

INDUSTRY INSIGHT

AUTONOMOUS DRIVING & THE NEXT GENERATION OF TRANSPORT IN CHINA

CHINA, DECEMBER 2016



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INTRODUCTION TO AUTONOMOUS DRIVING IN CHINA

China has become the biggest vehicle manufacturer and market in the world since 2009. With decades of effort, China has built up a full system of production and supply of vehicles. As with the country itself, the growth of China's auto industry has been remarkable. But its growth is expected to slow down under the context of "New Normal". There is still a long way for China to go to become a leading country in the automobile industry as China still falls behind in many aspects such as R&D and standards. However, the autonomous driving has given China a chance to stand out from the race. With connected cars, the core technology shifts from the engine and gear box to artificial intelligence and which is an area where China is among the world leaders, giving China a chance to catch up and seize the leadership.

The country's automakers and suppliers already seem to have a distinct advantage over their foreign competitors. Thanks to a large group of connected consumers who are eager to enter the connected car era, a supportive government and advanced technologies, China may take the lead in the worldwide race to build connected cars and future transport system. Much depends on its pace of innovation: its companies' ability to move faster than their Japanese, U.S., and European counterparts and own the future of the connected car.

In 2015, the State Council announced its latest 10-year plan, called "Made in China 2025", with the goal of transforming the country into an innovation hub in a variety of sectors, including the automotive industry. The government plans to support domestic companies working on connectivity and renewable energy technologies, in hopes of making them industry leaders, both locally and globally. In one statement, the Ministry of Industry and Information Technology (MIIT) announced these goals for intelligent and connected vehicles by 2025: reducing traffic accidents by more than 30 percent, setting safe autonomous driving speeds of 120 kilometers per hour, lowering energy consumption by 10 percent, and reducing emissions by more than 20 percent.

A more detailed roadmap with 450 pages for autonomous vehicles backed by the MIIT was released by Society of Automotive Engineers in China in October this year. The plan is expected to call for deploying self-driving cars within three to five years on highways and for urban driving by 2025. The roadmap also outlined technology framework, development milestones and prioritized tasks, which forges a consensus within China's auto industry so that the country rapidly can move towards producing and selling self-driving cars.

As a result of its efforts, by 2030, Chinese companies are expected to control 80 percent of the domestic market for vehicle entertainment modules and approximately 100 percent of the market for satellite navigation systems., the Chinese government protects its home market from foreign competition through trade and regulatory barriers; Google Maps, for instance, is not accessible in



the country, and the new 10-year plan may further increase entry barriers for Western competitors like Google, Apple, and Amazon.

Key take-away: China's combination of customer interest, government support, and technological innovation provides it with several natural advantages in building the connected car. But, as promising as the Chinese market is, and certainly will be, challenges remain, not just for Chinese companies but for every global automaker and supplier that wants a share of this huge market.

AUTONOMOUS DRIVING MARKET TO GROW RAPIDLY

The market size for intelligent and connected car technologies in China expects that by 2035 there will be around 8,6 million autonomous vehicles on the road, with about 3,4 million likely to be fully autonomous, while 5,2 million are semi-autonomous.

ADAS, as the primary stage products of self-driving vehicles, is expected to be the first to become popularized and commercialized. With the fast adoption of ADAS system, China's ADAS market size is expected to reach 200 billion yuan in 2020. Pre-installed market penetration rate reached 30% by 2020, while the annual penetration rate of after-market is expected to reach 5%.

Market size for ADAS in China 2014-2020 (forecast)

ADAS Module	Unit Price (CNY)	2015 Penetration Rate	2020 Penetration Rate	2015 Market Size (bn CNY)	2020 Market Size (bn CNY)
PDS	1,500	3%	30%	10	135
BSM	1,500	4%	30%	14	135
LDW	1,500	2%	30%	6	135
ACC	2,000	1%	30%	7	180
FCW	1,000	1%	30%	3	90
NVS	2,500	1%	5%	6	38
AEB	1,200	5%	50%	15	180
TSR	1,200	1%	15%	3	54
AP	1,200	3%	30%	8	108
SVC	4,000	1%	30%	10	360
AFL	1,000	1%	30%	3	90
DMS	1,200	0%	10%	0	36
After-installed ADAS system	2,500	0%	5%	10	375
Total				94	1916

Source: China Industry Information: www.chyxx.com

Key take-away: The market for automated driving systems is likely to grow rapidly in coming years. China is predicted to be the largest market and grow fast in the technology development.

DRIVERS BEHIND AUTONOMOUS DRIVING IN CHINA

The main drivers behind the development of autonomous driving in China are:

a) Improve traffic safety

Autonomous driving has the potential to improve traffic safety. 90% of all accidents are said to be caused by human error. The most obvious reason for China to go driverless is to make its hazardous roads safer. According to the World Health Organization (WTO), more than 250,000 people die on China's roads annually. Pedestrians, cyclists and people on motorcycles comprise 60% of the deaths. The WTO estimates there are 18,8 traffic-related deaths in China per 100,000 people per year, about average for middle-income nations but



more than double the rate in developed countries. The Chinese government is promoting ICT and telematics in cars. Automated braking, spatial indications and the opportunity to use other car's information to prevent accidents are prioritized.

b) Reduce energy consumption and emissions

The public is increasingly aware of air pollution. According to Chinese Ministry of Environmental Protection, vehicles have become the major source of air pollution in China. With the application of intelligent technology, the fuel/power efficiency will be remarkably improved, and the emissions will also be reduced.

c) Increase traffic efficiency

Mainly three societal costs are expected to be significantly lowered by extensively introducing automated driving systems. Firstly, fatalities and damages as a result of increased traffic safety. Secondly, environmental pollution by improving fuel efficiency. And third, less time loss due to traffic congestion by driving efficiently, reducing inter-vehicle space and being able to choose the most appropriate driving route

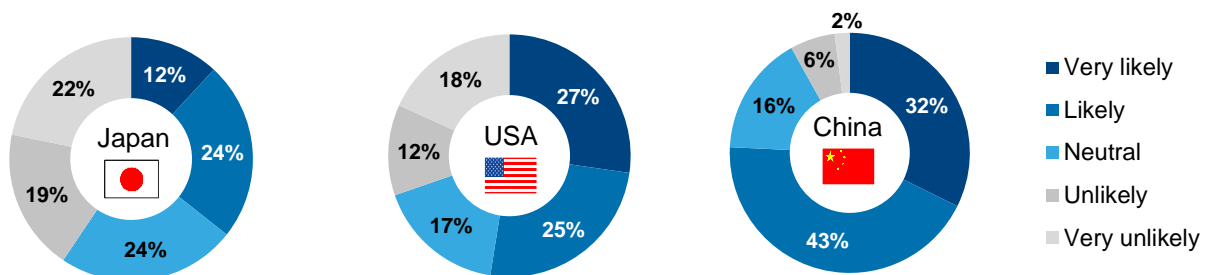
d) Stimulating the economy

China wishes to shift away from an investment-intensive, export-heavy model to a more sustainable model driven by consumption and innovation to revitalize its economy. An effort has been made to stimulate the economy by aspiring to become world-leading within automated driving, strengthening the national automotive industry's competitiveness and increasing high-value added exports.

e) Improve the living quality of citizens

A survey conducted by World Economic Forum in 2015 found Chinese consumers were enthusiastic about self-driving cars: 75% were willing to ride in one. The rate of acceptance in China is among the highest comparing to the United States, Germany, Japan and Korea.

Consumer attitudes, % of respondents likely/unlikely to try a self-driving car



Source: World Economic Forum 2015

Key take-away: The main drivers for automated driving development in China are to improve traffic safety, tackle the serious air pollutions and promote industry transformation. China opens test zones in its biggest metropolitan areas, namely Beijing, Shanghai and Chongqing, aiming to facilitate R&D, standard studies and policy formulation, and test and certify connected technology.

DEFINITION OF AUTONOMOUS DRIVING IN CHINA

The Chinese definition of autonomous driving is basically the same as the international definitions, but with its own explanation. In China, autonomous vehicle is defined as intelligent and connected vehicle (ICV), which emphasize on its connectivity with other vehicles and infrastructure as well as the ability to recognize the surrounding environments and take appropriate actions.



According to Society of Automotive Engineers in China, a connected and intelligent vehicle is the next generation vehicle, which is equipped with advanced vehicle sensors, controllers, actuators and other devices, integrated with modern communication and network technology, to exchange and share information with X (namely pedestrians, vehicles, roads and platform etc.), with functions of complex environmental perception, intelligent decision-making, collaborative control and implementation, providing safe, comfortable, energy saving and efficient driving, and ultimately replace humans to operate.

INTERNATIONAL STANDARDS & COLLABORATION

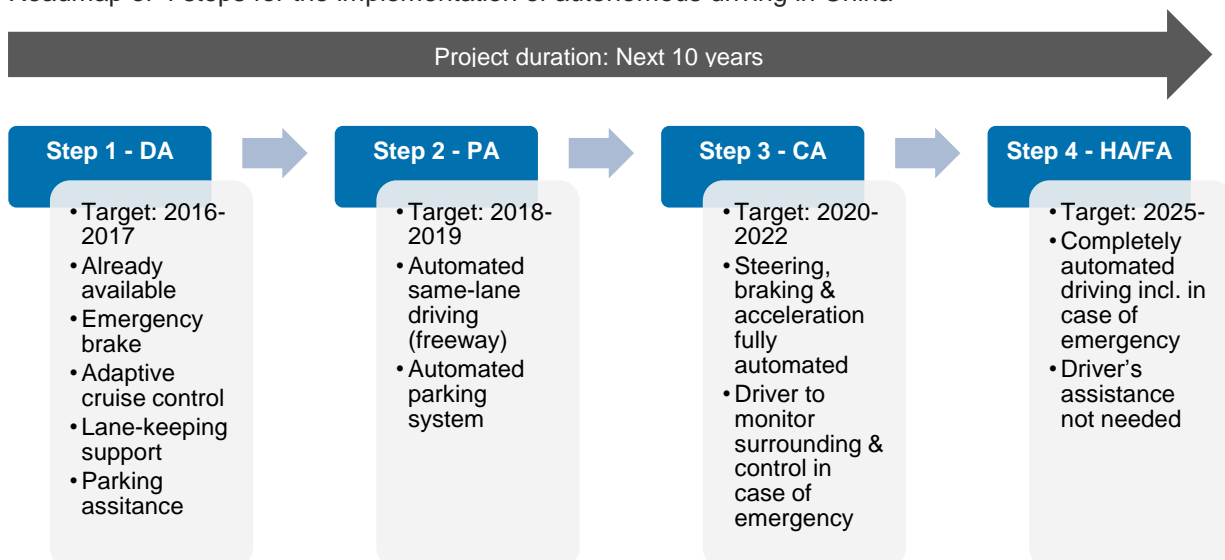
The international cooperation within the autonomous driving area is more on the industry side. China plans to build an intelligent and connected vehicle standard system which is in line with international ones and has Chinese characteristics by relying on the advantages of Chinese relevant ICV industries (especially independent innovation technologies).

- A number of cooperation between Chinese and foreign companies are carried out :
 - Volvo tested its autonomous driving cars in Beijing on the real road
 - Audi announced plans to work with Tencent, which operates the country's most popular sms app WeChat, to allow location sharing in vehicles
 - France's PSA, which makes Peugeots and Citroens will equip some of its cars with a Wi-Fi hotspot in collaboration with Alibaba, and offer an app to remotely check the vehicles's location and fuel levels
 - The U.S.'s Airbiquity, the global leader in connected vehicle technology, and Baidu, the leading Chinese Internet services provider, announced a partnership to provide connected car Internet services to the Chinese automotive market
- Further agreements are expected between Europe and Japan/Korea.
- The United States has the intention to introduce its own standards.

CHINESE INDUSTRY'S ROADMAP TO AUTONOMOUS DRIVING

Four steps have been outlined for the realization of autonomous driving: Level 1) Driver Assistance (DA), Level 2) Partial Automation (PA), Level 3) Conditional Automation (CA), Level 4) High Automation (HA), Level 5) Full Automation.

Roadmap of 4 steps for the implementation of autonomous driving in China



Source: Society of Automotive Engineers in China, 2016

The Society of Automotive Engineers of China (SAEC) announced the roadmap for intelligent and connected vehicles on October 26th, 2016. The roadmap states that three distinct five-year periods to 2030 for the development of autonomous vehicles, with cars capable of driving themselves in all, or nearly all, situations will first be hitting the market between 2021 and 2025. Some form of automated or assisted driving should be in every car by 2026 to 2030, according to the roadmap. The roadmap does not back one particular technology although it lays out a timeline for developing that single standard.

The global market for ADAS units is largely made up by step 1 technologies until step 2 technologies are expected to take off in 2016 and beyond. Step 3 technologies are forecasted to make their commercial debut in 2020.

Key take-away: Both China and the United States point out the importance of building the necessary infrastructure for connected vehicles, as both countries acknowledge this as key to realizing higher levels of automation. But China has no preference in the two mainstream technology routes. Both are encouraged as long as it fosters a healthy industry development. China has an advantage in that most of its regulatory processes related to autonomous driving vehicles operate at a national level. Its top-down approaches has the benefit of simplifying the maze of regulatory rules and procedures that exist elsewhere in federal systems.

PROGRESS AND ON-GOING ACTIVITIES

In order to keep up with the trend of international advanced technology of intelligent and connected vehicles, develop intelligent and connected vehicle product and technical services with independent intellectual rights, actively promote intelligent and connected vehicles' technical specification and standard the industry need urgently, boost domestic intelligent and connected vehicle market prosperity, SAE-China have dedicated vast efforts to positively organize automotive enterprises, scientific research institutes, mobile operators, software and hardware manufactures up to 30 members, co-sponsor and establish the "China Industry Technology Innovation Strategic Alliance for Intelligent and Connected Vehicles" working on aspects of generic technical development, standards, testing, demonstration, communication and others.

China set up 3 national test sites for connected and self-driving cars in Shanghai, Beijing and Chongqing, which aim to facilitate R&D, standard studies and policy formulation, as well as test and certify connected car technology. At the Shanghai base, test cars will initially be put through 29 different driving simulation programs, such as vehicle collision, brake alert and pedestrian crossing alert. The government plans to expand the number of testing programs to 100 by late 2017. From 2018-2019, 5,000 automated vehicles will be deployed in an expanding testing area of 100 square kilometers. And then in 2020, China plans to launch a self-driving vehicle demonstration city near Shanghai.

In addition to the roadmap released by SEAC, the National Technical Committee of Auto Standardization has developed a roadmap for ICV standard and regulations, and carried out a series of investigations regarding the ADAS technologies and products application and traffic accidents analysis.

Until now, there are ten domestic manufacturers, including FAW, SAIC, Changan, BAIC, Great Wall, GAG, Dongfeng, Geely, BYD and Lifan, have launched their testing vehicle models or testing plans for the next 5-10 years. The average investment in the development of autonomous driving of each company is estimated to exceed 100 million yuan so far.

WHAT ARE THE MAIN OUTSTANDING ISSUES?

The main issues to be resolved are:

1. There are fragmentations over who will oversee regulation and development. There are multiple ministries who are responsible for the supervision of automatic driving and designers require greater clarity regarding who regulates and how they regulate.
2. Current Chinese rules mandate that drivers must be in the vehicle and keep hands on the steering wheel. That obviously complicates the introduction of autonomous vehicles and makes pilot projects unfeasible unless special exemptions are granted. Fully autonomous vehicles cannot be tested under actual road conditions unless there is governmental flexibility in granting road test exemptions.
3. Companies need special licenses from the National Administration of Surveying, Mapping, and Geo-Information to collect data on road conditions and the height or weight limits of bridges. They are forbidden to collect any road data around military districts. That places an undue burden on industry innovators and makes it difficult to compile the information needed in this sector.

Key take-away: The regulations regarding self-driving vehicles are only just emerging, as governments try to balance safety and public concern with a desire to foster innovation and successful new auto ventures. Chinese top-down approach will give China an edge over the U.S. and Europe in the race to develop self-driving cars because it allows China to swiftly implement massive infrastructure projects. But if the 10 ministries and departments could not coordinate and divide the duties clearly, this unique advantage will be weakened.

INTERESTING OPPORTUNITIES FOR SWEDISH COMPANIES

There are both business and collaboration opportunities with Chinese companies as the domestic automotive industry is still lagging behind to reach the third step of the automated driving roadmap. The Chinese market is highly interesting with its large automotive manufacturing industry and it's also interesting from a research collaboration perspective. Furthermore, there is already awareness in the Chinese automotive industry of the progress of autonomous driving in Sweden. Chinese automotive companies are keen to follow developments within this area in Sweden, especially the collaboration between companies, academia and government in Gothenburg.

There is a gap of industrial foundation between China and other countries although ICVs themselves are standing at the same line. China is now encouraging the first- and second-tier suppliers to take part in the game, led by the OEMs and Tech giants, to develop independent innovation technologies. Meanwhile, Chinese companies are looking into advanced solutions globally to complement its deficiency. The "Made in China 2025" led by Ministry of Industry and Information Technology is fundamental for the overall framework while the Ministry of Transport is involved in research, construction of new infrastructure systems and fosters the demand for many types of terminal equipment on a national safety level. Additionally, other government bodies, academia & research organizations, automotive manufacturers, technology providers, electronics & component manufacturers etc. are all involved in the development of the next-generation transportation system in China. Several of these are reaching out for collaboration with international counterparts.

The Chinese market has never been (and still isn't) an easy market for foreign companies to operate in, but our experience is that it is very rewarding to collaborate with Chinese players at an early stage, which provides an opportunity to influence the standards and policy making. There is a changing attitude towards international business practices and increased openness towards foreign collaboration among Chinese companies. With the ambition to become the industry leader in the world, Chinese companies are more likely to optimize their resource allocations from globalized

perspective. This has been highlighted by the biggest Chinese OEMs when setting up their R&D centers in the more developed areas to gain more international competitiveness while completing the domestic supply system. This is just one example of a changing business environment.

Swedish companies in automotive related industries with unique products or services should examine opportunities arising from China's ambition to become the industry leader and gain international market shares within automated driving systems and the development of the next generation of transport systems.

Of potential interest to Chinese companies are products and services relating to data, security, communication and sensors. These are some identified potential areas of collaboration:

- Technology to build up ICV environment awareness system
- Technology for ICV integrated control
- Technology for communication
 - Vehicle-to-vehicle (V2V)
 - Vehicle-to-everything (V2X)
- Technologies for data & security
 - Know-how on making dynamic maps utilizing big data
 - Information security for V2X technologies
- Technology for machine vision deep cognition
- Sensor technologies
 - Sensing condition and actions of driver
 - Sensing other vehicles
 - Radar technologies, able to detect obstacles in foggy/bad weather condition
- Research and application of cloud network integration
- Evaluation system and environment for ICV test

BUSINESS SWEDEN AND THE AUTOMOTIVE INDUSTRY IN CHINA

Business Sweden has been active, with offices Peking and Shanghai, since 1994. Throughout the years, we have built a far-reaching network of contacts with specialized market knowledge, which facilitates the expansion of Swedish companies and attracts Chinese investments. We have been working closely with the Chinese automotive industry for years.

There are business and collaboration opportunities with Chinese companies and organizations as the market for automated driving is expanding. China is predicted to be the biggest markets and technology contributor, as the Chinese automotive industry is of significant strategic importance to the country. Its output accounts for approximately 10% of the GDP and passenger car production of Chinese companies represent over one quarter of global production.

We have observed a changing attitude towards international business practices among Chinese companies under the context of “New Normal”. Swedish companies in automotive related industries with unique products or services should examine opportunities arising from China’s ambition to become the leader within automated driving systems. Please contact Business Sweden in Beijing for a discussion on current developments, potential areas of interest and key stakeholders for your company in the Chinese automotive industry.

CONTACT INFORMATION:

BUSINESS SWEDEN, SHANGHAI

Telephone: +86 21 6218 9955 (+8 hours GMT)

E-mail: china@business-sweden.se

Address: 12F, Sail Tower, 266 Hankou Road, Huangpu District, Shanghai 200001, P.R of China

BUSINESS SWEDEN, BEIJING

Telephone: +86 10 5815 6006 (+ 8 hours GMT)

E-mail: china@business-sweden.se

Address: Room 609, 6/F CYTS Plaza, No.5 Dongzhimen Nandajie, Dongcheng District, Beijing 100007, P.R of China