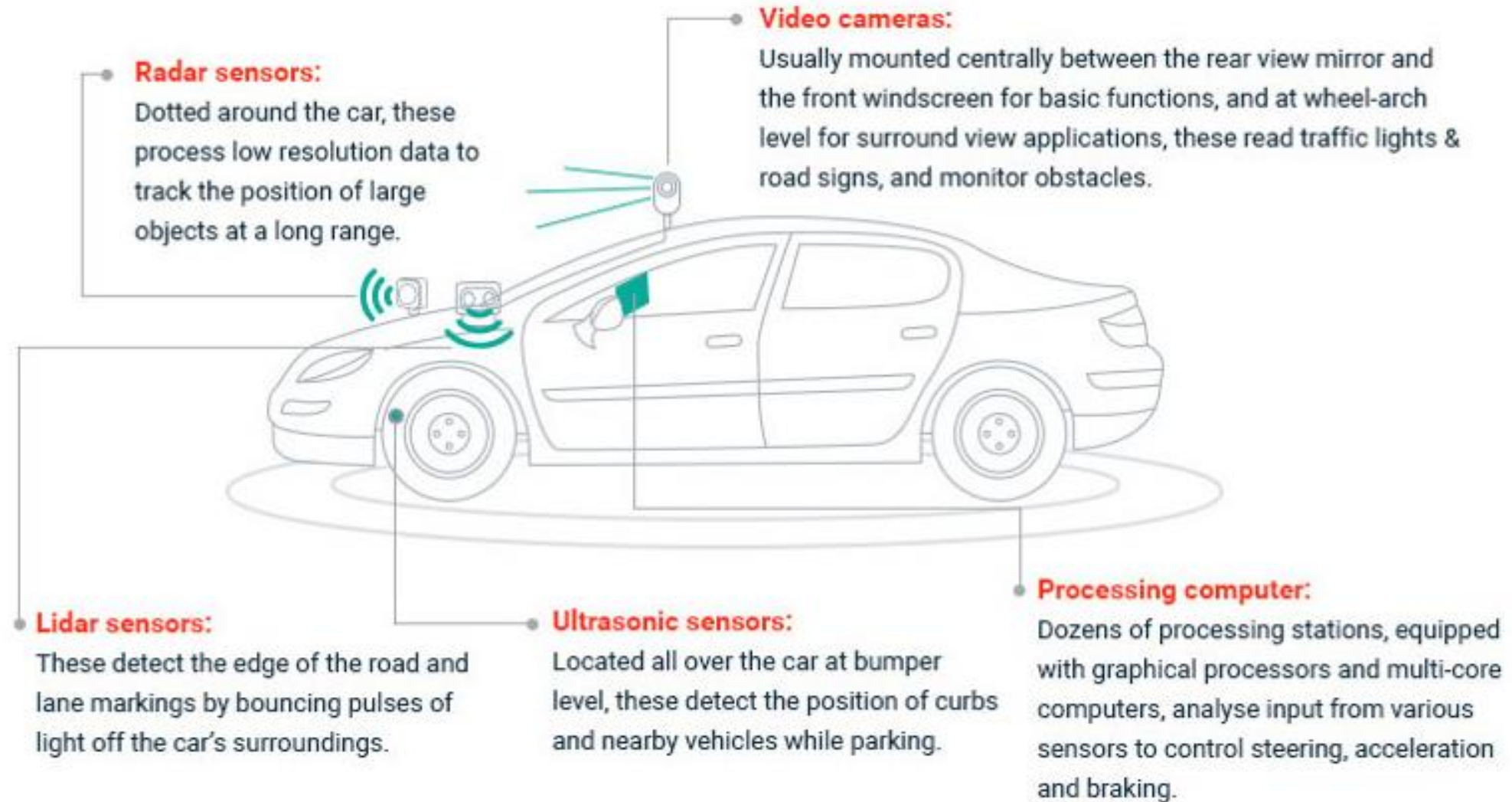Capability of the car to operate without human intervention
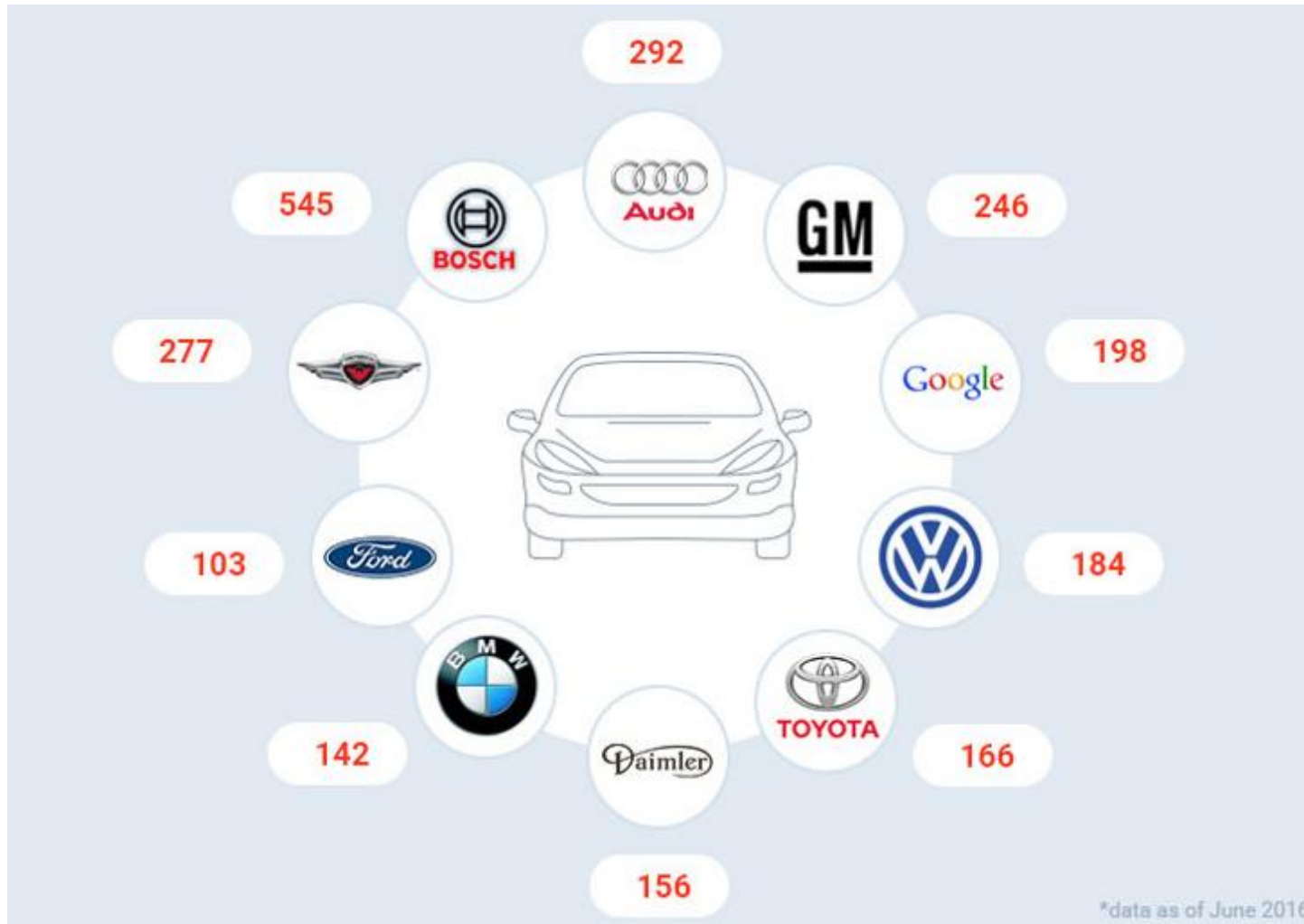
Data management

Engineering challenges

Sensing   Processing   Reacting

Data management

Radar sensors:
Dotted around the car, these process low resolution data to track the position of large objects at a long range.

Video cameras:
Usually mounted centrally between the rear view mirror and the front windscreen for basic functions, and at wheel-arch level for surround view applications, these read traffic lights & road signs, and monitor obstacles.

Lidar sensors:
These detect the edge of the road and lane markings by bouncing pulses of light off the car's surroundings.

Ultrasonic sensors:
Located all over the car at bumper level, these detect the position of curbs and nearby vehicles while parking.

Processing computer:
Dozens of processing stations, equipped with graphical processors and multi-core computers, analyse input from various sensors to control steering, acceleration and braking.

Data management

The picture before shows that there is not „THE sensor" but that many sensors and a lot of different types of sensors are necessary for an autonomous driving car

Data management

*data as of June 2016

Global autonomous driving patent filings sorted by companies in 2016

"Audi" is the strongest within the "VW Group" (Audi R8!)

Data management

FUTHER ADVANTAGES

TYPE OF SAVING (PER YEAR)	IF 10% OF CARS ARE SELF-DRIVING	IF 20% OF CARS ARE SELF-DRIVING
Lives Saved:	1,100	21,700
Fewer Crashes:	211,000	4,220,000
Economic Savings:	$5.5 billion	$109.7 billion
Travel Time Saved (million hrs) :	756	2772
Fuel Savings (million gallons) :	102	724

Data management

Further facts (addition to the slide before):

- Up to 94% of car crashes are caused by human error
- Less time commuting and higher speed limits could be achieved by the use of autonomous cars (calculating the most efficient route, knows where traffic jams are)

Data management

TEST TRACK IN DUESSELDORF

- Started in September 2018

- SAE level 2, partial automation

- Driver inside

- Focus on (internet-) infrastructure

Data management

DISCUSSION

Disadvantages?

Morale?

Data management

CURRENT DIFFICULTIES FOR AUTONOMOUS VEHICLES

- Human interaction
- The weather (heavy rain or snowy roads)
- Morality and ethics (see next slides!)
- The law
- Security and driver safety
- Cost and affordability

Discussion

ADVANTAGES AND DISADVANTAGES

- The good: less time spent commuting, road capacity greatly increased (more space!), higher speed limits

- The bad: drivers no longer needed (fewer jobs!), software concerns (safety, hacking), privacy concerns (collecting and sharing data)

Question of guilt, manufacturer or "driver"?

The Moral Machine

- Developed by MIT (Massachusetts Institute of Technology)
- Breaks are broken, driving towards a crosswalk
- Two options: keep going or steer to the left
- Originally 13 scenarios, meanwhile even more
- Death heads show who will die
- The Moral Machine can be executed by everyone, test is on the internet, just for collecting data, not for a concrete decision based on that in the end
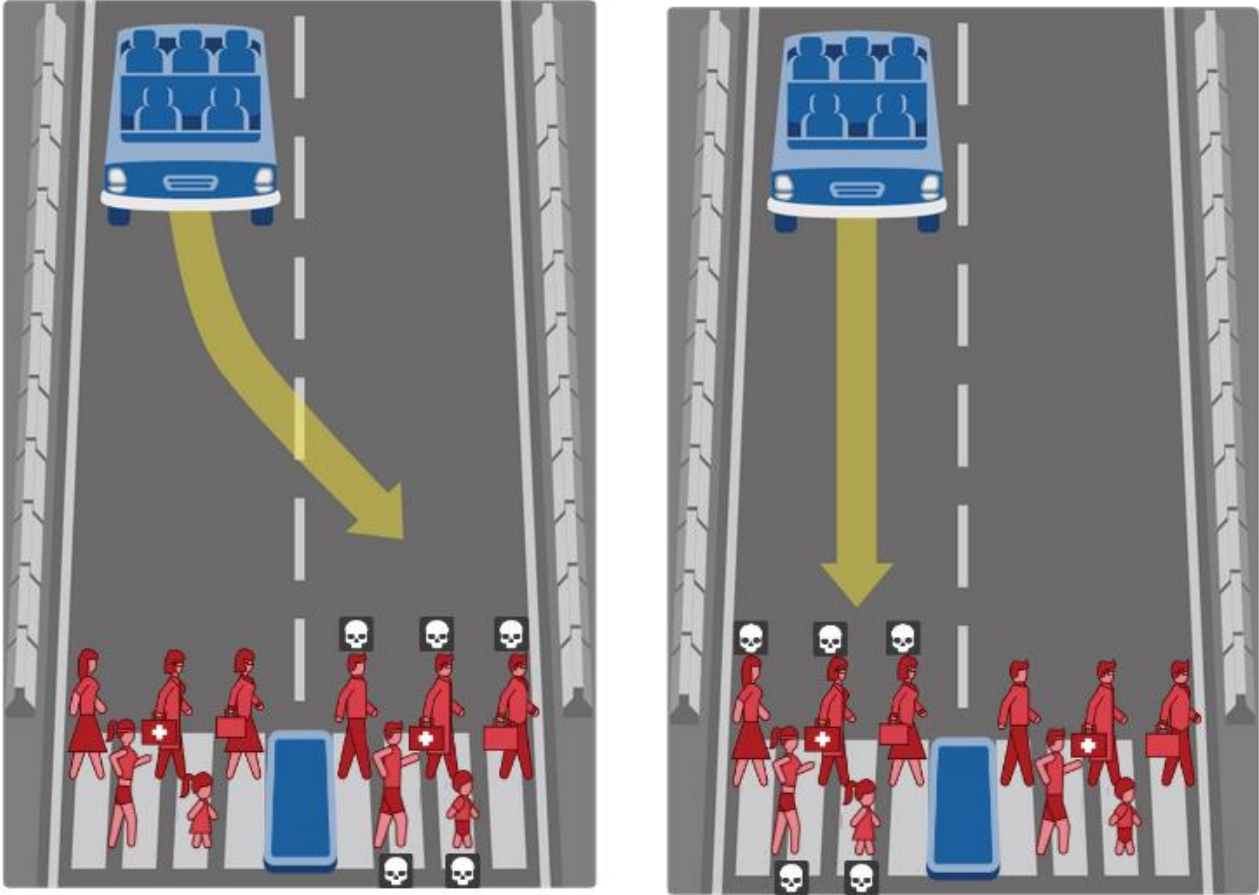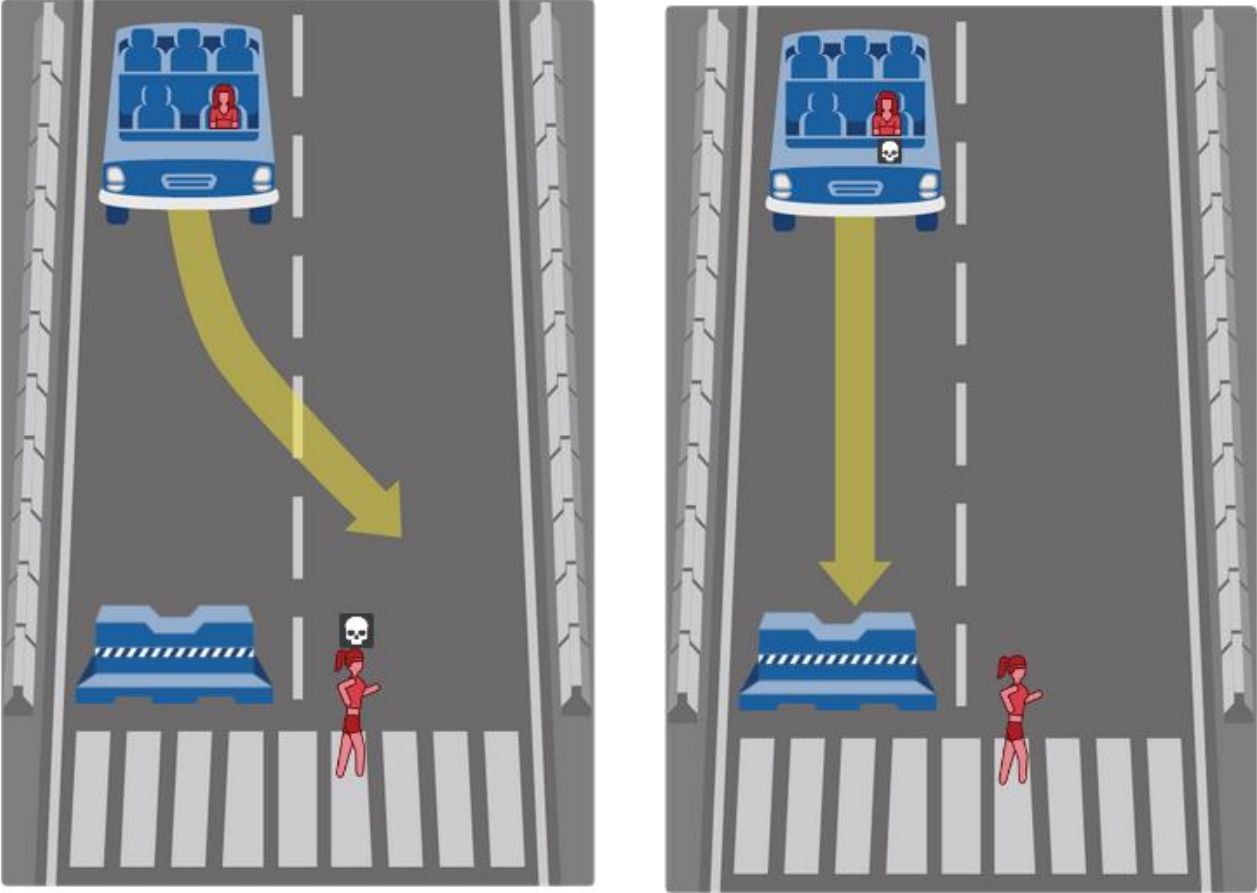
Moral Machine
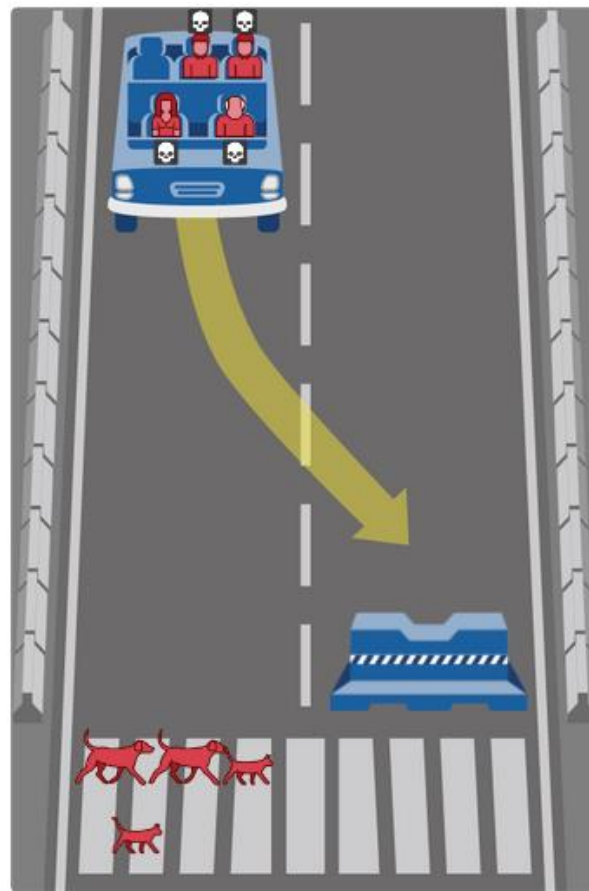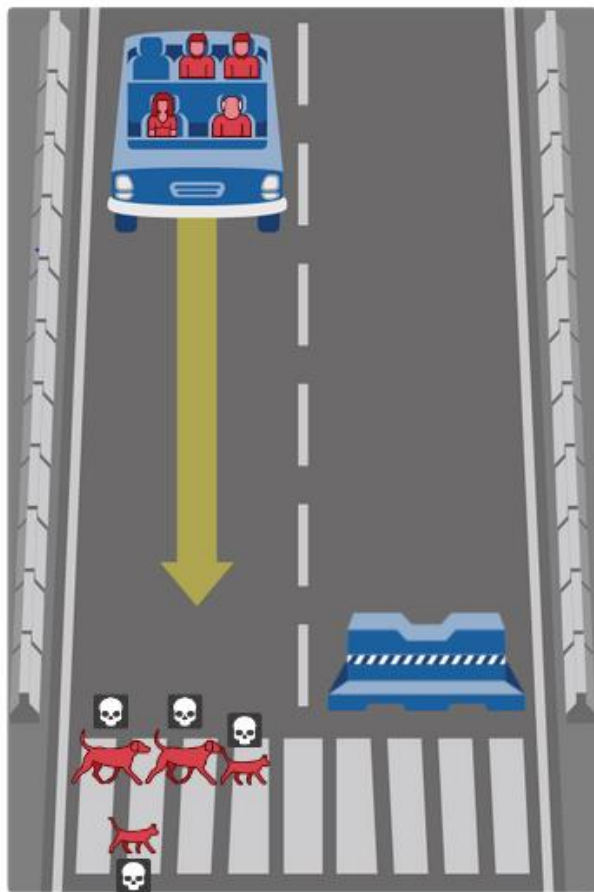
The Moral Machine - example
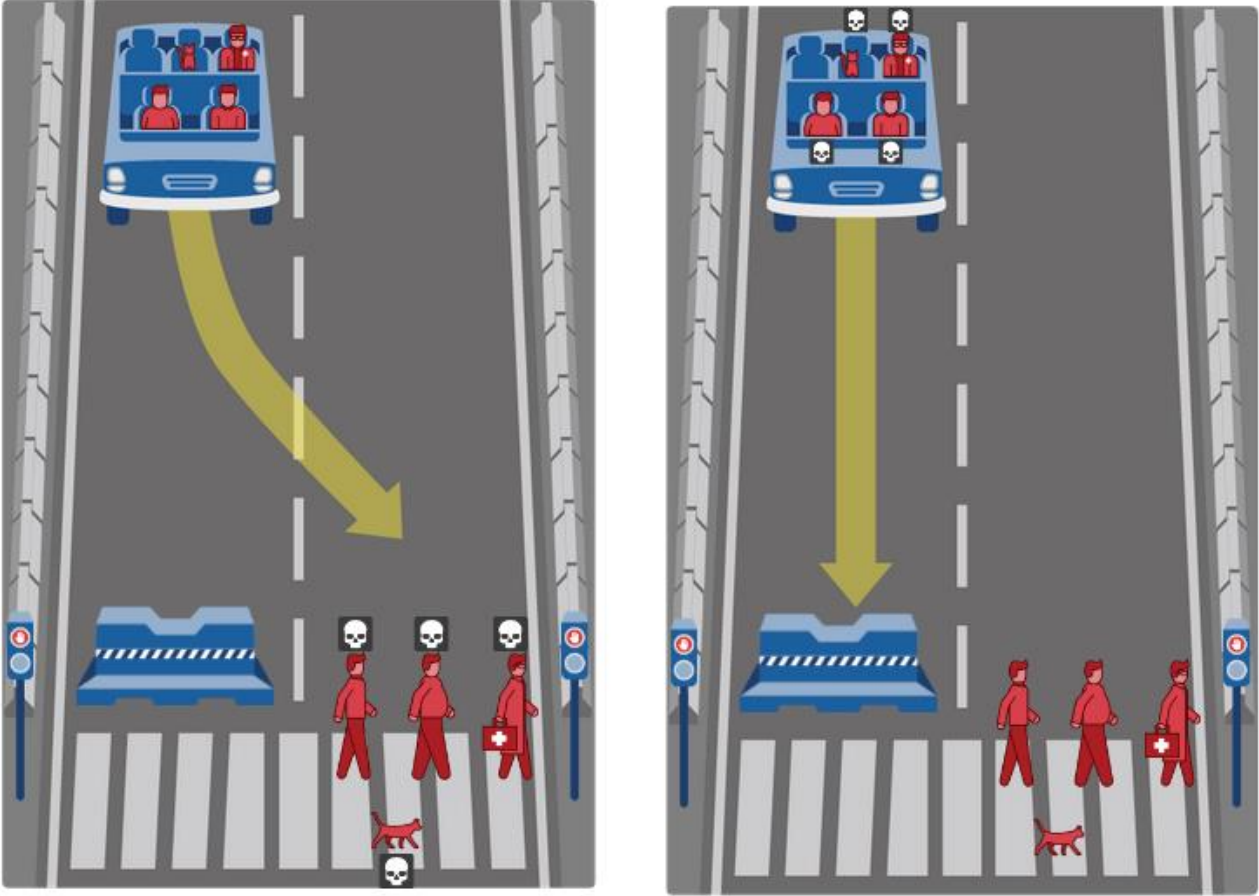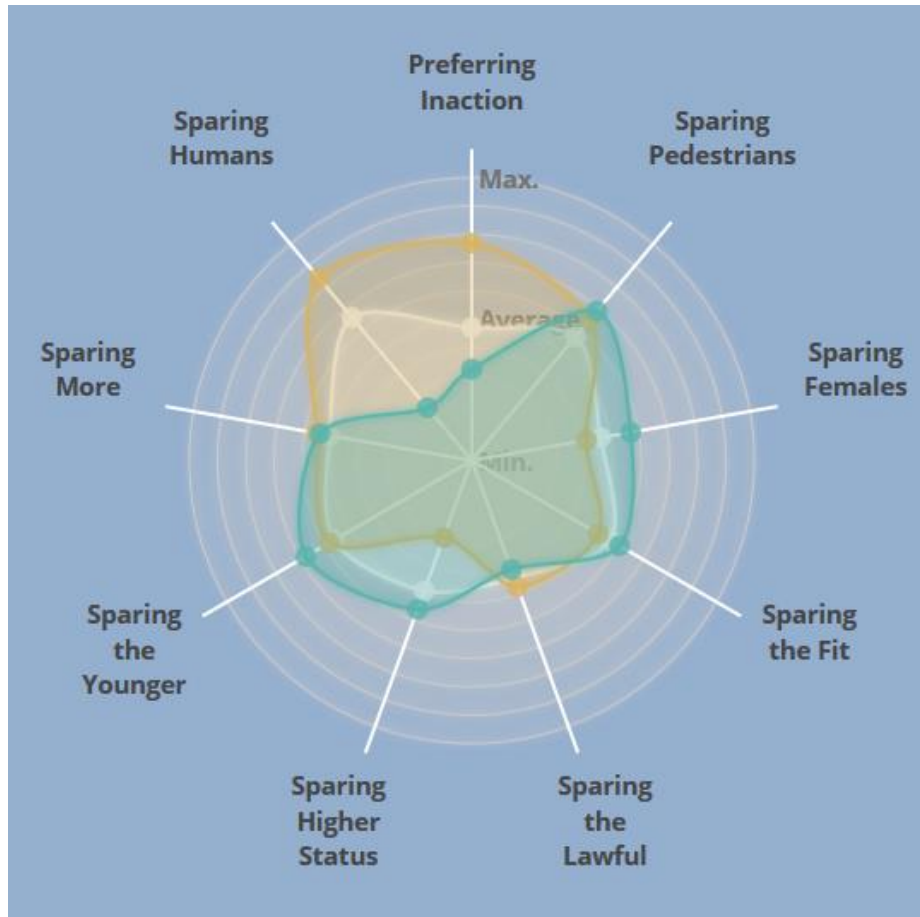
The Moral Machine - example
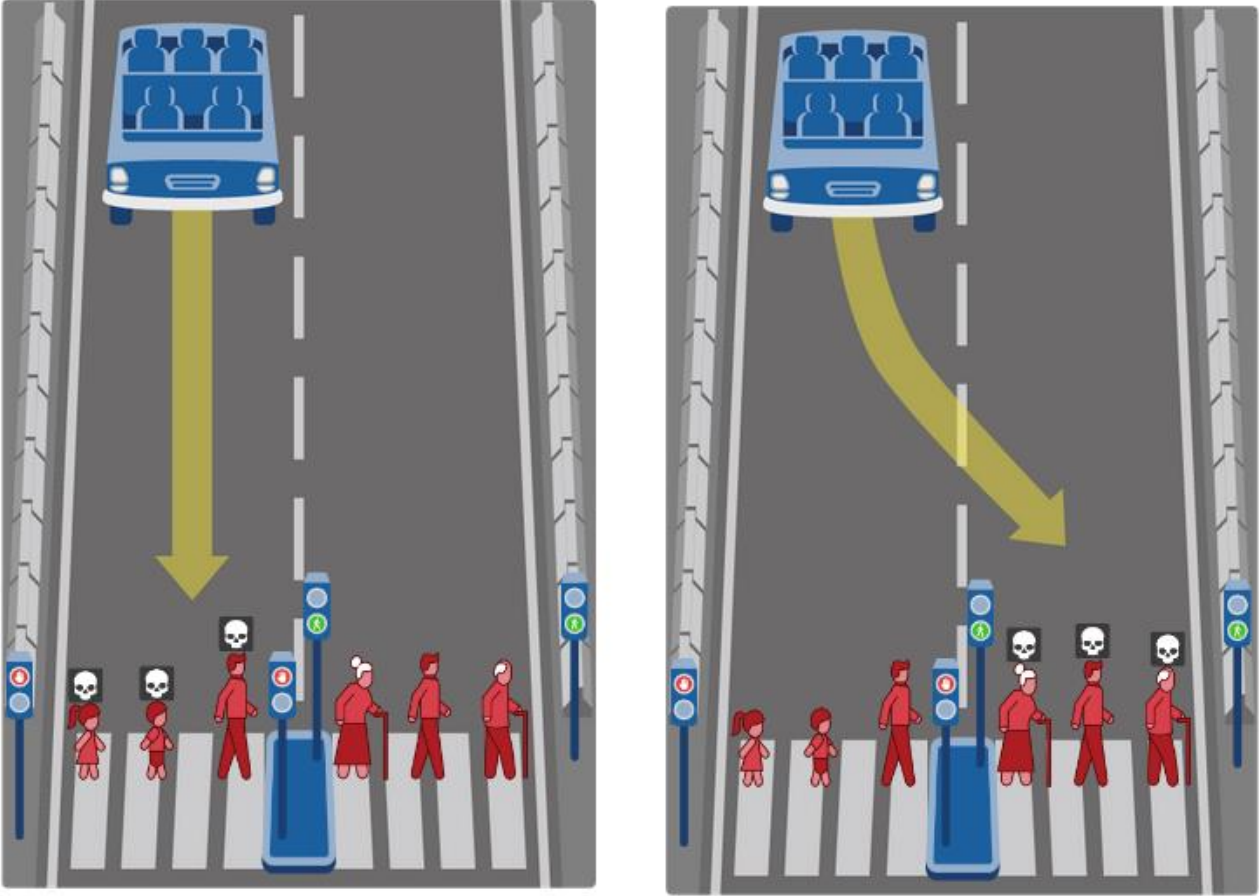
The Moral Machine - example

The Moral Machine - example

The Moral Machine

In the end a comparison can be shown, world ranking out of 117 countries

Here: green = Germany, yellow = Argentina, white = average over all

The Morale Machine

- Don't take that too serious, "The Moral Machine" should just increase attention and awareness for that topic that is also part of the whole and has also its right and impact on engineering!

- There are already less accidents (94% of all car crashes are caused by human error, they are already avoided!)

Summary

- **Main message of this presentation/training:** Everything is connected (not only in internet context!!), do not think to „small" only in engineering topics and details, lot of impact on and by many areas of life! More and more focus on interaction with other areas, very interdisciplinary field!!

THE END

THANK YOU FOR YOUR ATTENTION

ARE THERE ANY QUESTIONS?