



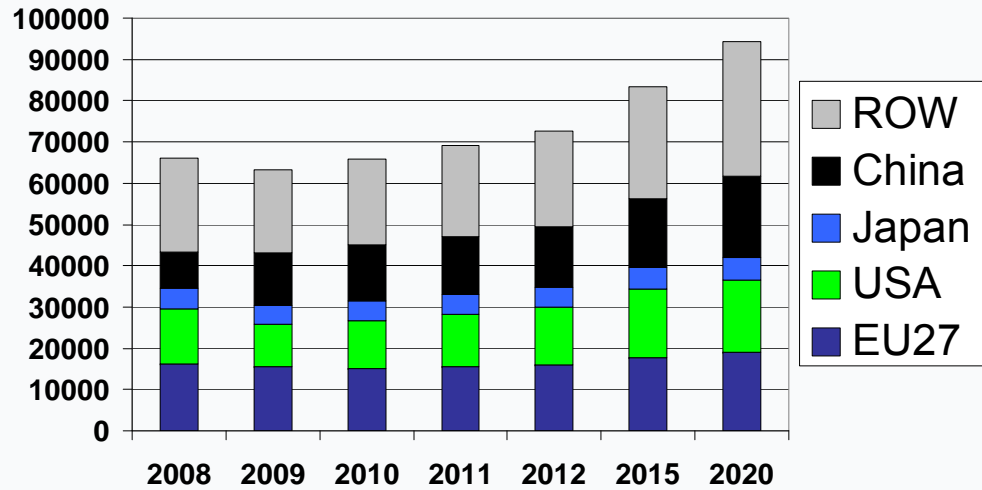
*Is Europe in the driving seat?
The Competitiveness of the European
Automotive Embedded Systems Industry*

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Information Society - JRC-IPTS, Seville*

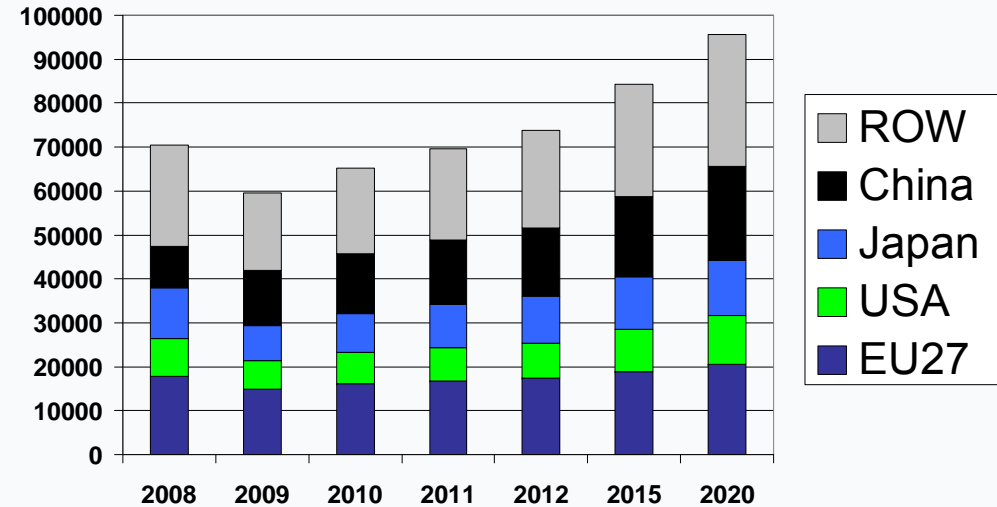
EU Science Journalists Association (EUSJA) visit

- Essential Automotive Market figures
- Drivers of Change in the Automotive Sector
- Zoom on the EU Automotive industry (2007)
- EU Position in ICT in the Automotive Industry
- EU Technology: Strengths and Weaknesses
- Technological Overview of Automotive Embedded Systems
- ICT-based Automotive Trends
- Software defined car evolution
- EU Application Software Competitiveness
- EU Embedded Automotive Software SWOT

Global Car Sales (thou)



Global Car Production (thou)



Auto production & sales growing from 60M range in 2009 to 90M+ in 2020

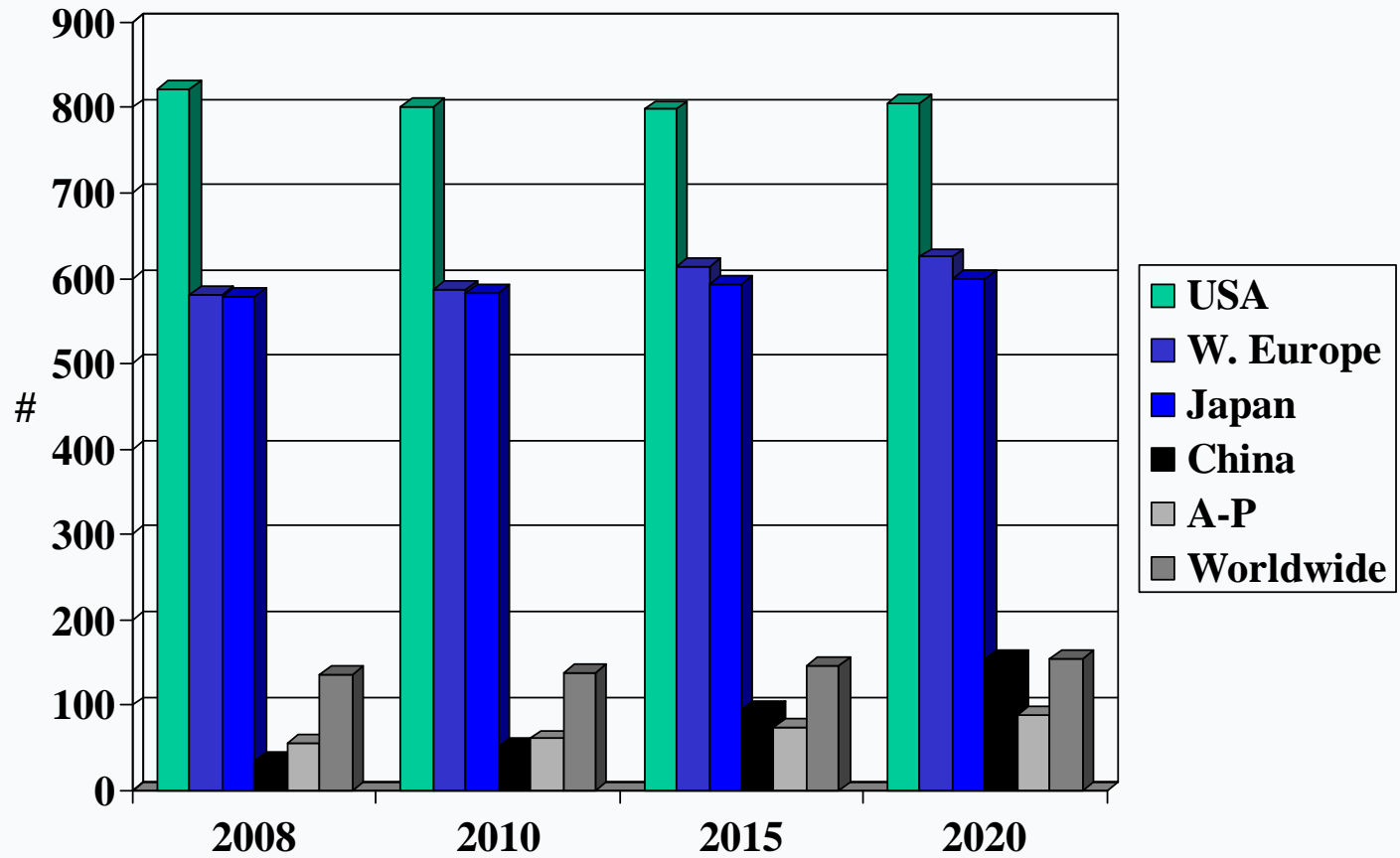
Developed countries are losing market share in auto sales: EU, USA & Japan

China & others developing regions are growing their share

Autos in-use per capita shows that USA/WE/Japan are near saturation with little growth

USA/WE/Japan auto sales are primarily replacing autos that are scrapped

China, ROW(A-P) and other regions are growing auto sales and autos in-use per capita



Lingering overproduction and tough competition - styling, price and features are used to differentiate market segments and sell cars – ICT content is key

- **Most improvements from ICT**
 - **Green Issues:** Lower emissions, Better fuel efficiency

- **New ICT based functions**
 - **Accident Mitigation:** passive system crash protection
 - **Infotainment Expansion:** digital music/TV, mobile

- **New ICT-based systems**
 - **Connected World/Car**
 - **Electric Car Revolution**

	Key Information	Other Information
Employment	<ul style="list-style-type: none"> •Direct jobs: 2.2 million •Total jobs: 12.1 million 	<ul style="list-style-type: none"> •6.5% of manufacturing jobs •6% of all jobs
Revenue	<ul style="list-style-type: none"> •Worldwide: € 551 billion 	<ul style="list-style-type: none"> •ACEA members
R&D investment	<ul style="list-style-type: none"> •Europe: €20 billion •Worldwide: €40 billion 	<ul style="list-style-type: none"> •4% of sales (ACEA members) •7% of sales (ACEA members)
Automotive production	<ul style="list-style-type: none"> •19.7 million vehicles •17.1 million passenger cars 	<ul style="list-style-type: none"> •Cars, vans, trucks, buses •27% of worldwide total
Exports	<ul style="list-style-type: none"> •€42.8 billion net trade 	<ul style="list-style-type: none"> •Leading EU export industry
Vehicle taxes	<ul style="list-style-type: none"> •€381 billion in government revenue 	<ul style="list-style-type: none"> •3.5% of European GDP

Source: ACEA (European Automotive Manufacturers' Association), www.acea.be

	Key Information	Comments
Luxury Auto Position	<ul style="list-style-type: none"> • Luxury cars always ICT • EU has 3 top luxury brands 	<ul style="list-style-type: none"> • Due to initial high ICT price • BMW, Mercedes-Benz and Audi
Strong ICT Suppliers	<ul style="list-style-type: none"> • ICT innovation for luxury brands • Later ICT for volume brands • Non-EU ICT business follows 	<ul style="list-style-type: none"> • Early market entry and leadership • Learning curve and tech advances • From non-EU car manufacturers
Independent Car Suppliers	<ul style="list-style-type: none"> • All key EU suppliers independent • Captive suppliers in USA and Japan 	<ul style="list-style-type: none"> • Strong competition and business savvy • Delphi/Visteon/Denso captive earlier
Key ICT Suppliers	<ul style="list-style-type: none"> • Bosch and Continental are leaders • Autoliv, Hella, Valeo, others 	<ul style="list-style-type: none"> • Across most ICT segments • Leaders in specific ICT segments
Software Companies	<ul style="list-style-type: none"> • Many small, strong companies • Mostly focused on EU ICT 	<ul style="list-style-type: none"> • Focused on specific car manufacturers • Some global success, more is likely
Automotive Semiconductor	<ul style="list-style-type: none"> • Infineon and ST Micro are leaders • NXP and other are strong 	<ul style="list-style-type: none"> • Across many ICT segments • Leaders in specific ICT segments

	Key Information	Other Information
BMW	<ul style="list-style-type: none"> ▶ Leading luxury brand worldwide ▶ Software innovator ▶ Leader in AUTOSAR & Genivi 	<ul style="list-style-type: none"> ▶ USA, Europe and other regions ▶ Crucial to continued EU SW leadership ▶ Understands benefits of SW API
VW	<ul style="list-style-type: none"> ▶ 3rd largest auto producer ▶ Leader in EU, China, other regions ▶ Top EU electronics customer 	<ul style="list-style-type: none"> ▶ Gained share in 2009 recession ▶ Strong presence in most regions ▶ Software, semiconductor & electronics
Other EU Auto OEMs	<ul style="list-style-type: none"> ▶ M-B is another luxury brand leader ▶ M-B: 2nd to BMW in SW innovation ▶ Others are average in SW 	<ul style="list-style-type: none"> ▶ USA, Europe and other regions ▶ Strong in driver assist and ADAS ▶ PSA, Renault & Fiat
Tier 1 Companies	<ul style="list-style-type: none"> ▶ Bosch & Continental: World-class ▶ Many other strong companies ▶ EU has strongest Tier 1 companies 	<ul style="list-style-type: none"> ▶ Multiple segments, Strong in SW ▶ Autoliv, Hella, Magneti, Valeo ▶ EU position, but also other regions
Semi Companies	<ul style="list-style-type: none"> ▶ Infineon & ST Micro: World-class ▶ NXP strong in infotainment 	<ul style="list-style-type: none"> ▶ Across multiple auto segments ▶ Other good companies in automotive
EU Weakness	<ul style="list-style-type: none"> ▶ Too focused on combustion engine ▶ EV: when-question, not if-question ▶ EU can catch-up in EV ▶ Infotainment SW is fair to good 	<ul style="list-style-type: none"> ▶ EU strength, but will fade post 2020 ▶ EU has the most to lose ▶ Requires public-private effort ▶ More infotainment effort needed

Automotive ICT Product: ECU Domain Description

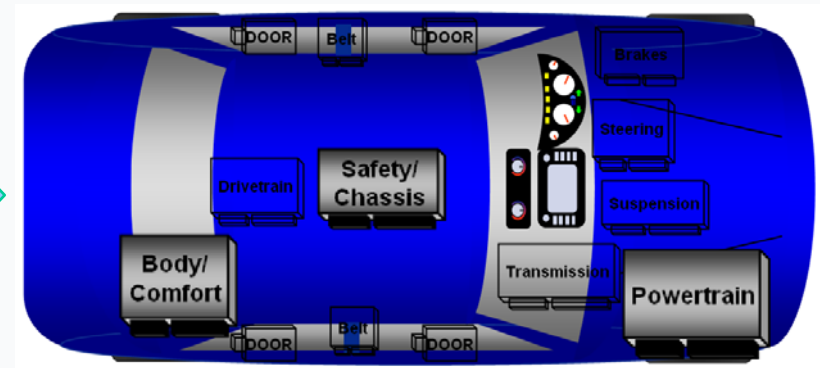
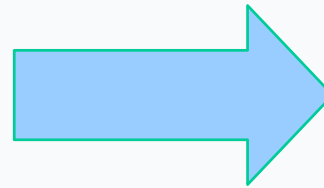
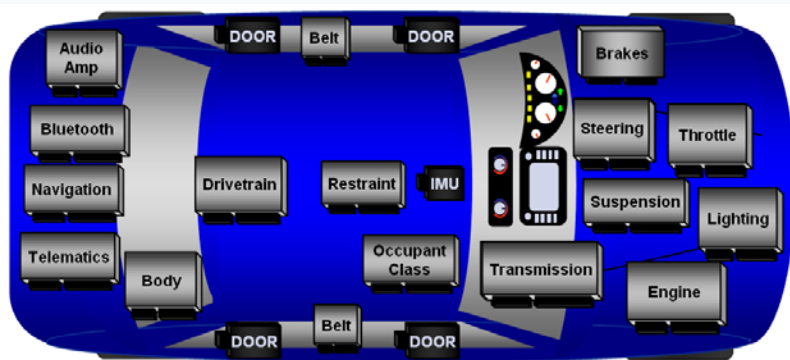
Domain	Key Information	ECU Examples
Powertrain: 5-10 ECUs	Controls the car's power and its distribution to the wheels	<ul style="list-style-type: none"> • Engine control • Transmission control
Chassis: 3-5 ECUs	Controls the functions that guides the car's direction, speed, braking and suspension	<ul style="list-style-type: none"> • Steering control • Brake control • Suspension control
Safety, Driver Assist and ADAS 5-10 ECUs	Controls the car's safety systems. Many new systems are emerging	<ul style="list-style-type: none"> • Air bag control • Seat belt control • Driver assist systems-ADAS
Body and Comfort: 10-30 ECUs	Controls the driver and passengers' convenience and comfort systems. Includes dash board and related controls	<ul style="list-style-type: none"> • Heater and air conditioning • Windows and seat control • Window wipers • Instrument cluster display
Infotainment: 5-7 ECUs	Controls the entertainment and information systems used by driver and passengers	<ul style="list-style-type: none"> • Radio and music systems • Navigation systems • Telematics and mobile phone

ECU HARDWARE OVERVIEW	
Microcomputer (MCU)	Many types, often defined by bit-size 32-bit are most powerful MCUs now On-chip memory for many functions On-chip electronic buses, several types
Memory	Extra memory for complex functions
Electronic buses	Multiple buses: low speed to high speed High-speed use separate control chips
Sensors	Measure pressure, temp, speed etc.
Actuators	Control mechanical devices in car

AUTO SOFTWARE OVERVIEW		
	Core Auto Systems	Infotainment Systems
System Examples	Powertrain Chassis & Body Safety & driver assist	Entertainment (Head-unit) Navigation Telematics
Application Software Examples	ECU control software: Engine management Anti-lock brake system Air bag management	ECU control software: Turn-by-turn navigation Digital music player software eCall activation software
Operating System	Middleware software OS nucleus (kernel)	Middleware software OS nucleus (kernel)
Driver Software Examples	Electronic bus control Pressure sensor driver Fuel injection driver	DVD or disk control software Speech input or output software Display control software
Software Standards	AUTOSAR to be dominant	GENIVI Alliance QNX, Microsoft Auto & others

Transition from high hardware reliance to high software reliance

1. Integration in domain controllers



Copyright: AUTOLIV Inc, 2010

2. Commoditisation and standardisation of automotive software

AUTOSAR Implications		
	Key Information	Other Information
Positive Implications	<ul style="list-style-type: none"> EU companies lead standard effort EU companies lead deployment Standards expand market size EU company opportunities Application opportunity last longest 	<ul style="list-style-type: none"> Multiple upgrades to come EU luxury brands lead Early EU expertise gained OS, driver and applications Applications need innovation
Negative Implications	<ul style="list-style-type: none"> Standards increase competition Standards lead to commodity products Commodity products has low profit 	<ul style="list-style-type: none"> Global expertise, not local Post 2015 for OS and driver Favours low-cost regions

The car is the most complex product in volume production!

ECU domain clusters
Remote SW Upgrades
Software security

SW Defined Car Era
Changeable operation
Graceful degradation

AUTOSAR
Remote Diagnostics
Software APIs

Digital Car Era
Platform architecture
Re-usable software

ECUs

Analog-Digital Car Era
Digital control system growth

Analog Car Era
Analog control systems

Complex SW-based product are eventually linked to a SW management center
• **Cars: not if, but when**



Category	Key Information	Comments
Core Auto Applications	<ul style="list-style-type: none"> ▶ Powertrain: EU leadership ▶ Chassis: EU leadership ▶ Others: Mostly EU leadership 	<ul style="list-style-type: none"> ▶ EU need to lead EV SW ▶ Standards may erode lead ▶ Commoditization is a threat
Infotainment	<ul style="list-style-type: none"> ▶ EU need to improve 	<ul style="list-style-type: none"> ▶ App stores create more risk
Auto Apps Stores	<ul style="list-style-type: none"> ▶ Wide open competition ▶ Potential software upheaval 	<ul style="list-style-type: none"> ▶ Much uncertainty ▶ EU need to invest & innovate
ADAS Software	<ul style="list-style-type: none"> ▶ EU: ADAS & sensor expertise ▶ Software & sensor systems 	<ul style="list-style-type: none"> ▶ Leverage into SW leadership ▶ AUTOSAR or GENIVI platforms?
V2X Software	<ul style="list-style-type: none"> ▶ V2X is software intensive ▶ Layered software architecture ▶ Some from PC & CE software ▶ EU/USA/Jp lead standards ▶ V2X deployment lead needed 	<ul style="list-style-type: none"> ▶ EU need to lead in V2X software ▶ CVIS is defining architecture ▶ EU need to invest more ▶ Coordination with USA & Japan ▶ Regulation would be leadership
Autonomous Driving SW	<ul style="list-style-type: none"> ▶ Mature V2X application ▶ Who will lead these apps? 	<ul style="list-style-type: none"> ▶ Emerging post-2020 ▶ EU need to invest in this field

	Key Information	Other Information
Connected Car Application Software	<ul style="list-style-type: none"> • Many applications emerging • EU is behind in telematics • eCall can be basis for telematics apps • Multiple communication links emerging 	<ul style="list-style-type: none"> • For car, driver and passengers • Link to ECUs become important • eCall is EU chance to catch up • ECU, driver and infotainment links
ADAS Software = Driver error correction	<ul style="list-style-type: none"> • Software intensive systems • Many applications emerging • Builds on driver assist applications • EU has ADAS system and sensor expertise 	<ul style="list-style-type: none"> • Sensor-based systems • Major life and cost saver • Warns or corrects driver errors • Leverage into software leadership
V2V and V2I Software = Communication vehicle-road	<ul style="list-style-type: none"> • Many applications possible • EU's CVIS R&D project is important • More EU development needed • Early EU deployment create expertise 	<ul style="list-style-type: none"> • Safety, traffic and fuel-savings • Public and private cooperation • To complete system architecture • Systems and software experience
Autonomous Driving Software	<ul style="list-style-type: none"> • Builds on ADAS and V2X systems • Progressively more autonomous functions • Compute, sensor and software intensive 	<ul style="list-style-type: none"> • Deployment likely after 2020 • Complex ECUs and software • Large software opportunities

Strengths

- Luxury car leaders: most software is introduced
- AUTOSAR: Standards leadership
- AUTOSAR: Software competency & deployment
- Diesel and gasoline engine software
- Chassis control software (ABS, ESC)
- Safety and driver assist software
- Software and software tool companies
- V2X R&D programmes (CVIS & others)

Weaknesses

- Current EV deployment
- Current EV development
- Infotainment software OS and API standards
- Infotainment application software
- Telematics software and deployment

Opportunities

- EV software advances may make EU leaders at EV system level
- Automotive apps store leadership
- ADAS software and systems and applications
- eCall legislation would allow to catch-up in telematics and connected car applications
- V2X software and systems (regulation needed)
- Autonomous driving (post-2020)

Threats

- AUTOSAR commodity software (post-2015)
- Infotainment commodity software (post-2015)
- EV growth negates powertrain software market leadership (post-2020)

Thank you

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	Key Information	Comments
Powertrain Trends	<ul style="list-style-type: none"> Gas and diesel engine will improve Electric vehicle importance growing EV's electricity from many sources Long-term EV will become leader 	<ul style="list-style-type: none"> Mostly due to electronics advances EV is a when-question, not if-question , engine-generator, hydrogen Is it in 2025 or 2035?
Driver Assist and ADAS Trends	<ul style="list-style-type: none"> Mostly warning systems Mostly for luxury cars Driver error correction emerging Collision mitigation emerging Future integrated systems 	<ul style="list-style-type: none"> Lane, blind spot, speed, parking Ultrasound park assist is exception Stability control and others Improves safety systems effect Based on ICT
Connected Car Trends	<ul style="list-style-type: none"> Multiple communication links Telematics applications and services Connected navigation systems Connected auto control systems 	<ul style="list-style-type: none"> Embedded, driver phone and others eCall, safety and infotainment functions Traffic information and others Remote diagnostics and others
Entertainment Trends	<ul style="list-style-type: none"> Digital radio receivers Digital music player interfaces Internet radio emerging Premium audio systems 	<ul style="list-style-type: none"> Satellite radio in some regions USB, iPod and streaming Bluetooth High bandwidth communication link Surround sound music systems