Overview of Advanced Driver Assistance Systems for Industrial Vehicles

Presented by:

Alexander Glasmacher

CEO & President
ELOKON Inc.

ELOKON

MODEX 2020
GEORGIA WORLD CONGRESS CENTER
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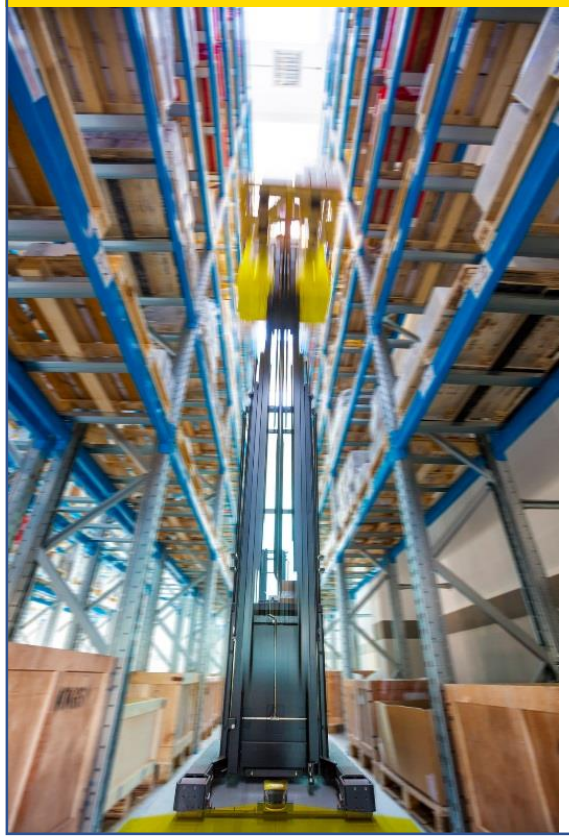
THE ELOKON Group

- German company, founded 1986, 130 employees
  - Subsidiaries in Tucker, GA; United Kingdom; Poland
- Leading global supplier of lift truck safety & warning systems
- Strong partnerships with all major lift truck OEMs
- History of innovation, service, customer-first focus
- Speaker: Alexander Glasmacher
  - President/CEO
  - Stanford University
  - 20+ years of experience in material handling industry

3.000+	40	1986	130
Customers	Countries	Established	Employees

ELOKON: Advanced Driver Assistance Systems for the Material Handling Industry

Increase VNA Safety



Products
- VNA Safety System
- VNA Warning System
- VNA Cold Store System

Technologies
- Laser/Lidar
- 3D Imaging
- RFID

Improve MHE Productivity

Products
- Collision Warning Systems
- Fleet Mgmt Systems
- Speed Reduction Systems

Technologies
- Ultra-wideband
- Radar
- 3D Ultrasound
- NFC

Solution Principles: Sensor-data-fusion, mesh networking, 3D environment recognition, redundant solutions

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Strong, Growing Acceptance in the Automotive Industry 02

Improving Adoption in Material Handling Industry 03

Key Technology Trends Driving Acceptance in MHI 04

Examples of Research & Product Development 05

Added Value for the Material Handling Industry 06

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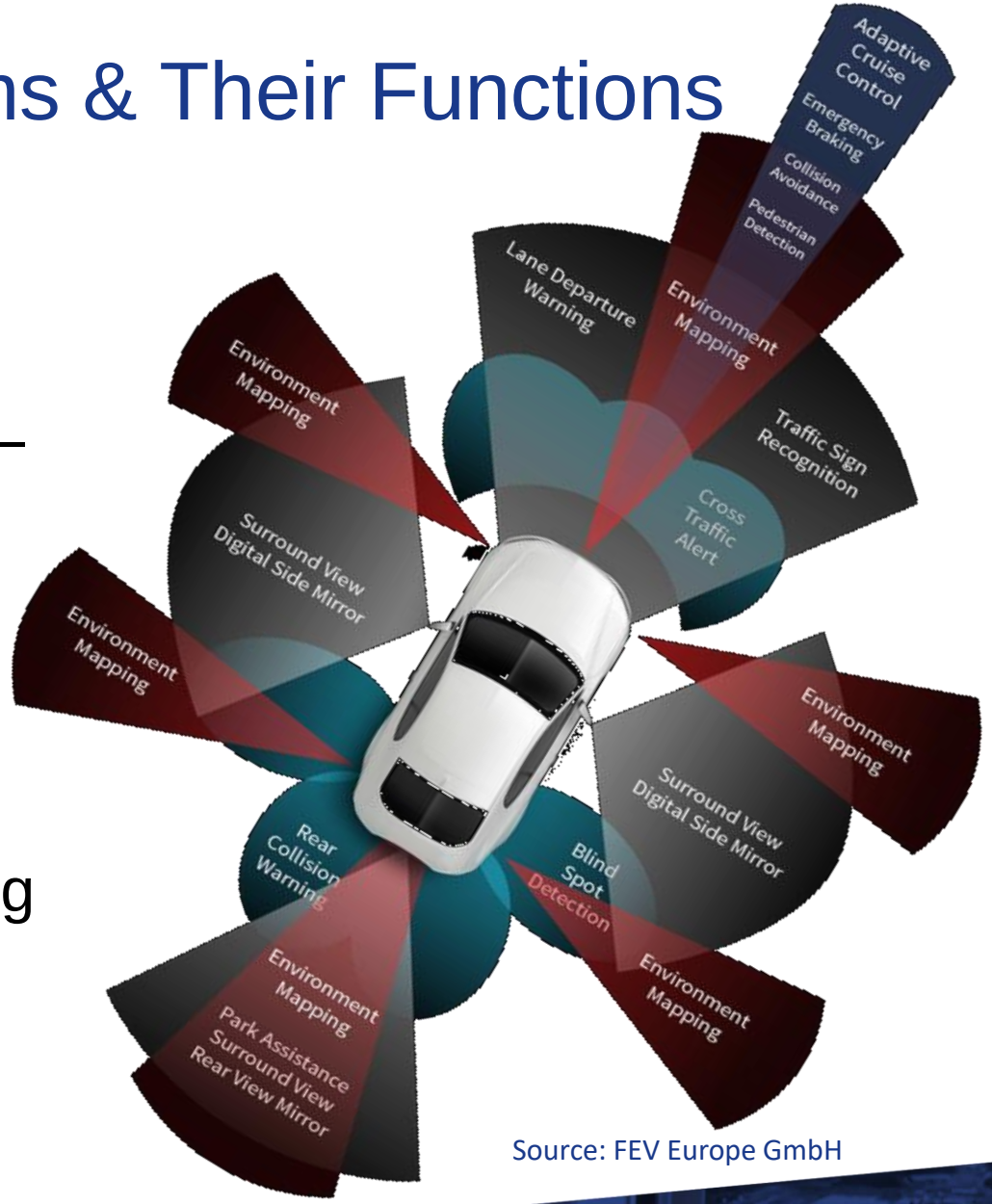
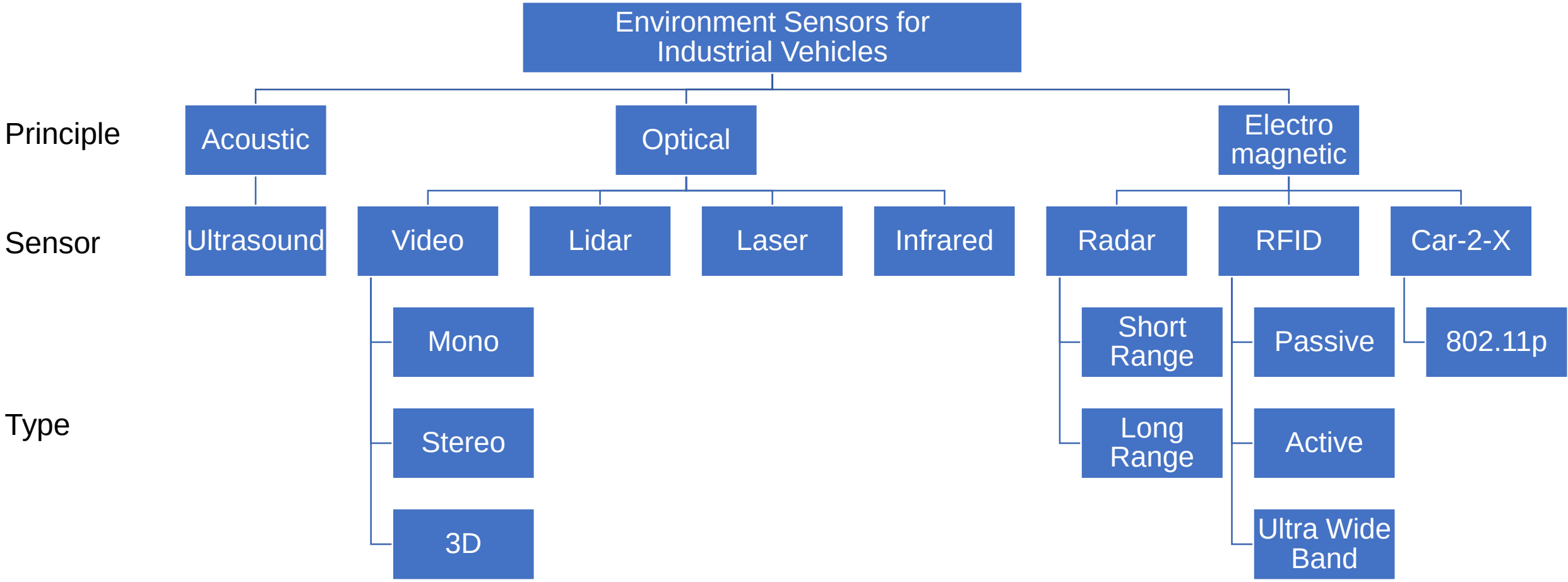
Advanced Driver Assistance Systems & Their Functions

- Electronic auxiliary devices on the vehicle
- Improved safety, comfort and ergonomics
- Provide optical, acoustic and tactile warnings – before or during critical driving situations
- Autonomous or semi-autonomous control of the drive, steering or signalling functions
  - Alerts to prevent accidents to humans or vehicles
  - Active intervention to prevent unsafe driving situations
- The responsibility rests with the driver



Source: FEV Europe GmbH

Technical Diversity of Environment Sensors



Source: http://www.cbcity.de/fahrzeugumfeldsensorik-ueberblick-und-vergleich-zwischen-lidar-radar-video

Driver Assistance Systems in the Context of Material Handling

Germany*

- Driver error and and insufficient safety awareness are frequent causes of serious or fatal accidents involving forklifts
- 40,000 accidents every year in Germany during internal transportation
- 3,600 – 3,700 of these are accidents with forklifts
- In 2014, 490 of these were serious, six were fatal

Great Britain

- “Five workers seriously injured or killed in incidents involving forklifts every weekday”

USA

- “20,000 workers are seriously injured in forklift related accidents every year in the U.S.A.“
- “100 workers are killed in forklift related accidents every year in the United States“

*Source: BGHW aktuell 3/2016

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Well Documented Value of Driver Assistance Systems
in the Automotive Industry

Emergency braking assistant: 28% fewer collisions resulting in personal injuries
(Studie der Unfallforschung der Versicherer, GDV, 2009)

Distance control: 17% fewer serious accidents resulting in personal injuries
(Bericht der Bundesanstalt für Straßenwesen, BASt Reihe Fahrzeugtechnik, Heft F60, 2006)

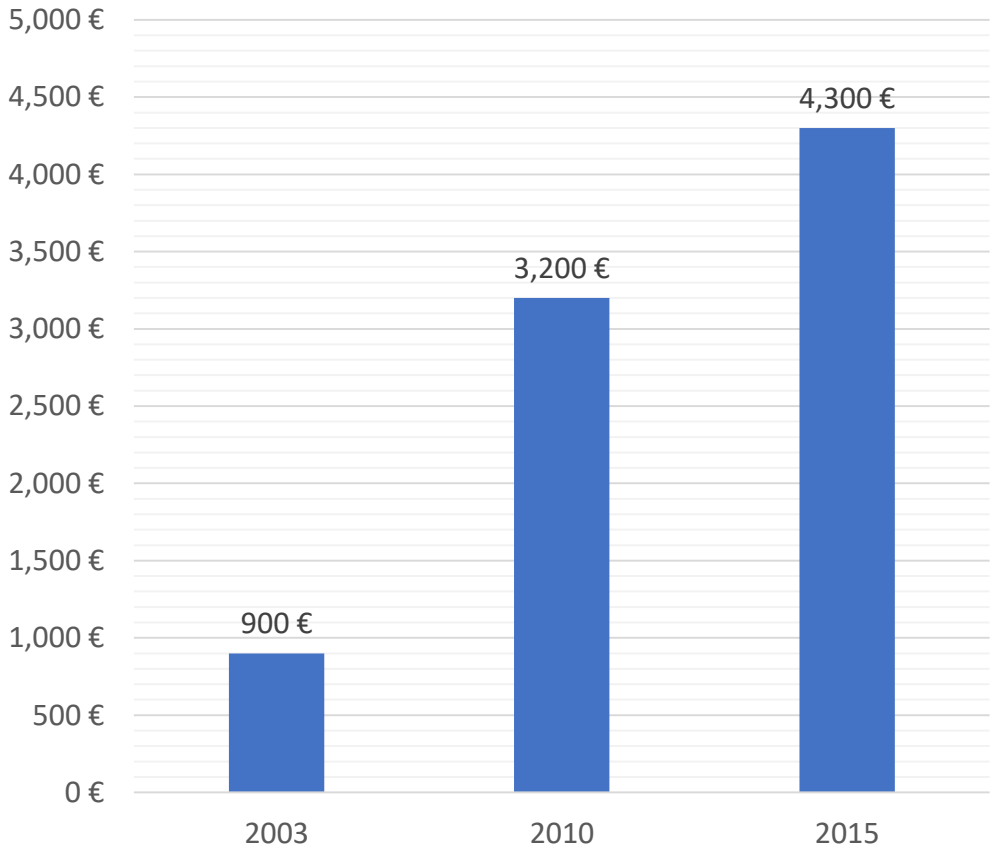
Lane assistance: 49% fewer HGV accidents when changing lanes on motorways
(Allianz Zentrum für Technik, AZT Wirkungspotentiale von ACC und Lane Guard System bei Nutzfahrzeugen, 2006)

Road sign recognition: 60% fewer traffic offenses due to speeding
(Kraftfahrt-Bundesamt, KBA Verkehrsauffälligkeiten, 2007)

Parking assistant: 30% of insurance claims are a result of parking maneuvers
(Allianz Zentrum für Technik, AZT 2008)

Prevalence of Driver Assistance Systems: Increase in Value per Automobile (average)*

1. 2003 - 2015 increase of ca. 30% p.a.
2. Anti-blocking systems, braking assistance, tire pressure systems, distance controls, high beam assistant
3. Customer survey: vehicle safety is #1 priority
4. Demographic shift
5. Key drivers: mandatory introduction, standardization & technical monitoring (Installation, authenticity and functionality)



*Source: 20. Juli 2017, https://de.wikipedia.org/w/index.php?title=Fahrerassistenzsystem&oldid=167426567

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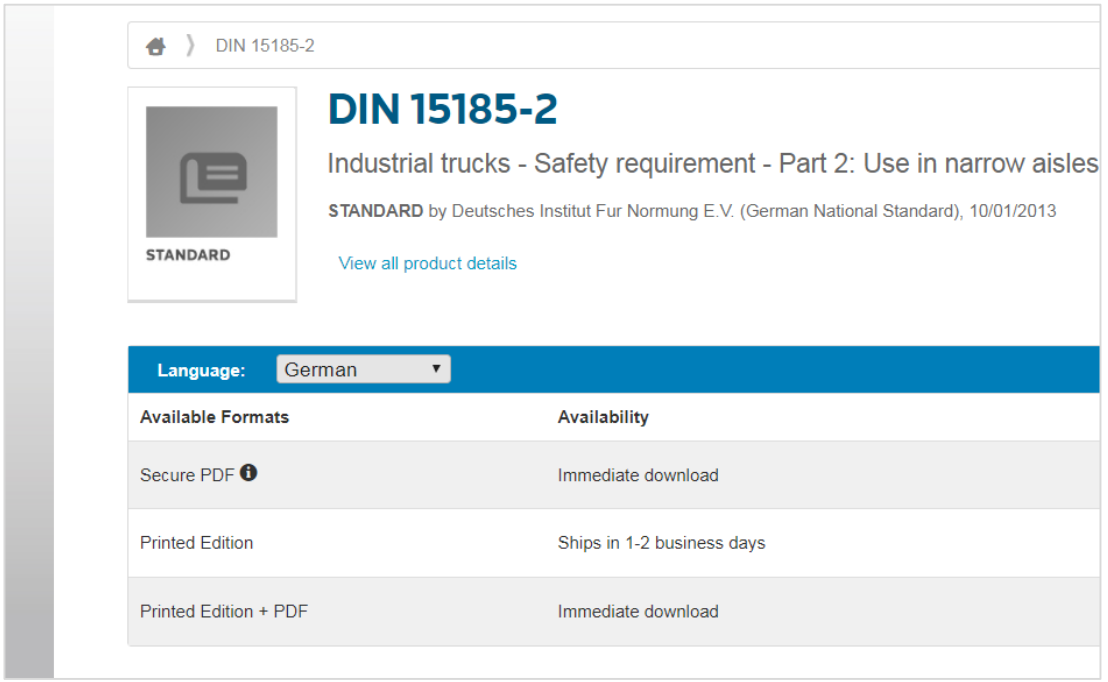
Key Drivers for Growth of Driver Assistance Systems in the Material Handling Industry

- VDI: technical committee, forklift trucks
- Conferences of professional health and safety associations (OSHA)
- EU machine directive 2006/42/EG
- Systematic development/broadening of equipment specifications
- International adoption of national mandatory measures
  - Example: German regulation for the protection of workers in very narrow aisle operating environments
  - DIN 15185 Part 2



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Mega Trend #1: Digitization is a Huge Opportunity for MHI

Threat?

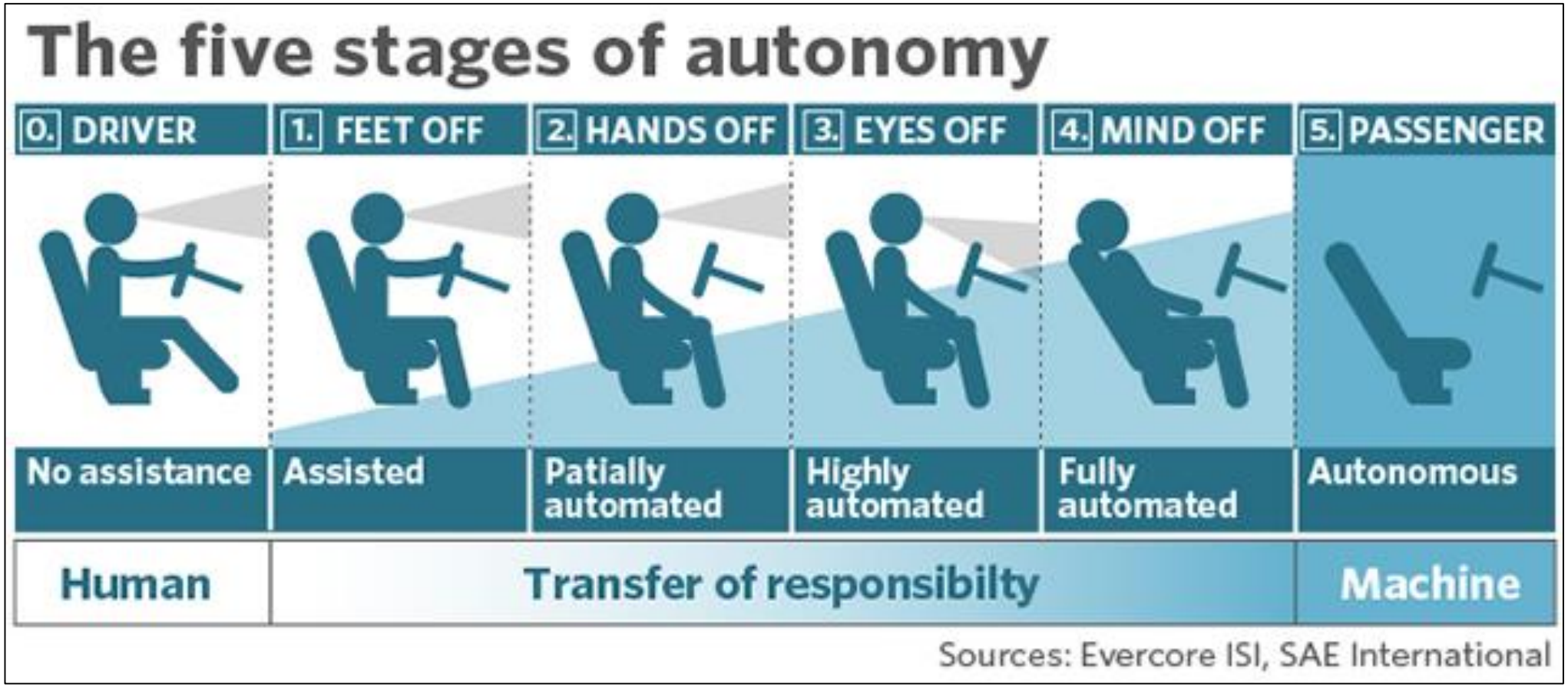
- Elimination of millions of jobs
- Loss of over ½ of current job profiles
- Threat to businesses
- Diminished data protection & privacy laws

Or **Opportunity?**

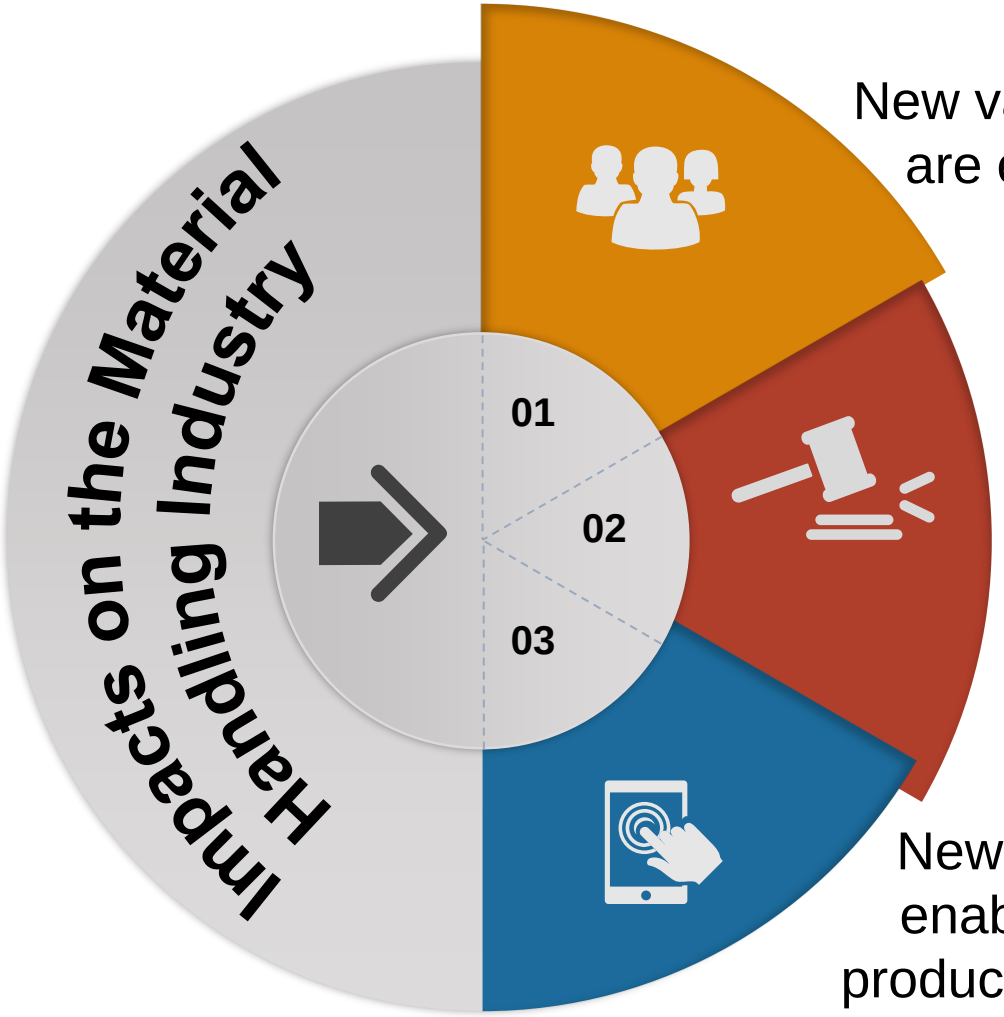
- Emergence of more/different work/jobs
- Creation of new job profiles
- Increased profitability; therefore more employment
- Creation of new industrial value chains and customer groups

We need to keep pace with changing trends and a new business landscape

Mega Trend #2: Autonomous Driving will Accelerate Adoption of Advanced Driver Assistance Systems in Material Handling



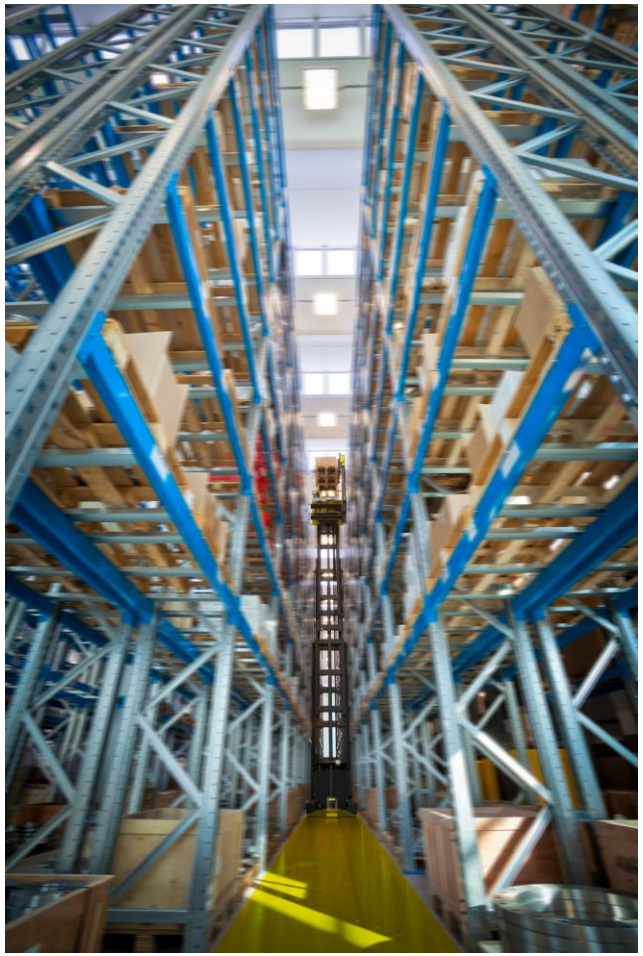
Impacts from Digitization & Autonomous Driving on the Material Handling Industry



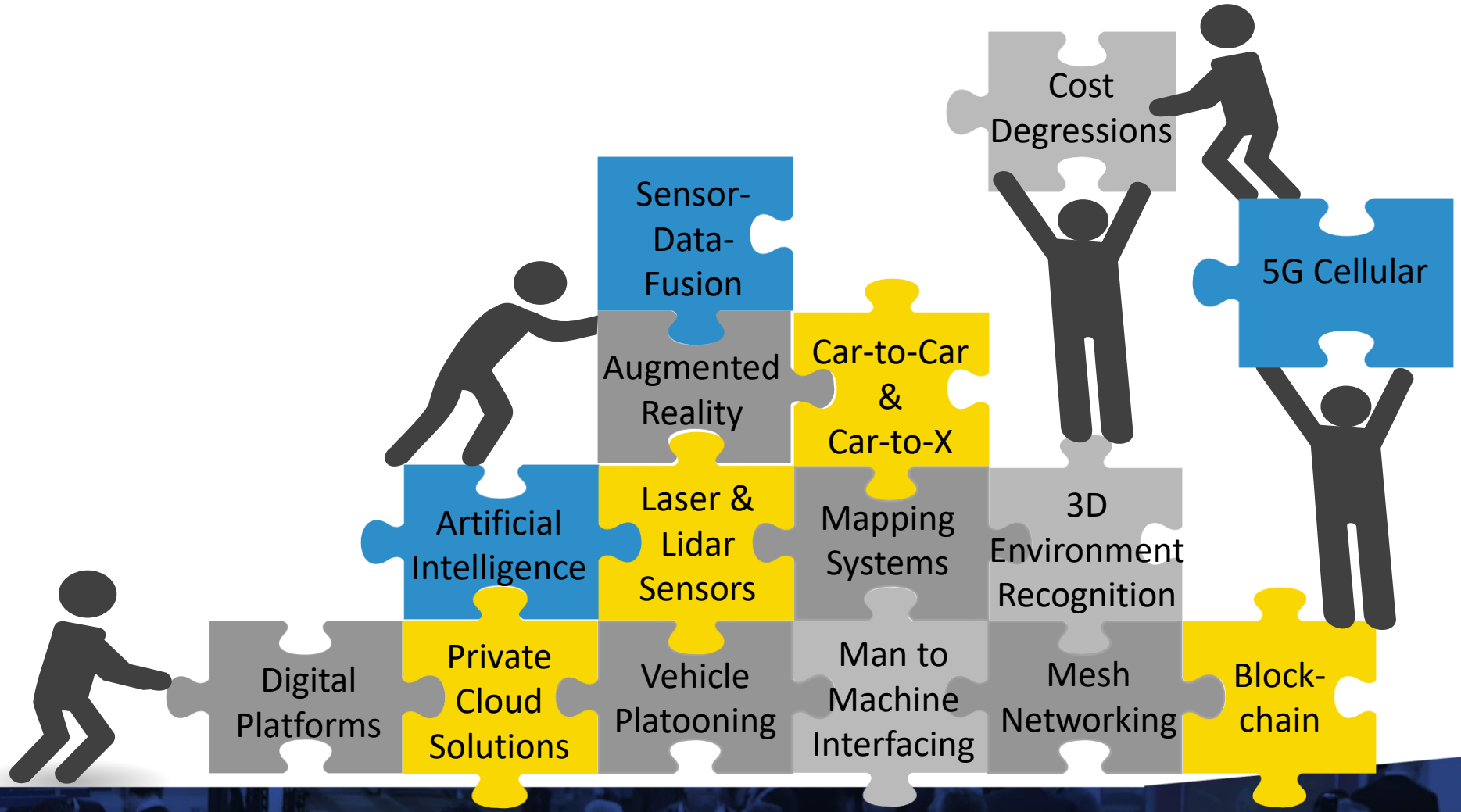
New value chains are emerging

New legislative frameworks need to be developed

New technologies enable innovative products and solutions



Impacts on New Product Solutions for the Material Handling Industry



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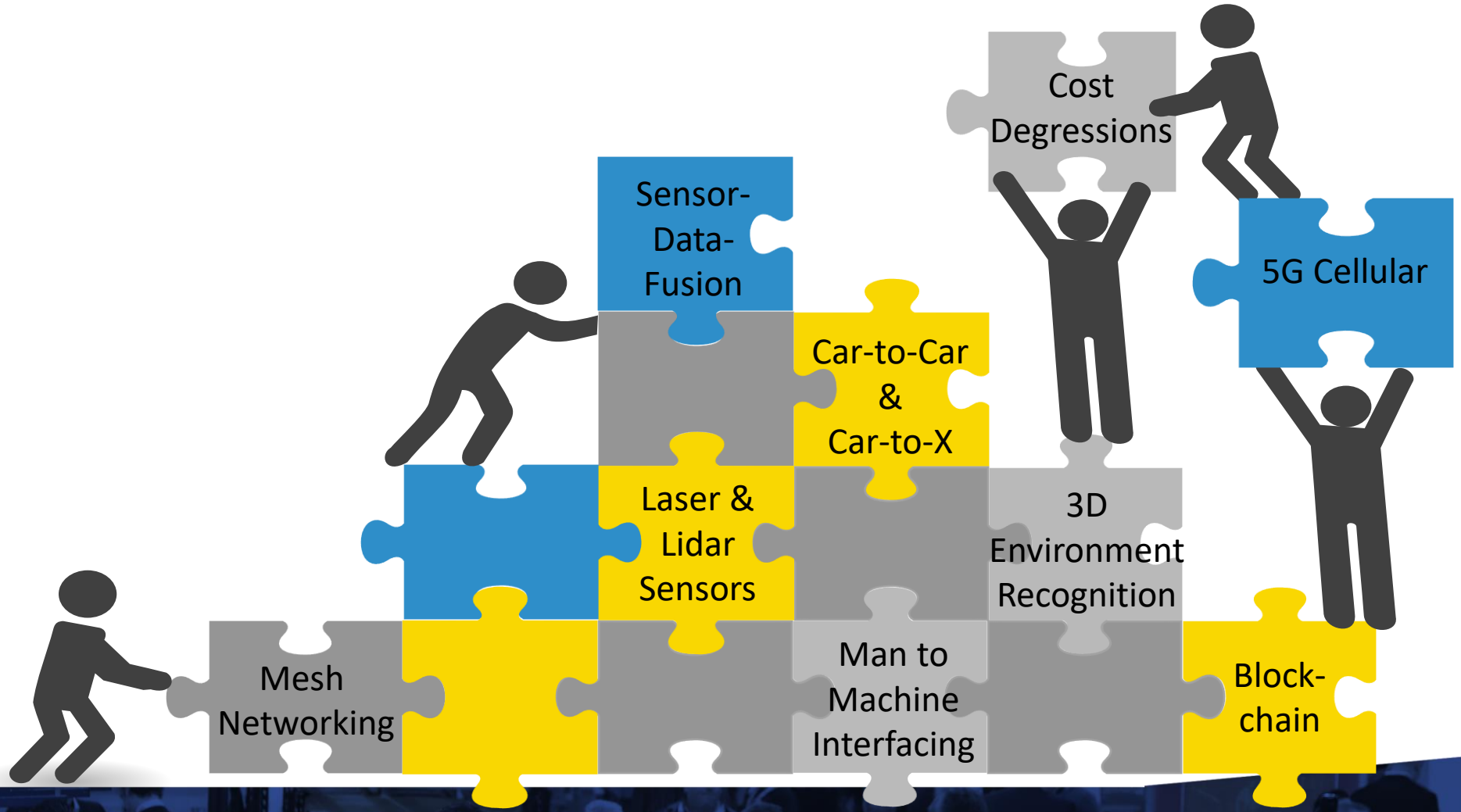
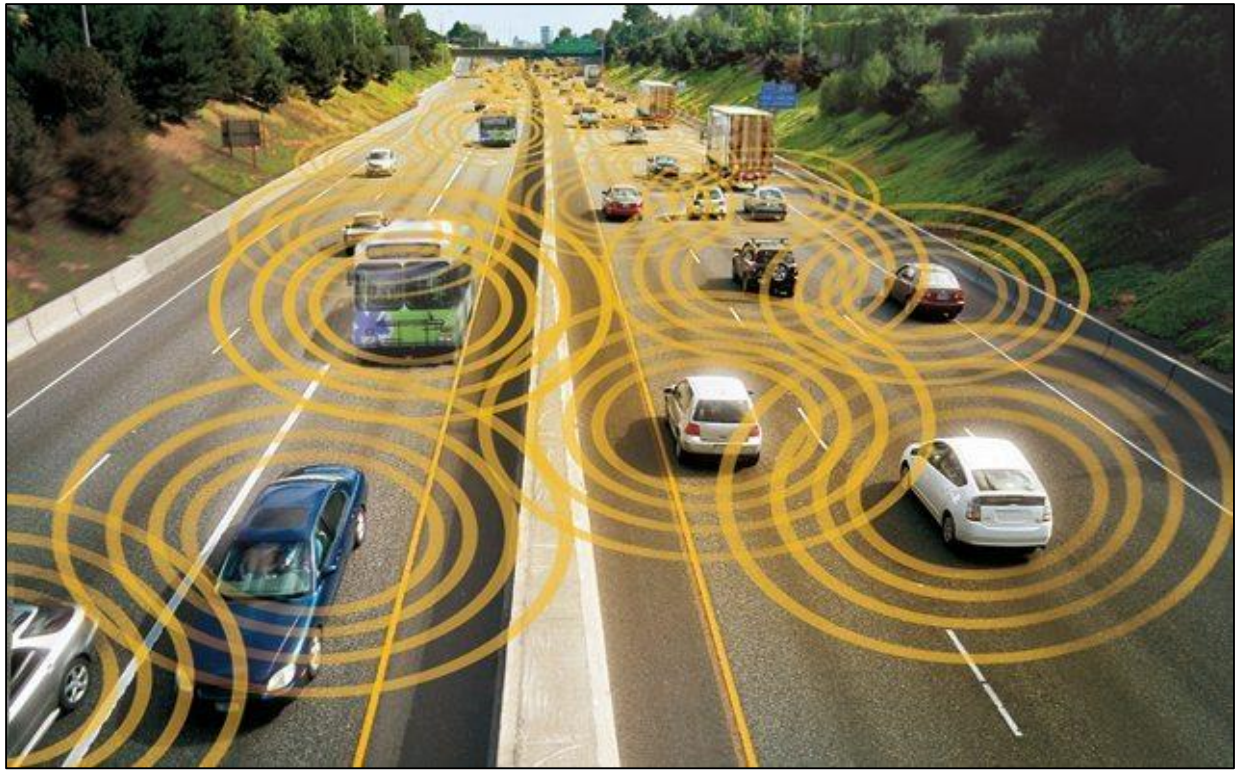


Trends on the Road to Autonomous Driving

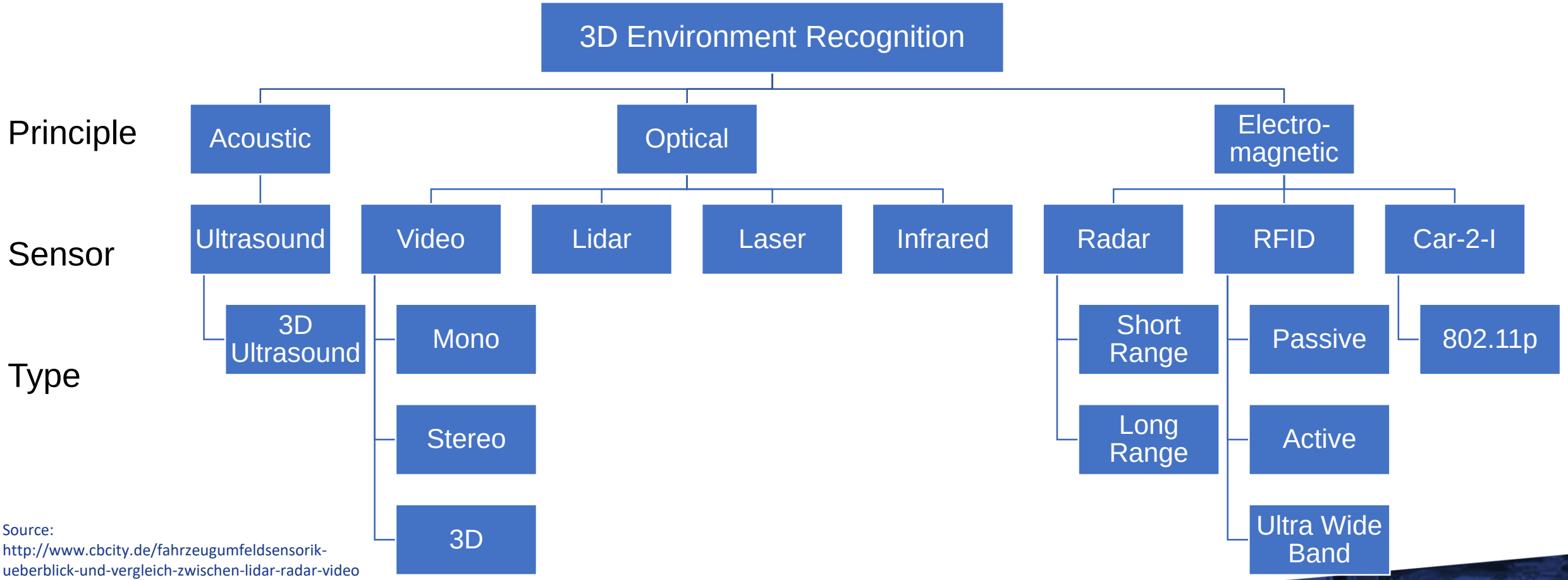
1. Enhancement of today‘s sensor-based applications
2. Improvement of man-to-machine interfaces
3. Increased use of car-to-car communication
4. Increased use of car-to-infrastructure integration/ communication

“cooperative” comm. systems



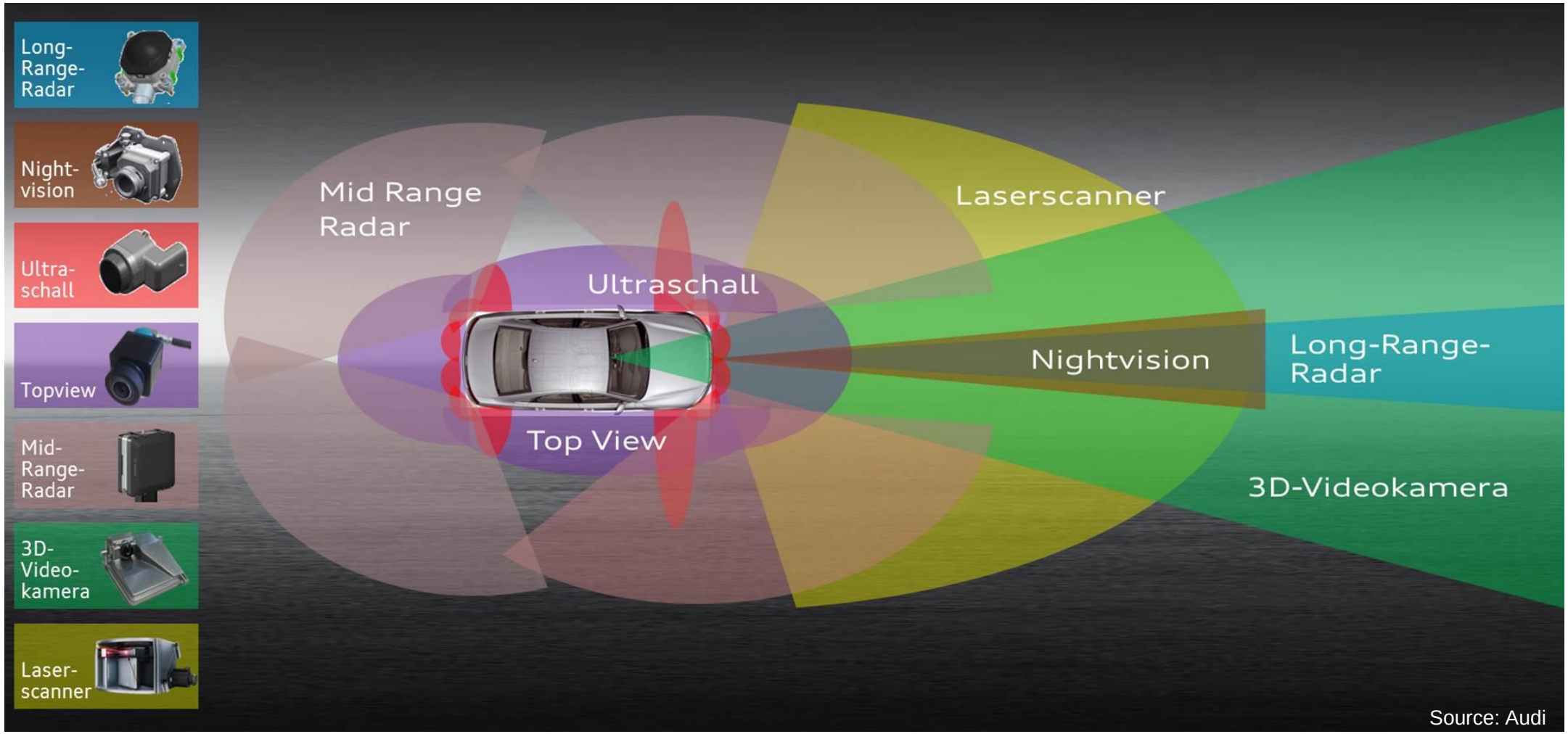
1. Enhancement of Today‘s Sensor-Based Applications

Via sensor-data fusion!



Source:
http://www.cbcity.de/fahrzeugumfeldsensorik-ueberblick-und-vergleich-zwischen-lidar-radar-video

Sensor-Data Fusion Facilitates 3D 360° Environment Recognition



2. Even More Important: Improvements in Man-to-Machine Interfaces

What can we learn from digitization?

Why?

- Distractions from assistance systems must be minimized
- Concentration needs to remain with the actual driving process
- Handling and warnings must influence drivers only minimally

Solutions:

- Use of touch-sensitive screens
- Engineering of highly intuitive visual, acoustic, and haptic (touch-based) feedback mechanisms
- Integration of mobile devices
- As simple as an analog car radio

3. & 4. Cooperative Communication Systems

High Importance in Product Development for Material Handling

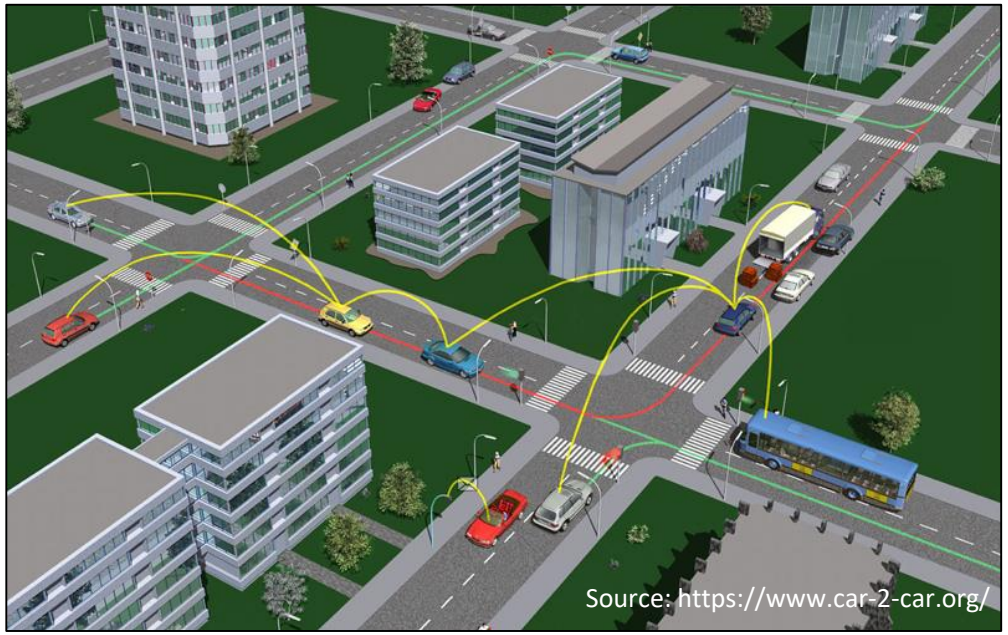
- Systems that enable vehicles to communicate with each other in real time

Positioning Solutions

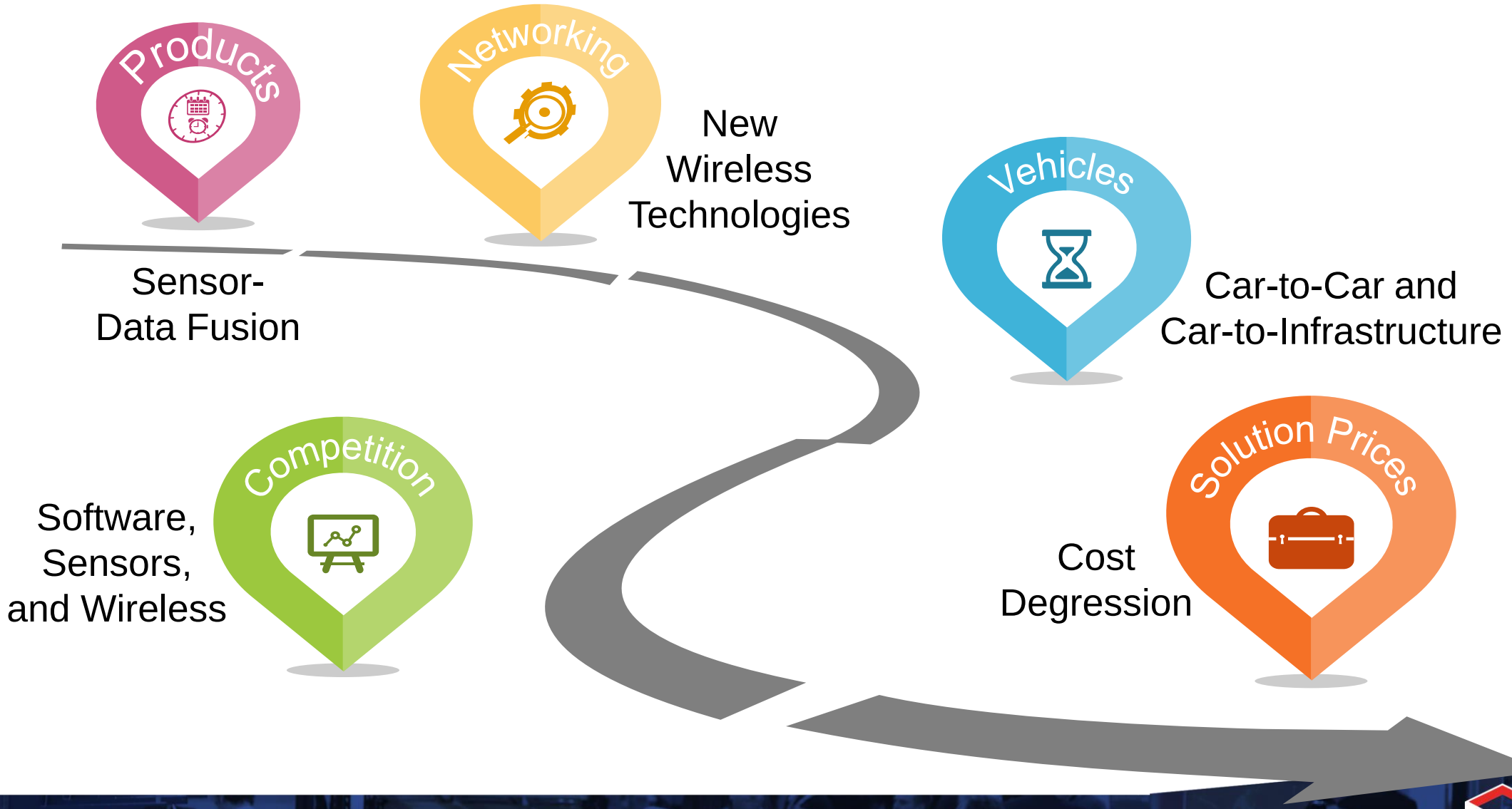
- Car-to-X, Car-to-Car
- Cooperative detection vs. autonomous or way detection

Example

- An “intersection assistant” identifies vehicles on a collision course: Locations determined via GPS; vehicles share in real time, SW algorithm prevents collision



Implications for Products in Material Handling



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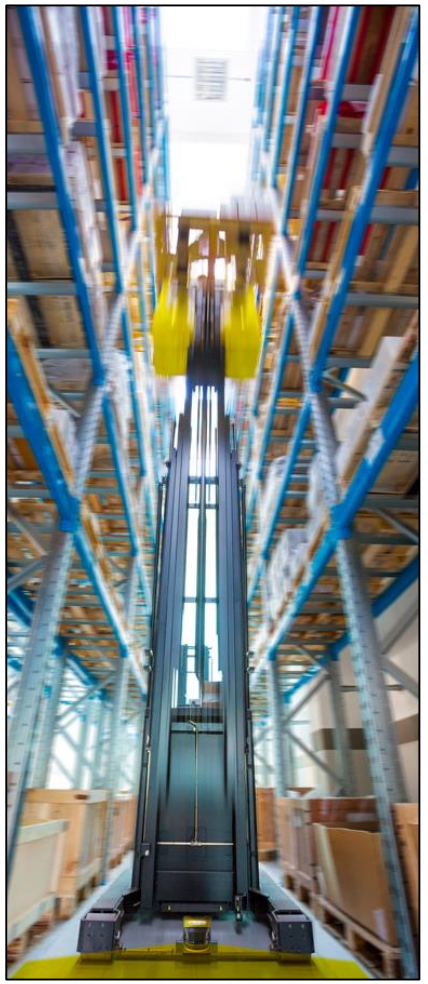
Engineering Warning Systems for VNA-Trucks

Objectives: cost reduction; integration of new technologies

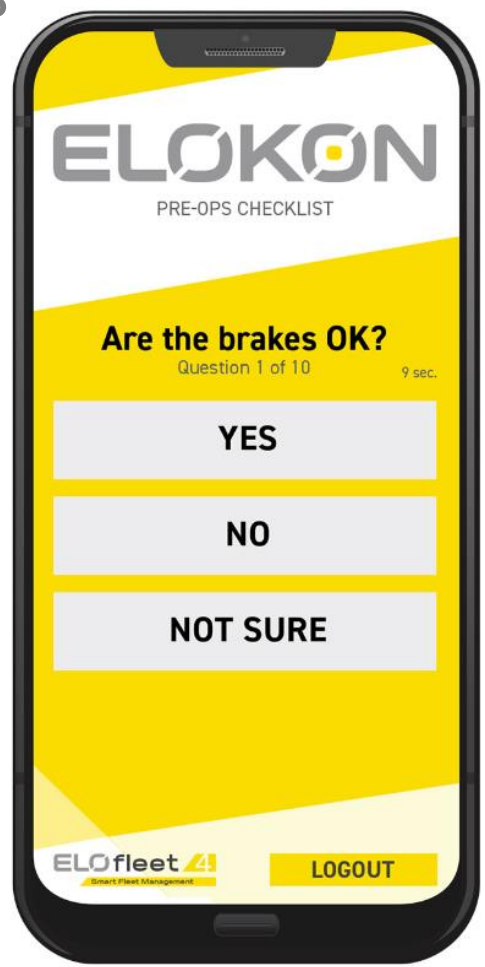
- Status quo: Lidar solutions used today as collision warning/ safety solutions in VNA environments
- At same time, RFID used for navigation
- Future: cooperative warning system
  - Trucks exchange communication data in real time
  - RFID collects location data
  - Data fusion occurs within software application on trucks
  - Result: real-time collision avoidance evaluation/warning on trucks
- Also possible TODAY, thanks to new site license-free wireless communication standards



Engineering of 3rd-Gen Fleet Management System

Objectives: New functions; improved man/machine interfaces

- Implement fleet management as an APP, using off-the-shelf mobile devices
- Provide private or public cloud platforms
- Enable predictive collision warning through redundant use of multiple sensor technologies (Integrate fleet management with proximity detection systems)
- Implement impact sensor as a MEMS chip to reduce size and number of system components
- Take advantage of car-to-car communication technology
- Integrate fleet management on WMS terminals
- Migrate solutions toward encompassing AGVs / AMRs



Research Project: Safety-Rated Mobile Picking Robot

- Implement a predictive, redundant solution: warn[illegible] collisions between picking robots & floor [illegible]
- 3D 360° environment recognition [illegible] fusion
- Automatic intention[illegible] dynamic envi[illegible] [illegible]itive, [illegible]obstacle avoidance
- Autonomous s[illegible] [illegible]out use of infrastructure
- Added values
  - Higher picking rates of robots
  - Greater employee and site safety

All possible?

Intelligent High-Visibility Safety Vest as a Smart Wearable

High-Visibility Safety Vest is Part of an Ultra Wideband Collision Warning System

- Actively monitors worker‘s safety in real time and provides emergency alerts
- Proximity detection system integrated in high-visibility vest
- Functions
  - Wi-Fi location
  - Alcohol sensor
  - “Charge or wear” alarm
  - Falling down sensor
  - Name tag & speaker to personalize vest
  - Inductive charging

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Added Value for Assistance Systems due to Digitization & Autonomous Driving in Material Handling

- Much improved employee and site safety, and significantly reduced workplace accidents
- Much smaller vehicle fleets, higher productivity and optimized route guidance
- Promotion of new products and applications
  - Picking robots as safety systems
  - Fully automatic “dark stores”
- Much improved and faster productivity recordings
  - For products and services with live data
  - For long-term resource planning

Key Takeaways for the Future of Driver Assistance Systems in Material Handling

Key Takeaways

1. Technology trends are usable one-to-one
2. Digitization & autonomous driving bolster the adoption of driver assistance systems in MHI
3. The future: computers on wheels
4. Software, sensors, and wireless technology will provide competitive advantages
5. We are witnessing disruptive change = major opportunities for new products!

Thank You!

Speaker: Alexander.Glasmacher@elokon.com

Website: www.elokon.com

Visit us at MODEX Booth 2929

Mr. Glasmacher at MODEX 2018, accepting MHI Innovation Award for best innovation of an existing product