ECEN 5053-002

Developing the Industrial Internet of Things

Week 13 - Lecture

Deep Dive: Automotive, Transportation

Dave Sluiter - Spring 2018

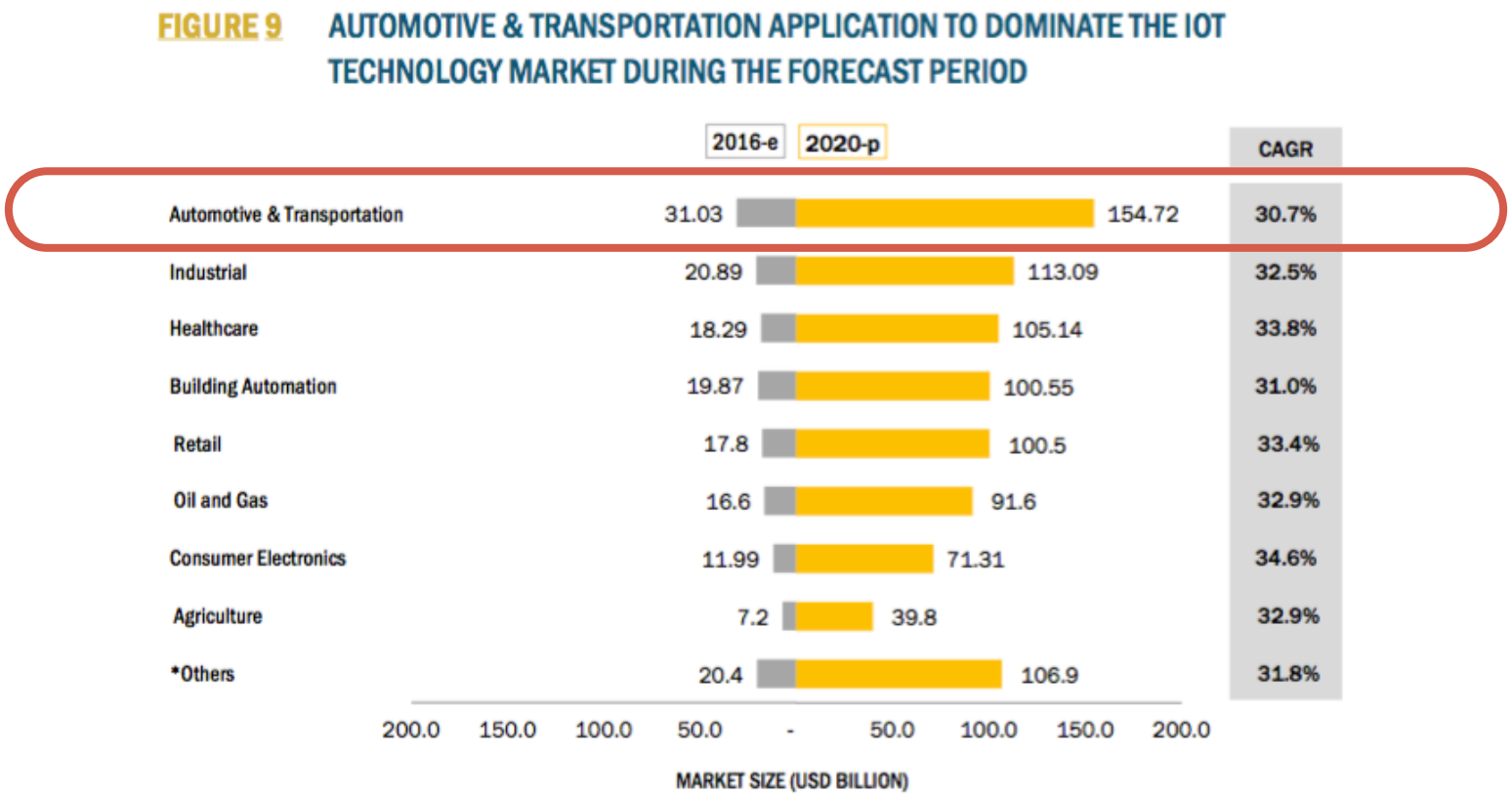
Material:

- Take a look at the **Automotive** and **Transportation** market
  - Cars
  - Trucking
  - Logistics
  - Trains (Rail)
  - Planes
  - Shipping (Container Ships)
  - Smart roads, traffic control systems
  - Smart parking

Learning Outcomes

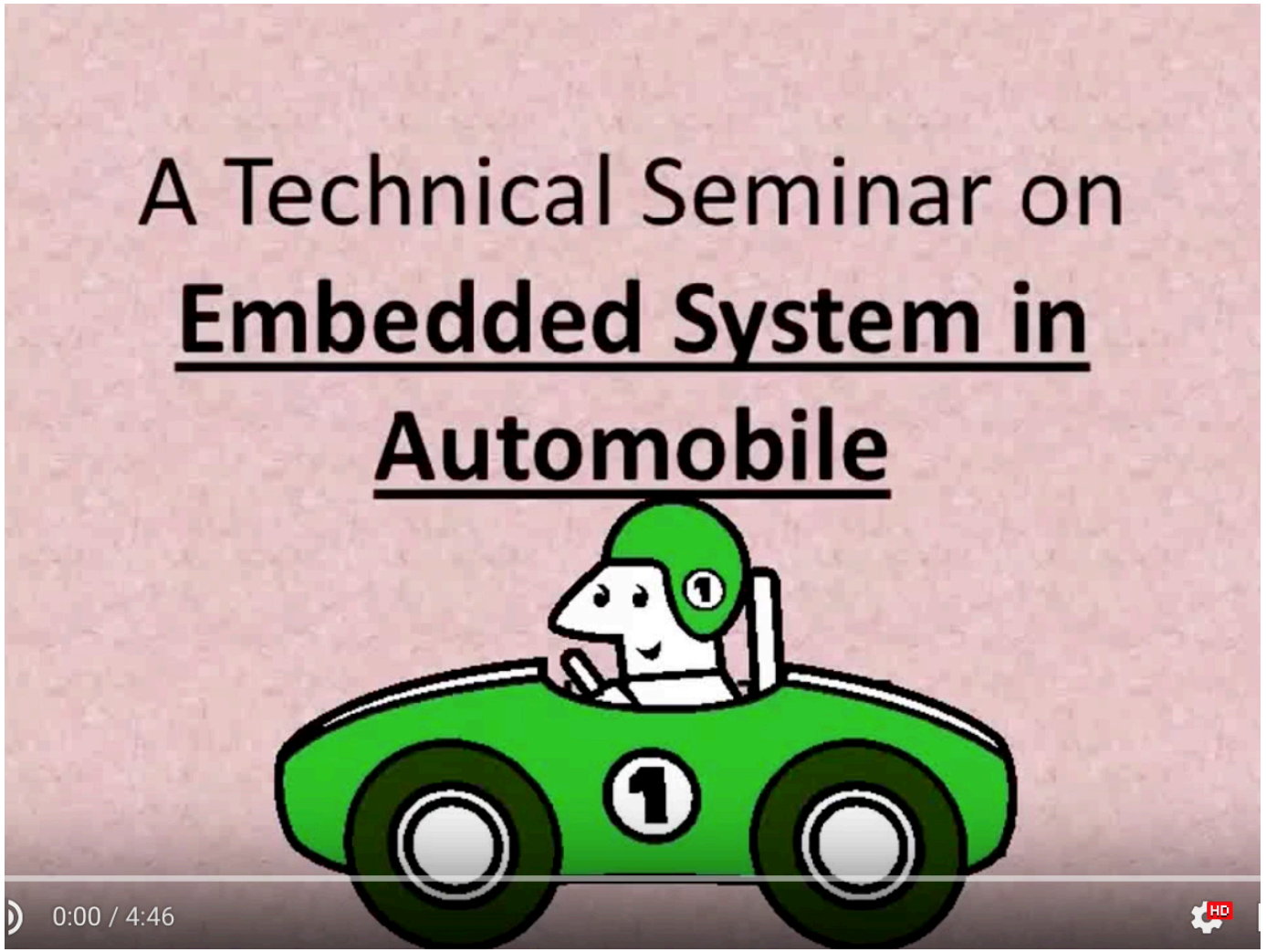
- Understand that enormous engineering opportunities exist
- Grasp how your ESE skills can be deployed in the Automotive and Transportation segment

Automotive and Transportation



Cars

Todays Cars



Source, Toyota: https://www.youtube.com/watch?v=XvGxw-Ou1js

Todays Cars - List of Embedded Systems

- Focus on safety
- Adaptive cruise control
- Car-to-car communication

Future Cars, 2020 Prediction

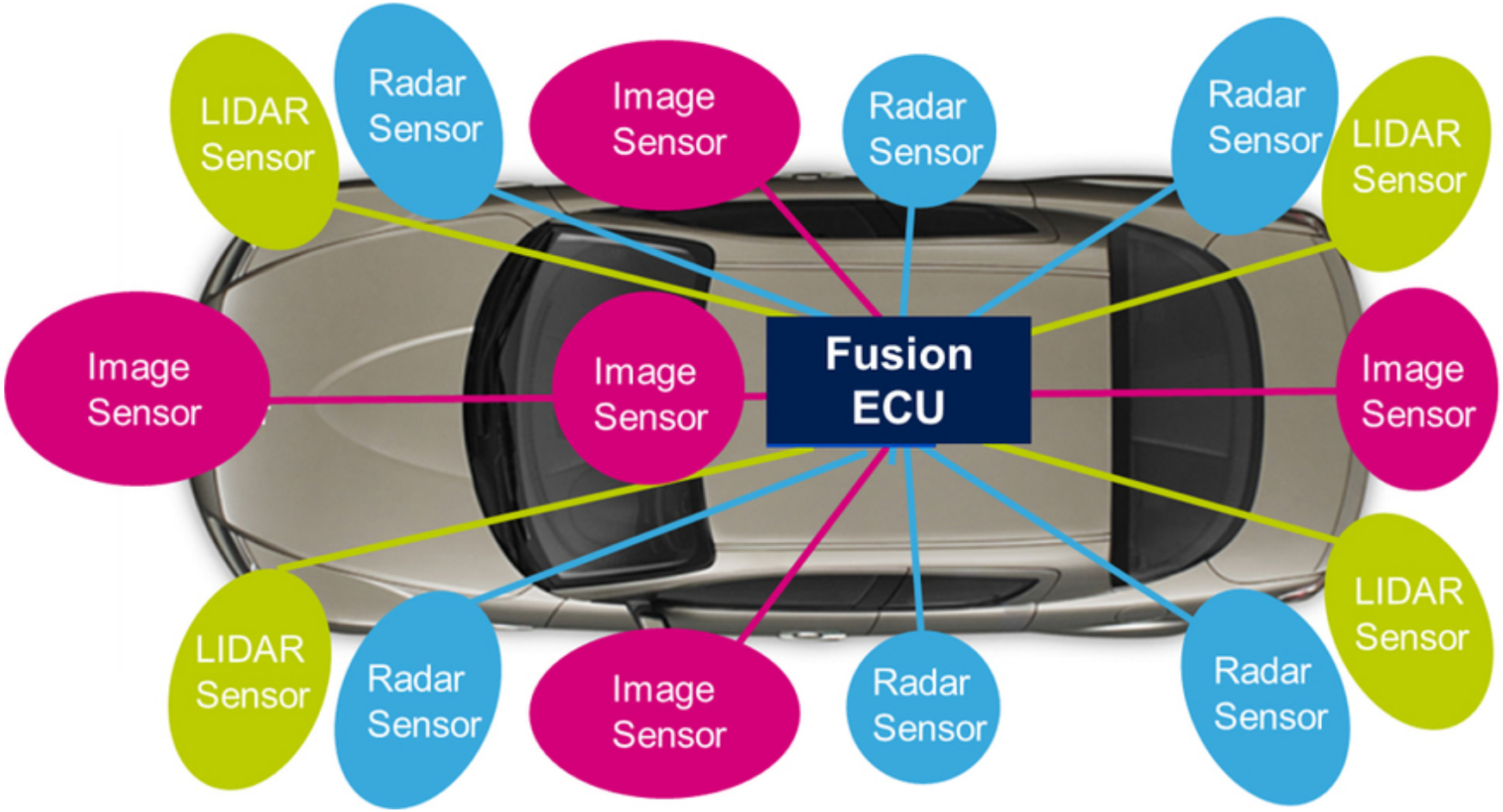
Source: https://www.youtube.com/watch?v=L4GvAGbkdu8

Levels of Autonomous Vehicle Driving

- Level 0: Human controls everything
- Level 1: Assisted driving, cruise control, adaptive cruise control
- Level 2: Partial automation, driver must monitor vehicle at all times. At least 1 system is fully automated: cruise control and lane centering
- Level 3: Conditional automation. Driver monitors vehicle at all times. Safety critical systems under certain conditions are shifted to the vehicle
- Level 4: High automation. No monitoring of vehicle by the driver. However not all driving scenarios are covered.
- Level 5: Full automation. Operator free driving.

Source: https://www.sensorsmag.com/components/three-sensor-types-drive-autonomous-vehicles also see PDF

Fully Autonomous Vehicle Sensors



- Radar to replace ultrasonic

LIDAR = Light Detection and Ranging

Trucking

Trucking - Michelin Tires

Historical Business Model

Manufacture and sell tires

Inexpensive sensors enabled added services

Embedded sensors

Manufacture and sell tires + offer feedback on tire wear, driving habits to reduce fuel usage

The entire business model shifted to a **service**[2]

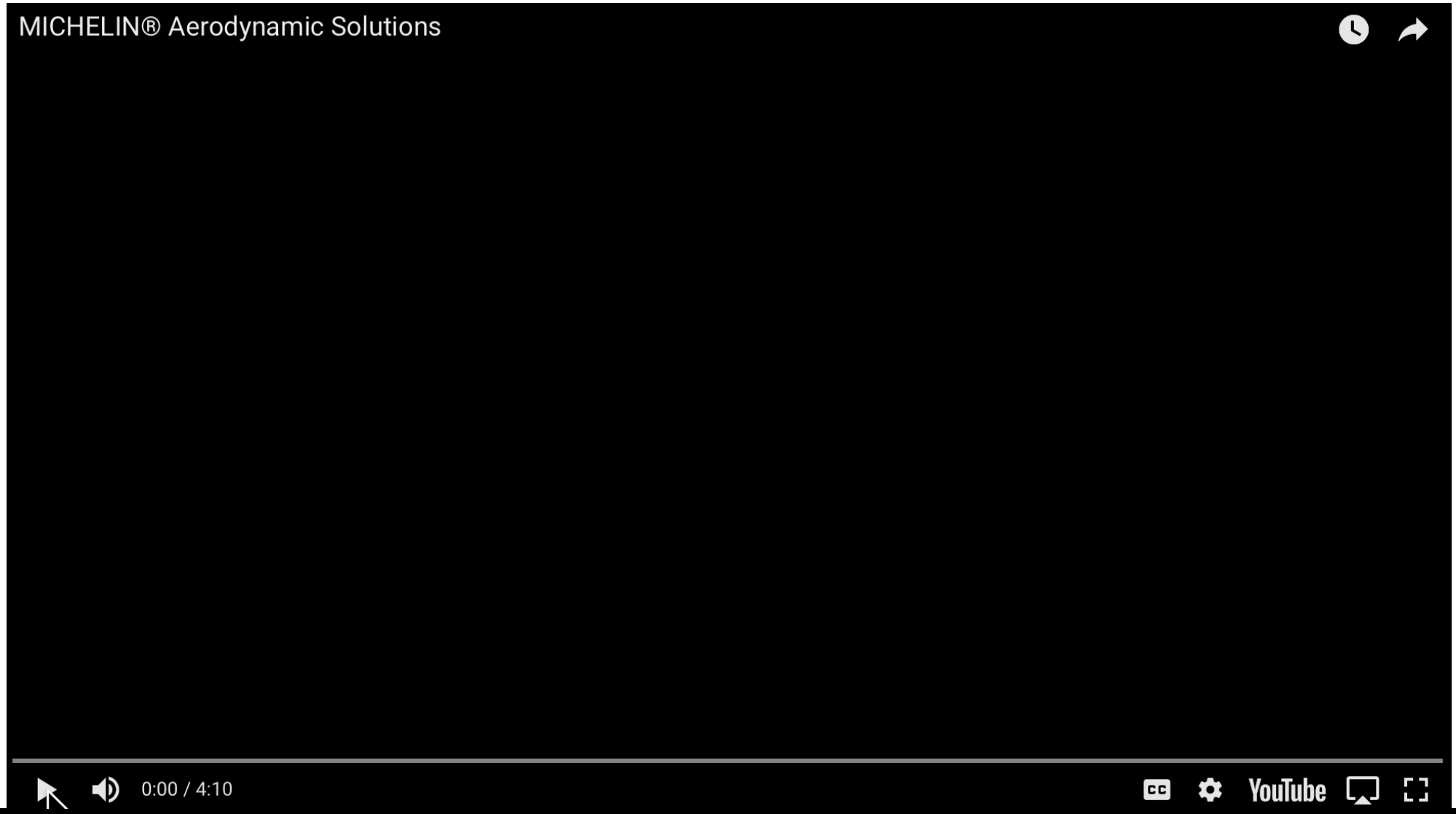
Offer tires as a service:
- Customers don't have to hold inventory => lowers their costs
- Offer feedback on tire wear, driving habits

time

See: https://rctom.hbs.org/submission/michelin-tires-as-a-service/ + PDF

2 - Michelin Advantage Program: https://www.michelintruck.com/services-and-programs/

Michelin Tires - New Products and Services



Weigh in Motion Market (CBInsights)

- Includes sensors and controller, software and services, Application (axle counting, weight enforcement, and weight-based toll collection
  - Kapsch TrafficCom (Austria)
  - Q-Free (Norway)
  - International Road Dynamics (Canada)
  - Kistler (Switzerland)
  - SWARCO (Austria)
  - FLIR Systems (US)
  - TE Connectivity (Switzerland)
  - Siemens (Germany)
  - Axis Communication (Sweden)
  - Raytheon (US)
  - SICK (Germany)
  - LeddarTech (Canada)
  - Sensys Networks (US)

Logistics

Deloitte

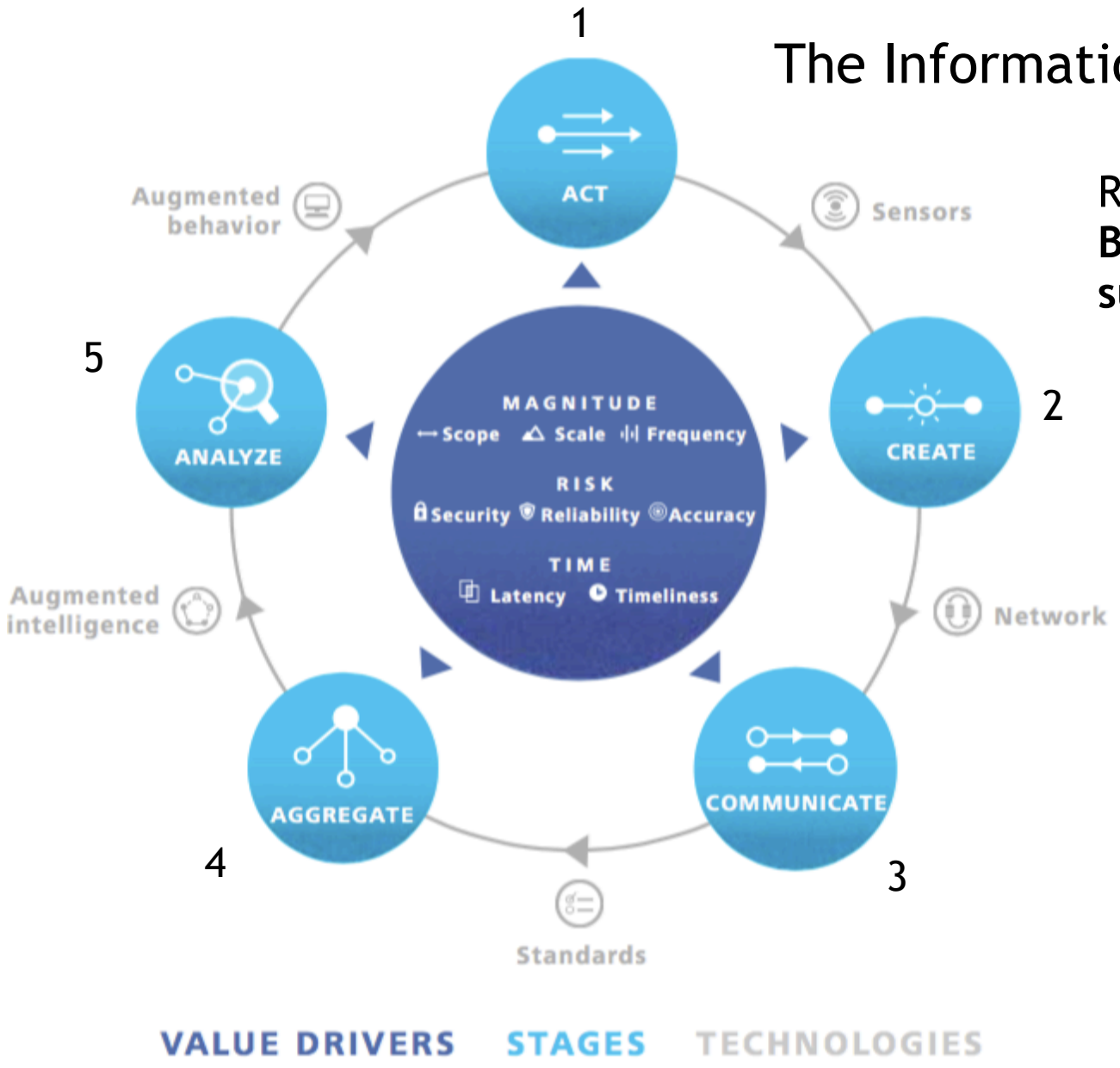
"Deloitte" is the brand under which tens of thousands of dedicated professionals in independent firms throughout the world collaborate to provide audit & assurance, consulting, risk and financial advisory, risk management, tax, and related services to select clients.

- Many business sectors are struggling with how to adapt to data-driven business operations. However, the transportation and logistics sectors are way ahead.
- These businesses were quick to see the benefits of new sensor and connection technologies
- Important: Define what business problems IIoT might solve
- Envisioning how IIoT creates value
- Understanding the information value loop leads to understanding:
  - Where to play and how to win

Source: https://www2.deloitte.com/tr/en/pages/technology-media-and-telecommunications/articles/internet-of-things-iot-in-shipping-industry.html
See PDF

Deloitte

The Information Value Loop



Remember the notion of:
Be the most valuable supplier of information

DHL and Cisco

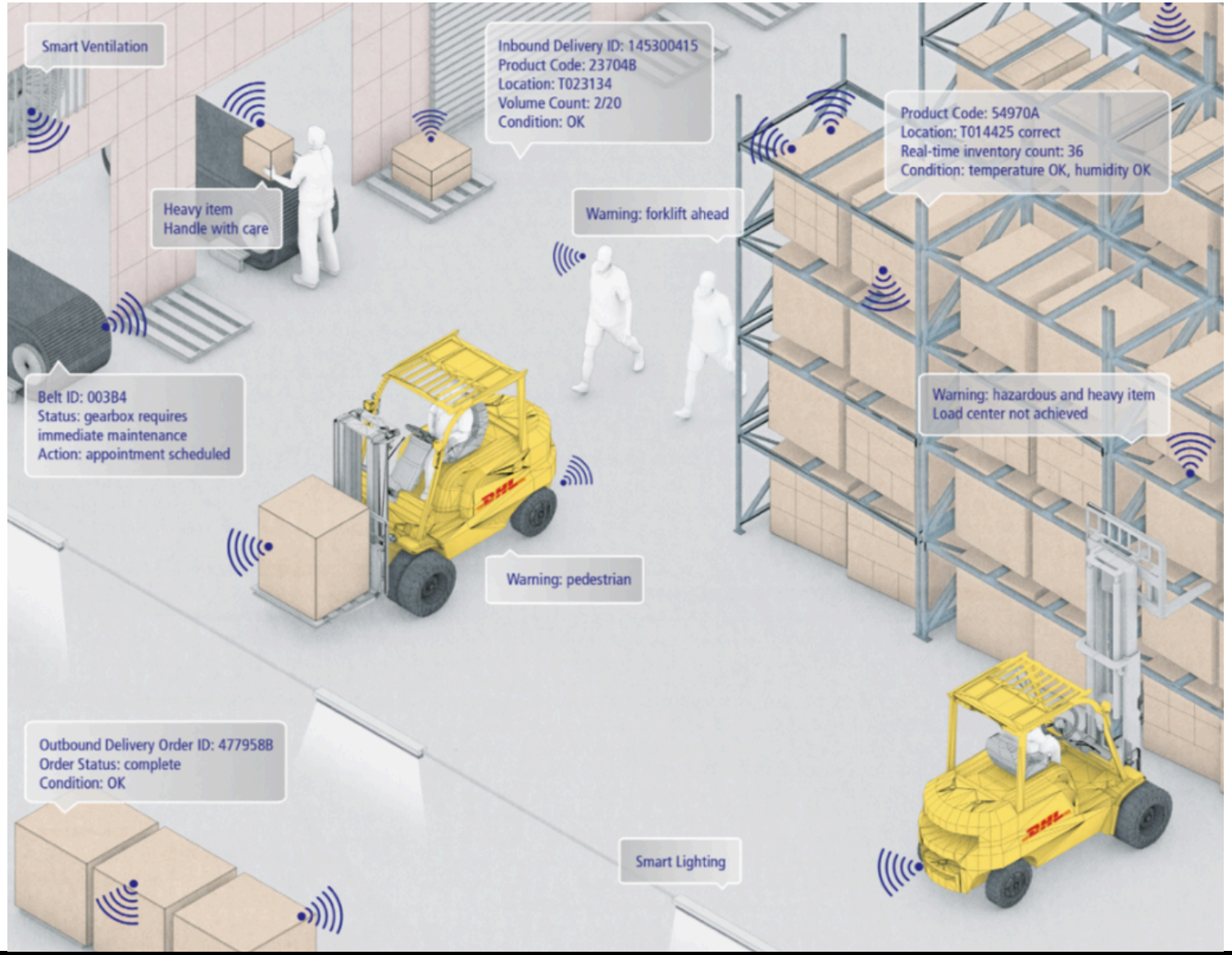
- Estimate $19 trillion in “value stake”
- Value stake is new profits created as a result of IIoT from markets that could not have existed before
- Smart parking is the “Killer App” for cities
- Parking generates revenue, and is a source of friction
  - Complaints from citizens
- The paper continues with:
  - Operational efficiency gains
  - Safety
  - Customer experience
  - New business models

Source: http://www.dhl.com/en/about_us/logistics_insights/dhl_trend_research/internet_of_things.html#.WhHJGLaZPUI
See PDF

DHL and Cisco

Smart Parking

DHL and Cisco



Warehouse application

Trains

Trains

- By updating legacy systems to IIoT and Big Data enabled train management systems
- Operators will be able to better utilize equipment (operational efficiencies), improve safety, reduce OpEx
- GE heavily involved
- Union Pacific, detecting wheel bearing failures and wheel cracks before they occur to prevent derailments
- Lots of data being generated
  - 1 New-generation train car produces ~1PB annual

Source: https://industrial-iot.com/2017/07/iiot-transformation-railways/
https://www.progressiverailroading.com/rail_industry_trends/article/The-Internet-of-Things-A-world-of-opportunity-for-railroads--47507

Planes

Planes

- The Pratt & Whitney Geared Turbo Fan (GTF) engine previously mentioned in class is demonstrating 10-15% reduction in fuel consumption with significant reductions in engine noise and emissions
- Ramping up the amount of data transmitted realtime. This data is analyzed to adjust how the aircrafts are flown to avoid potential issues before they occur
- Honeywell: “For us, there’s nothing more heavy metal than creating a more comfortable flight for passengers, with less turbulence, fewer delays and better high-speed internet,” said Kristin Slyker, vice president for connected aircraft at Honeywell Aerospace. “We’re using data to avoid bad weather and better prepare pilots, and we’re striving to get rid of maintenance delays with technology that can predict problems before they happen.”
- Airbus
  - “We have manufacturing facilities all around the world, we’ve been using IoT for years, for us its nothing new – it’s just a new spin on the technology — but we’ve been looking at collecting information from sensors from our factories for years.
  - “Airbus is working with IBM’s Watson team to collect more data on its flights and on-ground operations.”

Source: http://aviationweek.com/connected-aerospace/internet-aircraft-things-industry-set-be-transformed
https://internetofbusiness.com/honeywells-iot-aircraft-flight/
https://internetofbusiness.com/iot-helping-airbus-make-planes-better/

Ships

Autonomous Ships

Source: https://www.youtube.com/watch?v=Z5cTxSjjEXI
See also: https://www.youtube.com/watch?v=ZuX5qFdiiI0

Smart Roads

Smart Roads

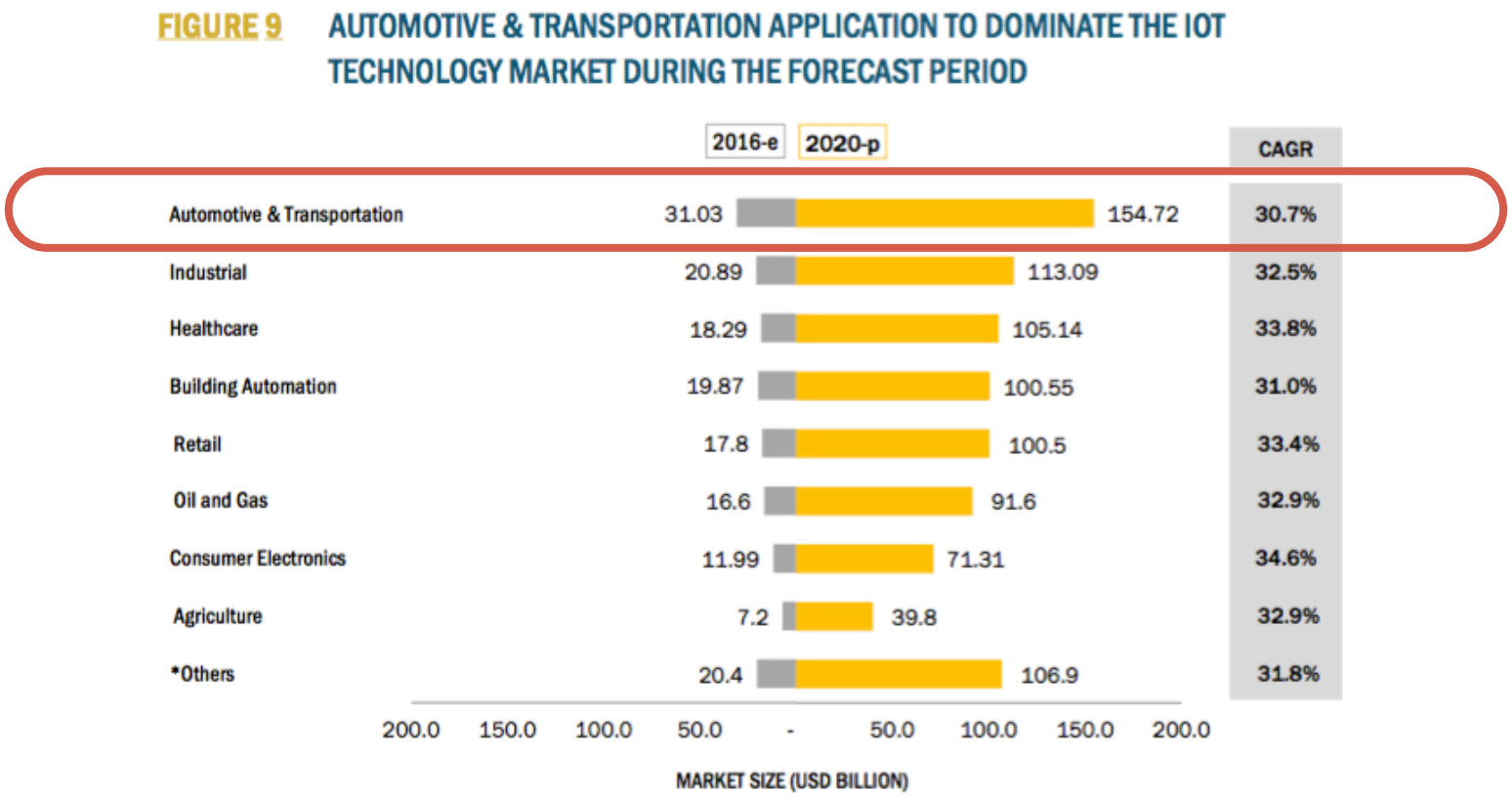
Source: https://www.youtube.com/watch?v=Ge4rG8ER_CU
See also: https://www.youtube.com/watch?v=uwLE3csyDAc (Toyota)
https://www.youtube.com/watch?v=MSs2fL4Usg8 (20 minutes, CDOT, Denver)

Smart Parking

Smart Parking

Source: https://www.youtube.com/watch?v=rXWrpE1Khkk
https://www.youtube.com/watch?v=vWIdSDxCYCI (carousel)
https://www.youtube.com/watch?v=MdIlfZWWSyw (India)
https://www.youtube.com/watch?v=znRPBQc0kRc (Parking availability)

Automotive and Transportation



Summary

- Massive Opportunities
  - Hardware design:
    - Sensor and actuator controllers, gateways and interfaces to corporate enterprise platforms (IBM, AWS, Google, Microsoft)
    - Wireless (or wired)
    - Connected Cars
    - GNSS
  - Software design:
    - Control system algorithms
    - Machine learning and data analytics

End