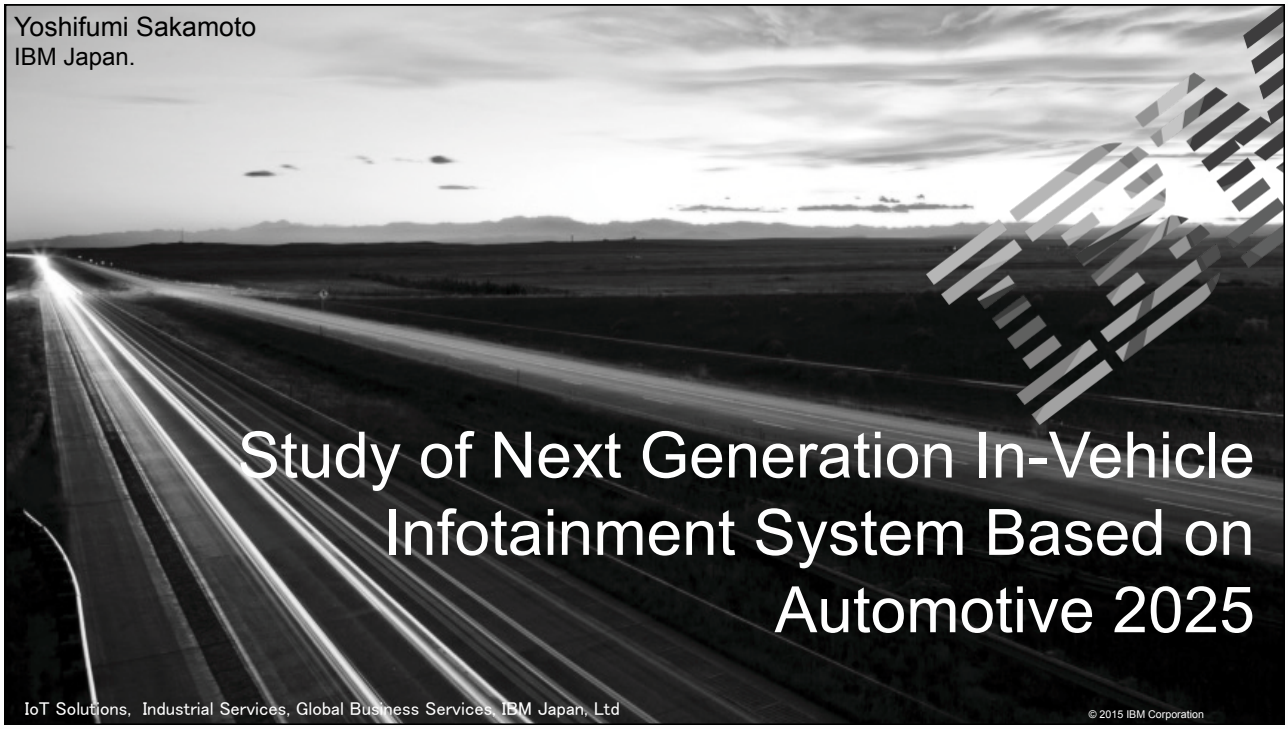
Yoshifumi Sakamoto
IBM Japan.



Study of Next Generation In-Vehicle Infotainment System Based on Automotive 2025

IoT Solutions, Industrial Services, Global Business Services, IBM Japan, Ltd

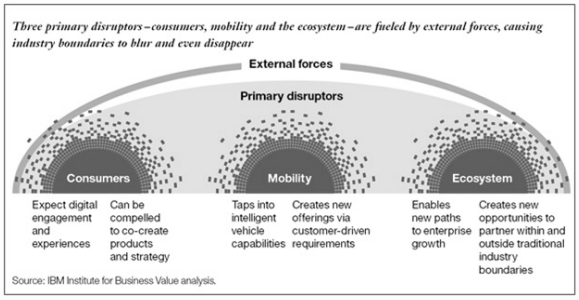
Abstract - Next-generation in-vehicle infotainment system

Showing rapid growth in functionality and performance

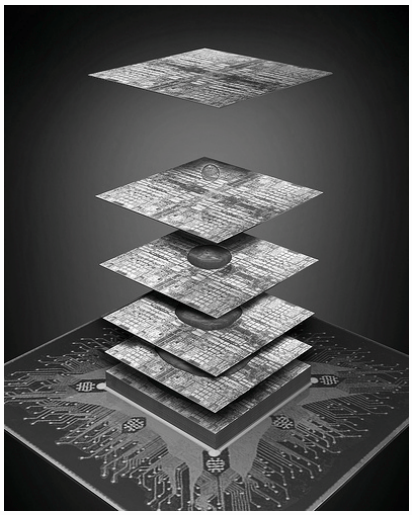
Photo source : JVCKENWOOD Corporation, 2015 International CES, Las Vegas. Digital Cockpit System specially designed for CES in collaboration with McLaren Automotive.

1. Navigation, voice recognition and terminal feature for cloud service providing multi-media
2. Positioning and vehicle information, and front end feature for Big Data that collect and process information from control systems
3. Cognitive and advanced driving support system feature consists of information provided to the driver

IBMs next future thought leadership study- “Automotive 2025”



PREDICTION



The study will focus on examining future macro-economic, consumer/social, ecosystem, and technology trends and the impact executives believe these trends will have on the global automotive industry.

What kind of functional elements required for SoC of next generation IVI system?

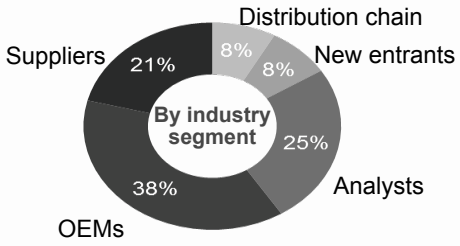
Automotive 2025: Industry without borders

Engage with consumers, embrace mobility, exploit the ecosystem

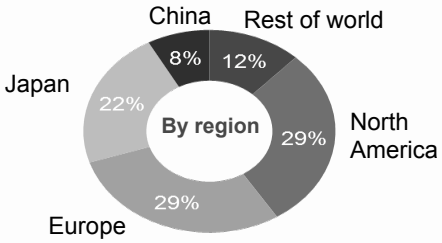
About the study

250+ hours of meaningful discussion about the future of the industry

175 *executives*



21 *countries*

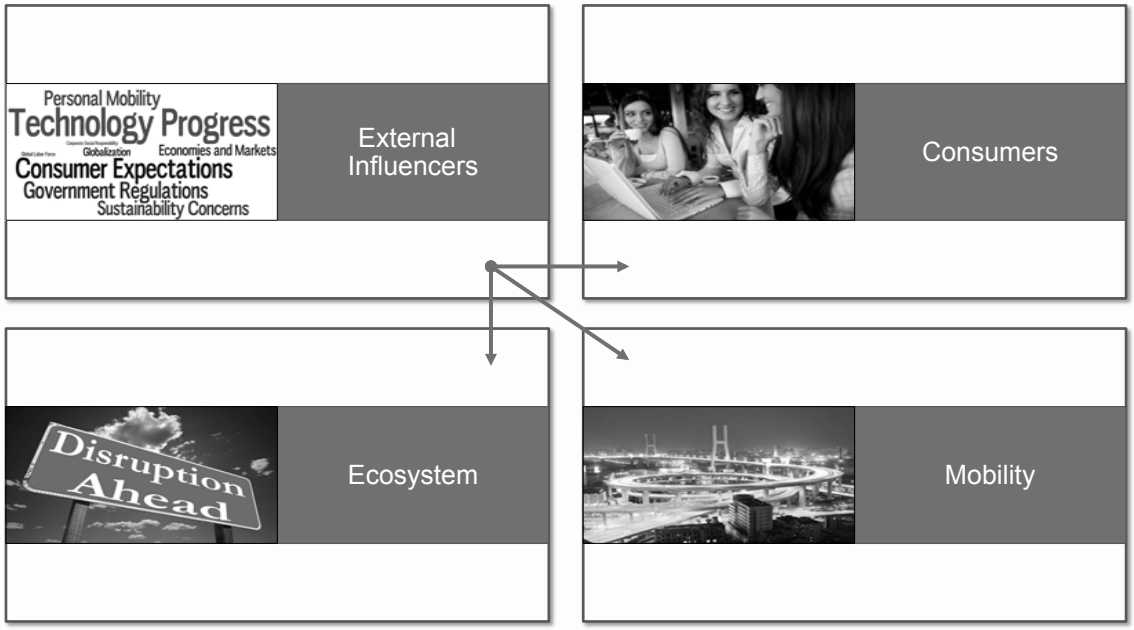


Historically rigid industry boundaries are being shattered by digitally enabled consumers, aggressive innovators to the auto ecosystem and even automotive enterprises themselves as they work to realize the mobility requirements of 2025

73% *of OEM executives rated mobility services as a significant area for co-creation with consumers*

73% *of all executives rated collaboration with other industries as the best opportunity for industry growth as we progress toward 2025*

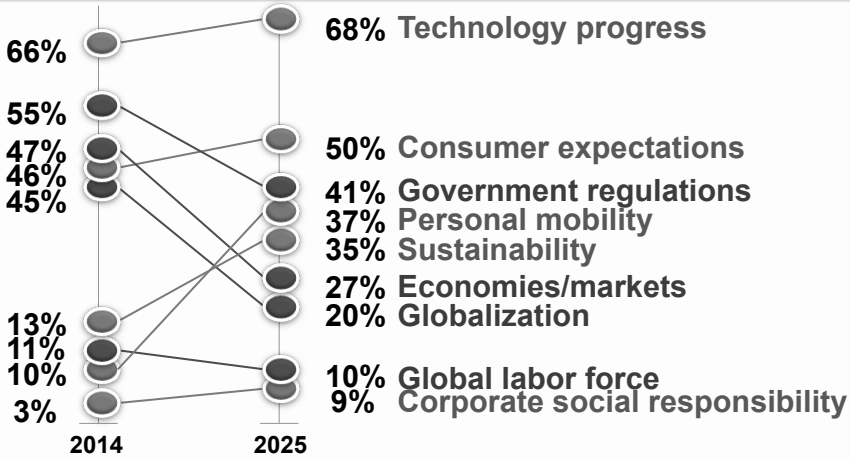
75% *of all executives rated expect non-traditional industry participants to have a key role in the automotive ecosystem by 2025*



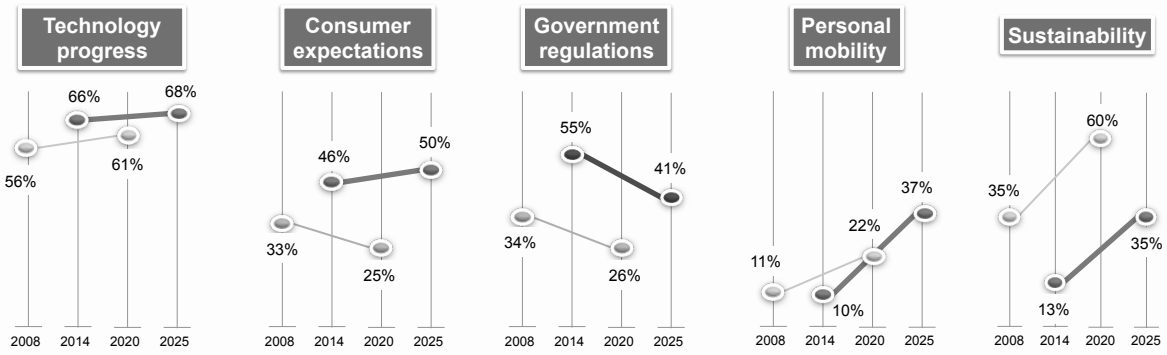
External Influencers

As we progress toward 2025, external forces having a direct impact on consumers will significantly increase, while those more focused on the business will decline

What are the most important external forces that will impact the industry today and in 2025

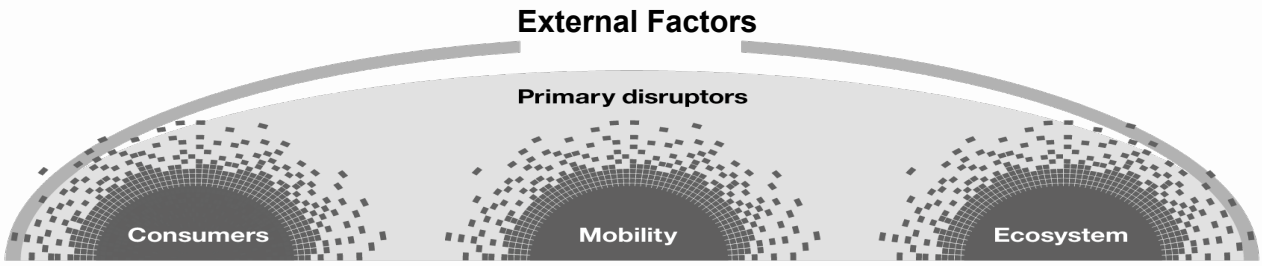


Compared to our Auto 2020 study, technology progress remained at the top while the next 4 showed considerable shifts



Auto 2020 Study: 2008 & 2020 Green – increase
Auto 2025 Study: 2014 & 20255 Blue – decrease

Three primary disruptors are causing industry boundaries to blur and even disappear



Consumers		Mobility		Ecosystem	
Expect digital engagement and experiences	Can be compelled to co-create products and strategy	Taps into intelligent vehicle capabilities	Creates new offerings via consumer-driven requirements	Enables new paths to enterprise growth	Creates new opportunities to collaborate within and outside traditional industry borders

Consumers

The expectations of seamless, omni-channeled, and individualized experiences along with greater desires to contribute to product and services innovation will transform the relationship consumers have with auto companies

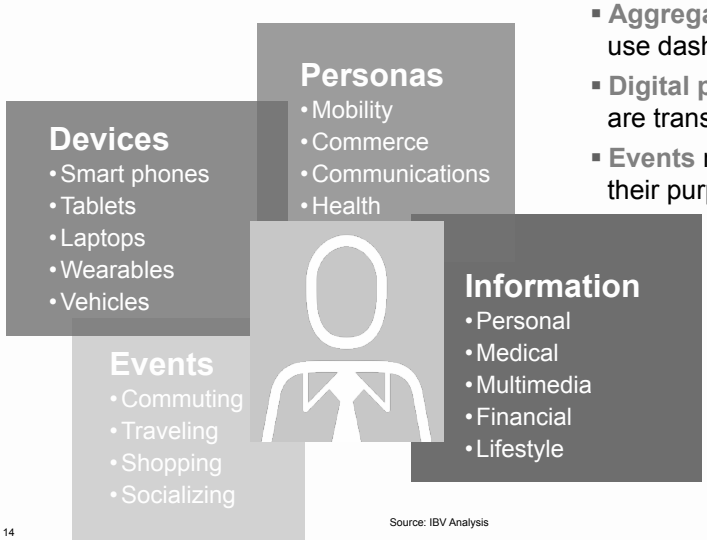
The digital commerce experience consumers expect is being driven by what they already get across other industries

Technology and lifestyle changes are driving new expectations to buy, own and use vehicles

Digital and social technologies compel the crowd to participate more directly in all aspects of the enterprise' business and offerings

The integration of devices, enriched with personal information through personas, to support the digital lifestyle of the sophisticated consumer

- **Integrated devices**, including the vehicle
- **Aggregated information** presented in easy-to-use dashboards
- **Digital personas** with personal preferences that are transferrable between vehicles
- **Events** modify how trips are configured based their purpose



Source: IBV Analysis

But automotive companies do not preform as well as leading industries with their digital relationships with consumers

Digitally empowered consumers

Digitally mature enterprises

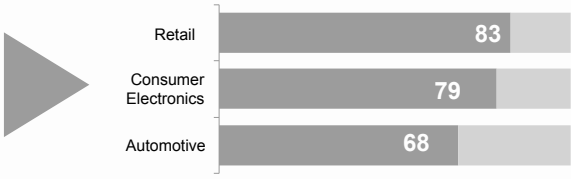
Buying

Digital Relationship
- Seamless
- Personalized
- Relevant
- Intuitive

Using

Owning

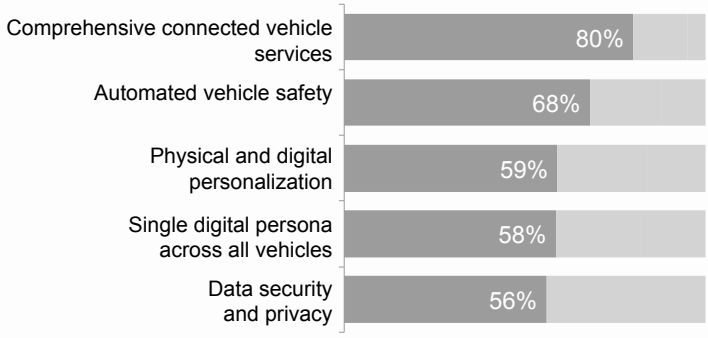
Forrester Research's *Consumer Experience Index*, indicates that Automotive lags digitally mature industries such as Retail and Consumer Electronics in delivering a superior online digital experience



Source: IBV Analysis
Forrester, 2014 Consumer Experience Index, https://www.forrester.com/The+Customer+Experience+Index+2014/quickscan/-/E-RES109081

The expectations of **using** vehicles has transcended beyond only driving to an enhanced experience of connected, automated, personalized and secure

What do you see as key differentiators to consumers in 2025

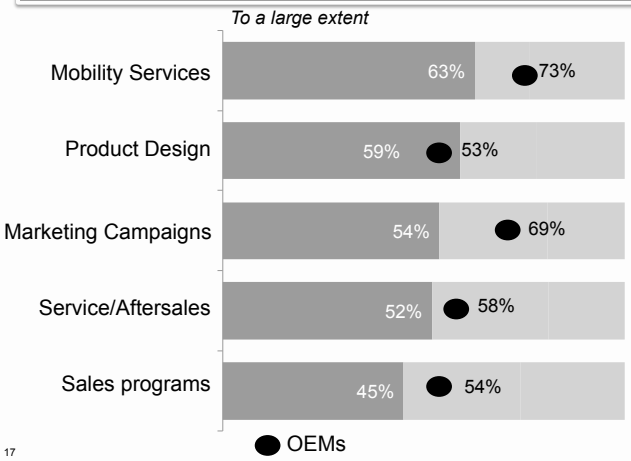


Vehicles will become integrated part of person's life usage of via smart phone and connected car features providing personalized mobility services.

VP, Advanced Engineering, Major European Supplier

Greater expectations of companies for consumers to actively participate in the **co-creation** of new programs, products and services

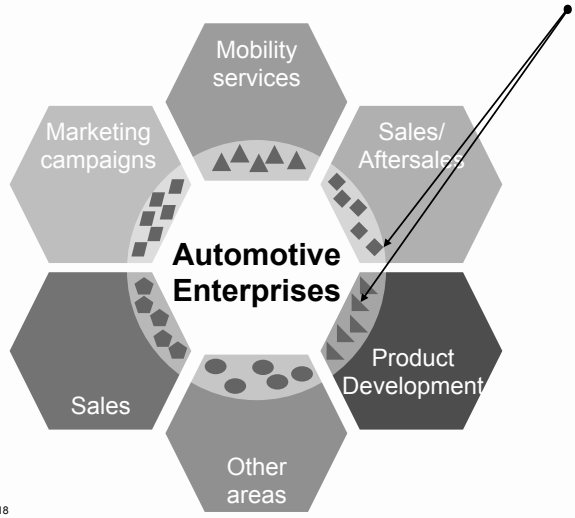
How extensive will your company use co-creation with consumers in the following areas by 2025



Power of the crowd

- Desire of consumers to influence
- The power of many
- Thinking out of the box
- Encourages innovation and new ideas
- Not constrained by corporate culture

Multiple **systems of engagement** will be required to collaborate with the specific crowd needed for a given situation



Systems of engagement must be easy, intuitive and provide a great experience to the consumer

- Engaging and entertaining so that consumers enjoy and are delighted by them
- Mobile and accessible anywhere and at anytime
- Target multiple channels related to the topic
- Act and think in a similar way consumers do and learn from the interactions
- Leverage high volumes of information regardless of the source or format

Consumer Recommendations

Embrace the wisdom of the customer

- Learn from great consumer experiences in other industries
- Listen widely, analyze extensively and engage quickly with consumers when opportunities arise. Target channels that are mobile and accessible anywhere, at any time
- Deliver intuitive, meaningful and consistent digital experiences across all consumer channels

Deliver lifestyle choices

- Envision lifestyle choices and user experiences through journey maps
- Develop new ownership and usage models that meet consumer expectations and create alternative revenue streams Explore similar models in other industries.
- Focus on in-vehicle capabilities that deliver the digital, automated and personalized experience consumers expect

Exploit your crowd

- Collaborate with crowds to uncover new ideas.
- Implement effective “systems of engagement” for the best results.
- Follow up on consumer input and recognize people for their contributions and ideas that are used.

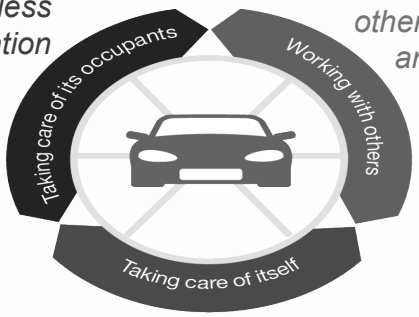
Mobility

Intelligent, intuitive, self-enabling vehicles provide greater personalized experiences through their ability to “take care” of their occupants, themselves and work with others

Self-integrating
Secure, seamless digital integration

Self-socializing
Vehicle social networks to assist others, utilizing the vehicle for ancillary tasks

Self-configuring
Personalization and customization to environment



Self-driving
Automated and autonomous mobility

Self-learning
Cognitively optimizing performance to occupants and environment

Self-healing
Analytics and prognostics for service and maintenance

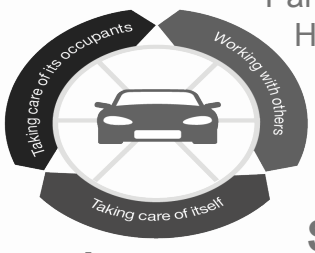
What vehicle innovations will become commonplace by 2025

Cognitive cars will be commonplace by 2025, but self-driving cars will not.

Vehicle digital persona interchange
Within a brand – **78%**
Within an automaker – **62%**
Between automakers – **26%**

Automated
Partially – **84%**
Highly – **55%**
Fully – **19%**

Autonomous
Limited – **38%**
Fully – **8%**

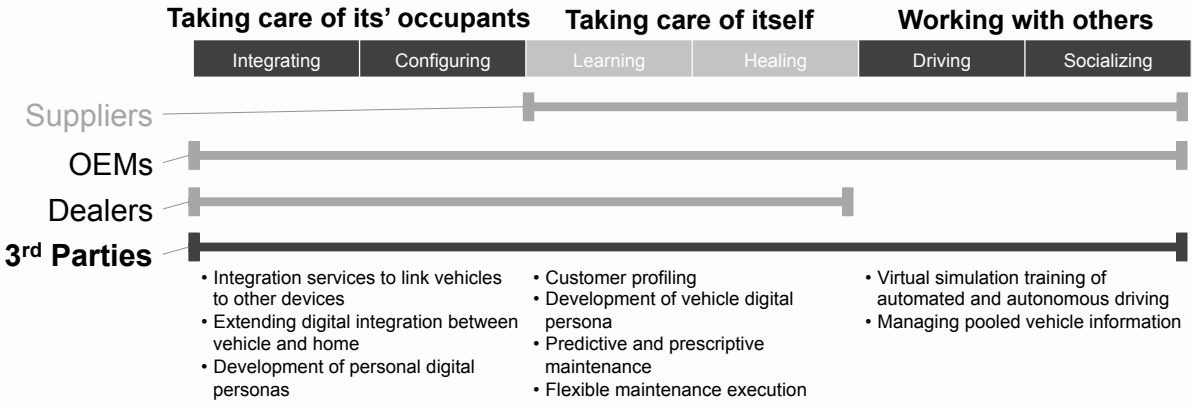


In-vehicle cognitive learning
74%

Social networks for vehicles
57%

There are new opportunities for all industry participants around the integration of intelligent vehicles into consumer's digital lives

75% *of executives rated the inclusion of non-traditional industry participants as the biggest change that will affect the automotive industry by 2025*



- Integration services to link vehicles to other devices
- Extending digital integration between vehicle and home
- Development of personal digital personas

- Customer profiling
- Development of vehicle digital persona
- Predictive and prescriptive maintenance
- Flexible maintenance execution

- Virtual simulation training of automated and autonomous driving
- Managing pooled vehicle information

Only a small portion of the mobility ecosystem is driven by the automotive industry today with the rest driven by the consumer

Partners and competitors will come…

Non-traditional industry participants

…and consumers will choose

Importance of the vehicle brand beyond ownership

Consumer-driven mobility

	Vehicle	Multi-modal	Ancillary
Vehicle Centric	**•Safety/security •Vehicle performance •Vehicle diagnostics •Intelligent driving •EV services**		•Service scheduling •Vehicle tracking
Driver Convenience	•Weather •Smart navigation •Real-time traffic •Parking		•Pay-as-you-go •Automatic toll pay
Occupant Experience	•Digital personas •Location services •Information services •Digital commerce •Concierge •Car renting •Car sharing •Ride sharing •Taxi scheduling	•Intermodal travel solutions •Availability alerts	•Health monitoring •Learning services •Office on wheels •Entertainment •Events •Lifestyle

Auto industry driven | Consumer driven

Personal Mobility Recommendations

Create an integrated, personalized in-vehicle experience

- Assure the vehicle is active in the Internet of Things.
- Leverage mobility personas and event-based personal data access and usage
- Work with others to provide a consistent digital experience regardless of ownership or usage model

Reap value from intelligent vehicles

- Use learning and automating capabilities to reduce complexity of use
- Analyze and use diverse forms of data
- Identify new business model and revenue-generating opportunities intelligent vehicles can enable, especially involving non-traditional industries

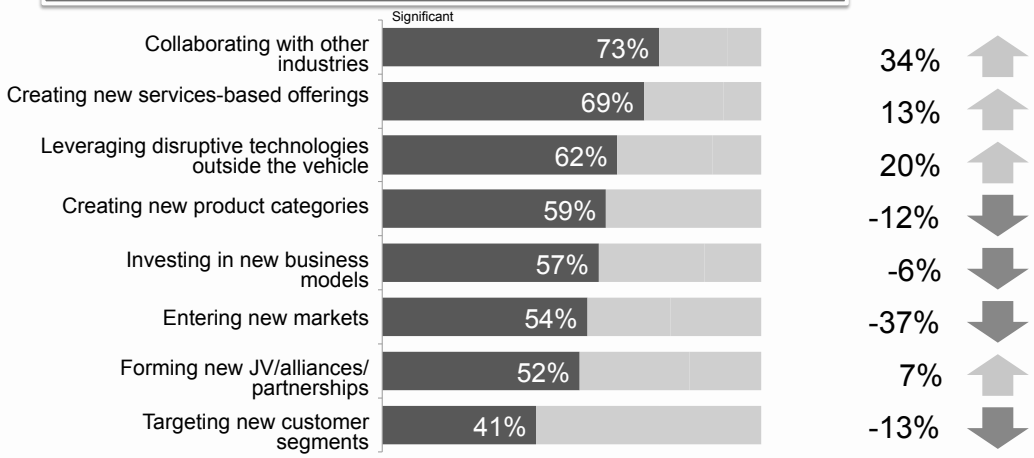
Move from mobility concepts to generating revenue: Stake a claim

- Create a separate mobility entity within your enterprise with the required support and investment to develop mobility strategies, products and services
- Embrace personal mobility services and extend the brand beyond the vehicle
- Recognize non-traditional industry participants and the value they can bring to your mobility solutions

The ecosystem

Multiple strategies will be used to drive growth in the industry, especially those that leverage new technologies and other industries

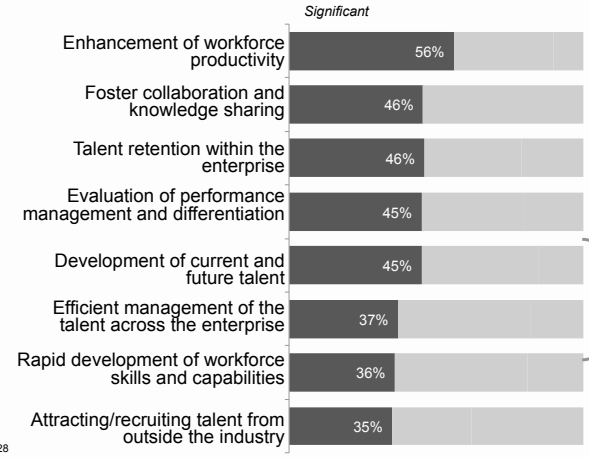
Where do you see the best opportunities for industry growth looking toward the year 2025



Percentage change from Auto 2020

The industry faces serious challenges in their ability to address future workforce needs, especially those that support their growth strategies

Rate the ability of your company to address the following workforce challenges on your path to 2025



"Developing talent the right way is a very challenging activity. We need new HR policies and initiatives to bring in talent from outside the industry."

Director of Mobility, Major Japan OEM

Particularly important for auto companies to improve these as they tie directly to the top growth strategies of working with other industries and leveraging technologies outside the vehicle

Ecosystem recommendations

Partner to disrupt

- Break down traditional barriers, seeking non-traditional partners and disruptive business models for untapped opportunities
- Leverage technologies outside the vehicle to create high-value product and services offerings that enhance mobility and the rest of the consumer experience
- Re-evaluate consumer segments in terms of mobility services versus product categories to envision potential services offerings

Address workforce challenges through new ways to collaborate

- Harness the collective intelligence of consumers, employees and partners through social tools and techniques
- Make pervasive use of deep data analytics to empower the workforce
- Strategically “re-skill” to meet ever-changing technology advancements, operational efficiencies and consumer expectations

Profit from ecosystem changes

- Take advantage of change to uncover new ways to transform processes and form new relationships
- Be accessible to non-traditional participants and quickly adapt to their culture, processes and development cycles
- Keep a consistent consumer relationship experience with participants in your value chain — even while major disruption occurs in both the work that is done and who does it

Key Recommendations

Consumer Recommendations	Mobility Recommendations	Ecosystem recommendations
Focus on in-vehicle capabilities that deliver the digital, automated and personalized experience consumers expect	Create an integrated, personalized in-vehicle experience Use learning and automating capabilities to reduce complexity of use Analyze and use diverse forms of data Embrace personal mobility services and extend the brand beyond the vehicle	Leverage technologies outside the vehicle to create high-value product and services offerings that enhance mobility and the rest of the consumer experience

Features vs Key Recommendations map

Key Recommendations/ Features	Digital Multimedia	Navigation	Location based services	Cloud based Service	Big data and analytics	self-driving
automated and personalized in-vehicle capabilities	✔	✔	✔	✔		✔
Create an integrated, personalized in-vehicle experience	✔	✔	✔	✔		
Use learning and automating capabilities			✔	✔		✔
Analyze and use diverse forms of data				✔	✔	✔
Embrace personal mobility services			✔	✔	✔	✔
Leverage technologies outside the vehicle			✔	✔	✔	

Digital Multimedia & Navigation

- Cloud-based streaming services becomes mainstream.
- Cloud-based Context aware natural voice recognition is utilized for various in-vehicle operation widely.
- Close link with smart phone like tethering, sharing multimedia contents is utilized also.

- Personalization of in-vehicle infotainment through web portal
- High-speed, stable and safe connection to the Internet and in-vehicle wireless connection.

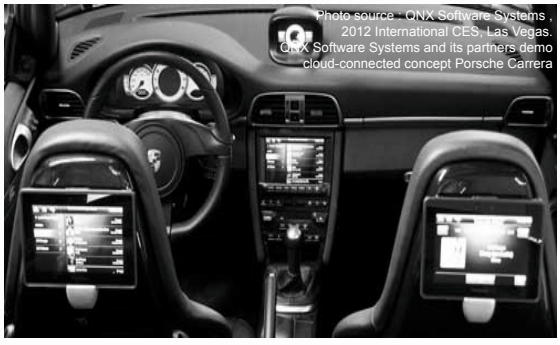


Photo source : QNX Software Systems , 2012 International CES, Las Vegas. QNX Software Systems and its partners demo cloud-connected concept Porsche Carrera

Location based services

- Simple Location based services has been already realized.
- LBS will accelerate by the improvement of cloud service in near future.
- Provider of LBS provides service.

LBS Based on Cloud

Data as a Service
- LBS provider generated data
- Maps, POIs, road networks
- Search results

User generated data
- Location history
- Photos, videos
- Search queries

Big data and analytics

- In vehicle, many kinds of data are analyzed in real-time and are converted.
- On cloud, execute real-time streaming processing and data store.
- Gateway which fitted plural communication protocol

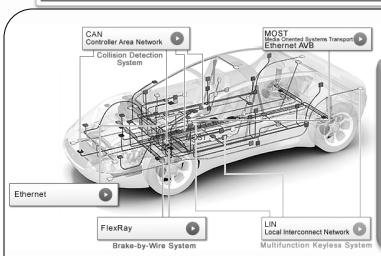


Photo source : RENESAS , In-Vehicle Networking Solutions

Gateway

CAN
LIN
Ethernet
MOST

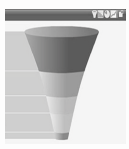
Front end feature for Big Data

Real-time analysis
Streaming processing
Data conversion
Compression
Abstraction
Security processing

Cloud

- Vehicle-Centric Control data
- Driving control data
- Operation information
- Dynamic Behavior of software
- Location Data

- Diag data
- Image recognition data
- Voice recognition data
- Sensor Data



Data storage

Stream processing

Cognitive cars will be commonplace by 2025, but self-driving cars will not.

Who owns the responsibility for the risks of the accident?

OEM? Suppler?
Social agreement? Insurance?
Law? Penalty?

The driver must own the risks by the automated driving, probably.

During automated driving always
- Car must evaluate risks continuously.
- Driver judge the acceptance of the evaluation result.

Partially automated

System takes control of longitudinal and lateral guidance in specific use case. Permanent driver supervision required.

Photo source : DIMLAR AG, Mercedes-Benz S500: First Fully Automated 100km Drive. July 11, 2014 • Driving Tips, News

Highly automated

System can cope with all situations in defined use case. Driver must always be in position to resume control.

Photo source : VOLVO, 12mil driverless cars to be on the road by 2035. Friday, 9 January 2015

Fully automated

System can cope with all situations during entire journey. No driver supervision required.

Photo source : THE WASHINGTON POST, Driverless car technology just got a huge boost. MAY 17, 2015.

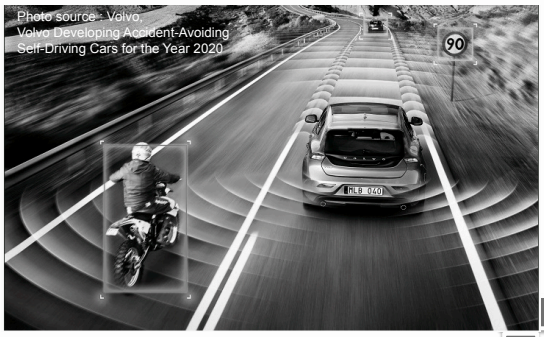


Photo source : Volvo,
Volvo Developing Accident-Avoiding Self-Driving Cars for the Year 2020

Photo source : RENESAS.
Ego-Motion(Visual odometry), 23 Jan 2015

Requires powerful and low-power Cognitive engine.
-Smart Cameras, Radar, Lidar, Ultra Sonic,
V2V(Vehicle-to-vehicle), V2I(vehicle to infrastructure)

Cognitive and advanced driving support system

Requires computing power. The workload includes 3D advanced navigation and infotainment, high-resolution digital instrument clusters, natural speech processing, and image processing for driver assistance.

High-contrast laser HUD with AR technology

high-resolution digital instrument clusters

3D advanced navigation and infotainment

Photo source : Pioneer,
Head Up Displays Go Down Market, 11 Sep 2013

In-Vehicle infotainment System Platform

In-vehicle

In-vehicle infotainment

- The Internet and in-vehicle wireless connection
- Personalization
- LBS services data generation
- Front end feature for Big Data
- Partially or High automated self-driving
- Digital cockpit
- High abstracted interface gateway to Vehicle centric control
- High speed video stream gateway or X-Bar
- Digital audio & Video – Streaming service
- Navigation

Cognitive Engine

- Smart Cameras
- Radar
- Lidar
- Ultra Sonic
- V2V(Vehicle-to-vehicle)
- V2I(vehicle to infrastructure)

Vehicle centric control

- next-generation integration ctl.
- Engine
- Brake
- Motor
- Battery
- Air bug / Pre-Crash safety

Telematics platform

Big data

- Vehicle-Centric Control data
- Driving control data
- Operation information
- Dynamic Behavior of software
- Location Data etc.

Business Analytics

Streaming Processing

- Vehicle-Centric Control data
- Driving control data
- Dynamic Behavior of software etc.

Automated Drive

- Cognitive
- Driving plan and monitoring
- Risk assessment / treatment

Real-time Vehicle Analytics

Service platform

Personalization

Apps. And web portal

Service Provider

Location based services
Data as a Service

B2B Service

Business Analytics

Security & Privacy

hardware assist – ex. EVITA light/medium/full

k-Anonymity / l-diversification / Differential Privacy / adversarial privacy

Autonomous or Cooperative

In suburbs

- low speed internet connection
- low-definition map data

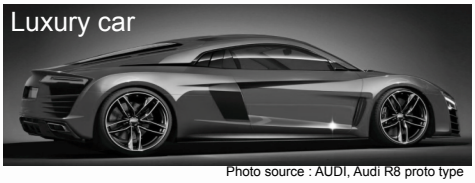
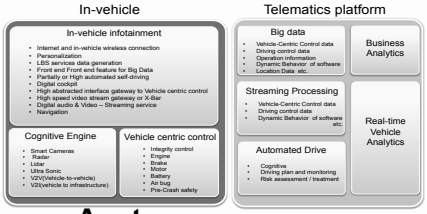


Photo source : AUDI, Audi R8 proto type

In-vehicle

Telematics platform



Autonomous

In urban areas

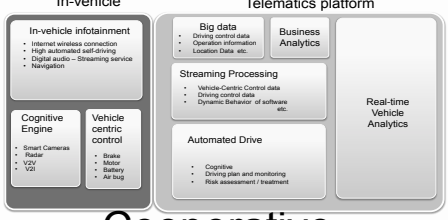
- High speed internet connection
- High-definition map data
- V2V(Vehicle-to-vehicle)
- V2I(vehicle to infrastructure)

Photo source TOYOTA, i-ROAD, TOYOTA DESIGN

Personal mobility

In-vehicle

Telematics platform



Cooperative

SoC feature for In-Vehicle Infotainment System

High-performance

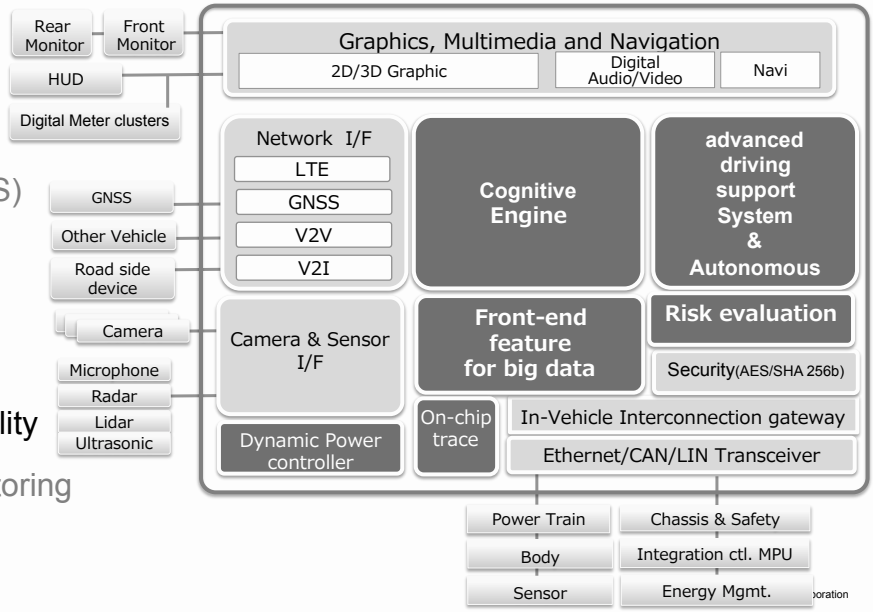
Over 10TOPS(10TFLOPS)

Low-power consumption

Under 20Wh

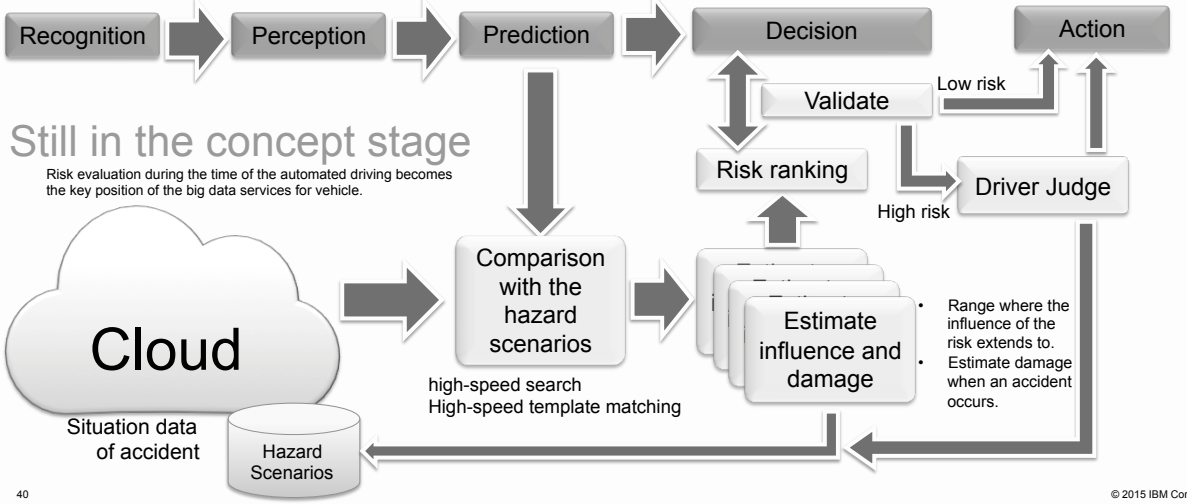
Improvement in dependability

Dynamic behavior monitoring



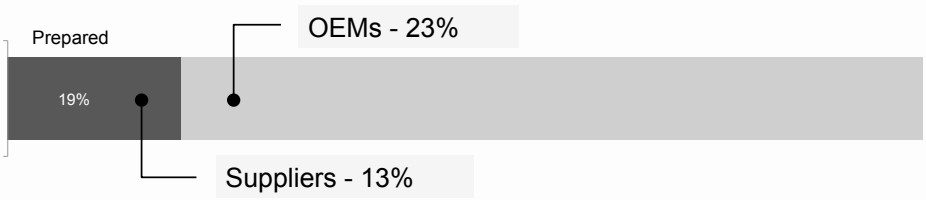
Risks assessment for automated driving

- Car must evaluate risks continuously.
- Driver judge the acceptance of the evaluation result.

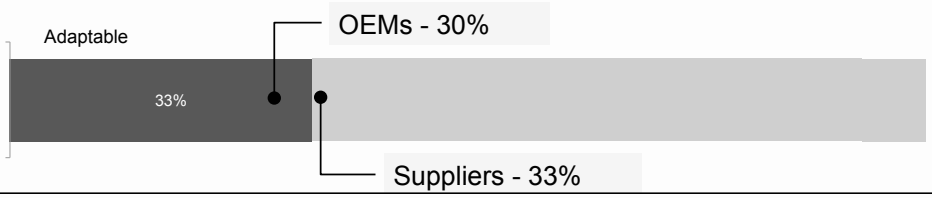


Conclusion - Prepared for the future?

*Based on everything we have covered today, **how prepared** is your company to face the challenges on the way to 2025?*



***How adaptable** is your company to face the challenges on the way to 2025?*



Thank you for your attention