

A Comparative Analysis of Autonomous Vehicle Policies among Korea, Japan, and France

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Abstract

Autonomous vehicles (AVs) are expected to transform the landscape of the automotive industry, the transportation system, and our social life. The role of government and its evolution regarding this emerging technology have received little attention in the literature than other subjects such as the advancement of AV technologies and the growth of the relevant private sector. This study explores the similarities and differences in the evolution of government policy on AVs in Korea, Japan, and France. Each country's official initiatives, policy actions, legislation, and flagship R&D programs for AVs are analyzed and compared each other in both qualitative and quantitative ways. The latter is done by employing a bibliometric analysis. The three countries' policies for AV development and deployment are divided into four categories: (1) research and development (R&D) and tests, (2) legal and regulatory framework, (3) infrastructure for AV deployment, and (4) social acceptance. All three countries commonly set AVs as a national strategic sector between 2013 and 2014 in order to promote the future competitiveness of their automotive industries and create new jobs. Large-scale R&D investment schemes for AVs accompanied or followed the national AV strategies. However, each country takes different approaches. France takes a demand-pull approach, focusing on making AVs socially acceptable. Korea, by contrast, takes a tech-push approach, focusing on making AVs technologically available. Japan takes a mixed approach, focusing on both technology and applications given its strong automotive industry and aging and decreasing population. The present study contributes to a better understanding of how the governments influence socio-economic transformation of the three countries in the emerging era of AVs.

Keywords

Autonomous vehicle, government policy, Korea, Japan, France.

JEL Classification: O38, O33

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1. Introduction

1.1. The Purpose of the Study

Since the 2010s, the autonomous driving (AD) technology has considerably advanced by utilizing artificial intelligence (AI). Autonomous vehicles (AVs) are expected to significantly change the landscape of the global automotive industry and the use of cars in one's life, transforming cars from simple transportation utility into an extension of our homes and offices (From the Smartphone, 2013). AVs are also expected to accelerate a shift from personal car ownership to shared mobility. Robo-Taxis and driverless freight trucks may eventually replace taxi and truck drivers. The AV has enormous potential in transforming our economy, society, and culture.

Governments in many countries have been implementing national policies for AV development and deployment to embrace this new paradigm. The present study aims to analyze the national AV initiatives and policy measures of Korea, France, and Japan in the 2010s comparatively. Government policy interacts with the country's society, economy, and industries. Thus, comprehension on government policies helps us understand how and why the country's society and economy transform. Government policies are instrumental in socio-economic transformation by a new technological paradigm because they provide the initial *rules of the game* that affect the practices and behavior of consumers, producers, and intermediaries in relevant sectors. For example, in the 1990s, the then Korean Ministry of Information and Telecommunication adopted Code-Division Multiple Access (CDMA) technology for the country's mobile network instead of Time-Division Multiple Access (Lee & Lim, 2001). This policy led electronics companies, such as Samsung, LG, and Hyundai, to developing CDMA equipment. Wireless telecommunications operators, such as SK Telecom, also constructed CDMA mobile networks. In the late 2010s, the Korean government's policy for the development of electric vehicles also sets the rules of the game. Fuel cell electric vehicles (FCEVs) are selected as a national strategic field (Ministry of Trade, Industry and Energy [MOTIE], 2019). The government plans to heavily invest in FCEV technology and relevant infrastructure, such as charging stations. This plan means that the Korean government will promote FCEV development, adding to the development of battery electric vehicles, which is an existing strategic item of the Korean government in the area of eco-friendly vehicles.

In this context, this study attempts to understand AV policies that the central government implements in Korea, France, and Japan and the context in which such policies were formulated. Given that government policy affects the practices and behavior of actors in relevant sectors, these findings contribute to an in-depth understanding of how and why these countries follow their own trajectories of socio-economic transformation, which in turn can help in formulating subsequent policy actions and business strategies in the public and private sectors, respectively, in the AV era.

Comparatively analyzing the AV policies of the three countries provides a deeper understanding of the AV policy of each country than when analyzing that of each country separately. The comparison also helps each of these countries recognize and adopt the policy measures of the other countries that are potentially useful for them. The similarities in the three

countries' AV policies may shed light on be common components of general AV policy. The differences can indicate the uniqueness of the respective countries' AV policies, reflecting their country-specific context of society, governance, industry, and so on. This knowledge provides policy implications for policy makers and researchers of other countries who formulate their own AV policies. Given that Korea, France, and Japan are active in upgrading their transport systems and have large automotive industries with global OEMs, such as Hyundai Renault, and Toyota, their policies for AV development and deployment are useful references to other countries. Korea is a useful reference, specifically to Asian developing countries, such as China and India, in essential aspects of government policies because it was a catching-up country until relatively recently compared with France and Japan.

1.2. Literature on Government Policy of AVs

National strategies or policies of AV development and deployment in the 2010s are mainly addressed in the form of status reports by think tanks and consulting firms (Chun & Koe, 2015; Korea Institute for Advancement of Technology [KIAT], 2017; KPMG, 2018, 2019; SBD Automotive, 2019). These reports compile and describe the latest development of AV policies of several countries. For example, SBD Automotive, a global consulting firm in the automotive industry, publishes *The Autonomous Car Legislation Guide*, which is a quarterly report on the development of legislation and safety regulations in Europe, USA, Japan, China, Russia, and, on an ad-hoc basis, other countries. In January 2018, consulting giant KPMG released a report entitled Autonomous Vehicles Readiness Index, which assesses the preparedness of 20 countries for AVs in terms of the four following pillars: 1) policy and legislation, 2) technology and innovation, 3) infrastructure, and 4) consumer acceptance (KPMG International Cooperative [KPMG], 2018). The report was updated once in February 2019 by adding five new countries for a total of 25.

These reports only focus on providing information on the recent development of single or multiple countries' AV policies, which means, these reports fail to explore the characteristics of a country's AV policy and analyze them comparatively among countries.

The academic literature on AV policy focuses on the potential impact of AVs and policy implications (Fagnant & Kockelman, 2015; Milakis et al., 2017), especially for the preparation of transportation policy (Bagloee et al., 2016; Fraedrich et al., 2019). Legal, regulatory and ethical issues that pertain to AV deployment are also among the major topics (Beiker, 2012; Bradshaw-Martin & Easton, 2014; Demiridi et al., 2019; Kohler & Colbert-Taylor, 2015; Lari et al., 2015; Lemann, 2019; Salatiello & Felver, 2017). However, the literature pays little attention to the characteristics of national AV policy as a driving factor of socio-economic transformation in the emerging AV era.

1.3. Research Methodology and Data

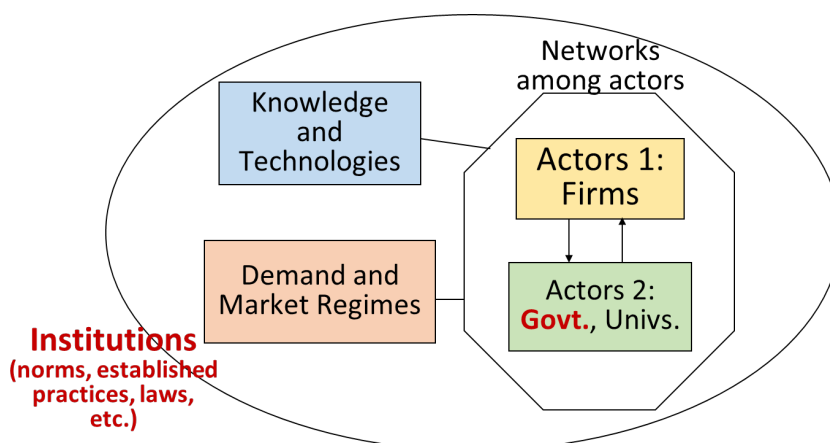
1.3.1. AV Policy Domains and Comparative Analysis

This study divides government policies for AV development and deployment into four categories: (1) research and development (R&D) and tests, (2) legal and regulatory framework, (3) infrastructure for AV deployment, and (4) social acceptance. The present study explores the key policies of Korea, Japan, and France in each of the four categories. The findings are used to analyze the government policies and their evolution of the three countries comparatively.

1.3.2. Sectoral Systems of Innovation (SSI)

This study employs the SSI (Malerba, 2004) as a theoretical framework. The SSI is a lens to analyze the innovation process and the factors affecting innovation (Malerba, 2004, p. i). The main building blocks of SSI include (a) knowledge and technologies, (b) actors (e.g., firm and government) and networks, (c) institutions (e.g., norms, practices, and laws), and (d) demand. In the SSI perspective, innovation process and sectoral transformation are the co-evolution of these four building blocks of the sector. Figure 1.1 presents the SSI and its building blocks.

Figure 1.1. SSI



Note. Adapted from Lee (2009, p. 26).

Given that the AV is technological innovation transforming the automotive and tech sectors, the SSI is a useful tool for analyzing the role of government policy in the socio-economic transformation induced by the emergence of AVs. The present study seeks out the contexts behind a country's decision to implement certain policies in terms of the four building blocks of the SSI framework. For example, truck platooning R&D and its tests on public roads are more active in France and Europe than in Japan and Korea because trucking is a much bigger industry in the former than in the latter. This factor is related to demand, which is the fourth building block of SSI. The Korean government's policy on automobiles tends to be influenced by the behavior of Hyundai Motor Group because the auto giant accounts for approximately 60% of the domestic market. This factor is related to the firm, which is the second building block of SSI.

1.3.3. Data and Sources

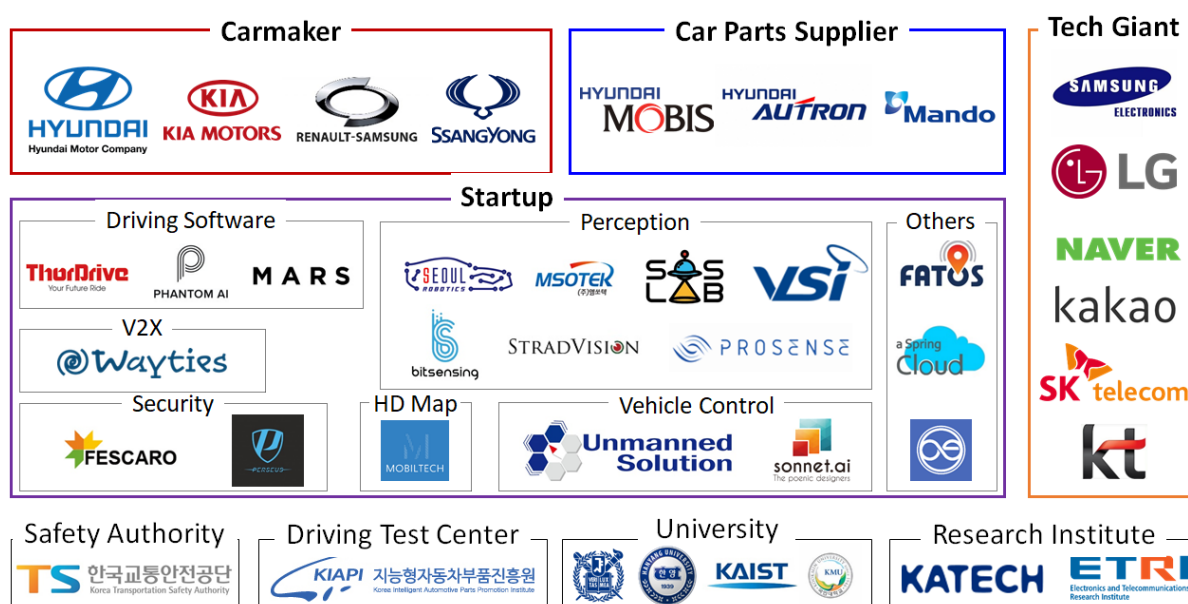
This study primarily relies on the official government policy documents of the three countries. Each country's initiatives, policy measures, legislation, and flagship R&D programs for AV development and deployments are analyzed and compared each other in both qualitative and quantitative ways. A bibliometric analysis is employed for the latter. Policy research reports by think tanks and news articles are used as secondary sources. Interviews were also conducted.

2. Korean AV Policy

2.1. Overview of the AV Development Landscape in Korea

Korea is the 7th largest auto manufacturing country worldwide, producing about 4 million motor vehicles in 2019 (Organisation Internationale des Constructeurs d'Automobiles, n.d.). In Korea, various actors, including carmakers, car parts suppliers, tech giants, and startups, are preparing for the coming self-driving car era. Figure 2.1 presents a breakdown of the Korean self-driving sector by actor type, including major players in each sector. The startups included in Figure 2.1 are the ones that received seed investments at the least as of September 2018.

Figure 2.1. Major Players in AV Development in Korea



Note. Author's visualization of the organizations' logos, which are collected from the Internet.

Among the OEMs with plants in Korea, Hyundai Motor Company demonstrated Level 4 automated driving on a 190 km highway road trip in February 2018. Kia Motors develops 5G-based vehicle-to-everything (V2X) (5G-V2X) communication networks with SK Telecom, which is Korea's largest wireless carrier.¹ Korean car part suppliers, such as Hyundai Mobis and Mando, focus on developing sensors for AVs. In August 2018, Hyundai Mobis invested

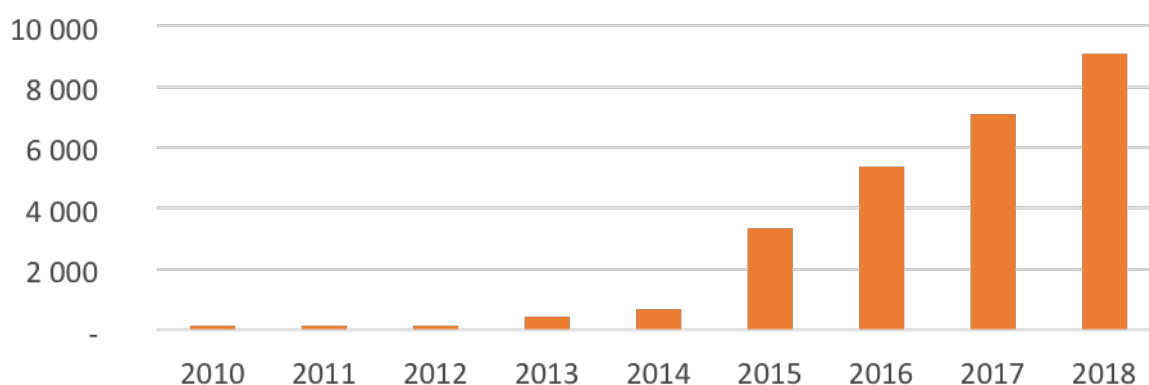
1. 5G is the fifth-generation wireless technology for digital cellular networks.

approximately 6 million euros in a Korean startup StradVision for deep-learning cameras. This investment is the largest in Hyundai Mobis' history, except for investments in its subsidiary companies. Tech giant Samsung Electronics acquired Harman, a U.S. car infotainment and audio company, for 8 billion US dollars in 2017. LG Electronics is actively partnering with various companies, including the global digital mapping company HERE Technologies, automotive semiconductor manufacturer NXP, German advanced driver assistance system developer HELLA Aglaia, and chipmaker Qualcomm, for its automated and connected car business.

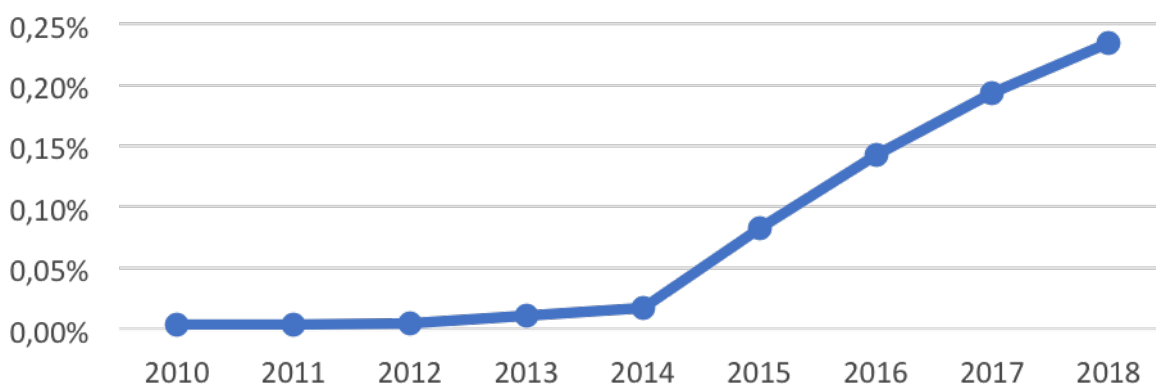
In addition, AVs have increasingly obtained public awareness in the 2010s, significantly since 2015. Figure 2.2 (a) presents the number of news articles on AVs in major Korean newspapers and its shares in total news. Between 2010 and 2012, AVs are marginally addressed as a news topic in about 100 news articles, and in 2013, the number of AV news articles more than doubled. Two years later, in 2015, AV news began to pour in. This trend is largely consistent with the Korean government's policy formulation activities, which will be elaborated in this chapter. Figure 2-2 (b) shows that the share of AV news articles in total news articles has a similar trend, thereby suggesting that the increase in the number of AV news articles is not due to an increase in the total number of news articles in the Korean media.

Figure 2.2. Evolution of Awareness of AVs in Korea

(a) Number of News Articles on AVs



(b) Share of AV News in Total News Articles



Note. Author's visualization of keyword search result numbers from Big Kinds: News Bigdata & Analysis (Big Kinds, www.bigkinds.or.kr).

2.2. Evolution of the Korean AV Policies in the 2010s

With hindsight, the evolution of the Korean government's AV policy in the 2010s can be divided into four stages:

- (1) Recognition phase (2012)
- (2) Selection phase (2013–2014)
- (3) Planning phase (2015–2016)
- (4) Acceleration phase (2017–2019)

Each phase is described in the following sub-sections.

2.2.1. Recognition Phase (2012)

In 2012, the Korean government started to recognize AV development as a policy task. In June 2012, the Ministry of Land, Infrastructure, and Transport (MOLIT), a ministry charged with transport and logistics in Korea, announced the 1st Master Plan for Motor Vehicle Policy (2012–2016). The Master Plan for Motor Vehicle Policy shall, by law, include the development prospects of the automotive technology, the orientation of the vehicle management and safety policies, and matters on vehicle R&D to manage motor vehicles and increase their safety efficiently. The 1st Master Plan included autonomous driving (AD) as a subtopic of the development of convergence of vehicles and information technology (IT). This plan is the first major government policy in Korea to address AV development as a policy task.

Three months later, in September 2012, AV development was included again in another major policy, entitled Promotion Strategy for IT Convergence (2013–2017). The five-year inter-ministerial strategy proposes the development of AVs and cooperative intelligent transport systems (C-ITS) as policy actions to promote convergence between IT and other fields. In this strategy, AV development was a subtopic of the development of vehicles and IT convergence. In the above-mentioned two policies, AV development is not a main policy task but a subtask of the other R&D tasks, suggesting that AVs are an emerging but incipient topic in formulating government policies in Korea in 2012.

2.2.2. Selection Phase (2013–2014)

In 2013–2014, the AD technology was selected as a strategic field at the sectoral and national levels. Formulated jointly by relevant ministries, the 3rd Master Plan for Science and Technology (2013–2017), announced in July 2013, selected 120 national strategic technologies, in which C-ITS was included. In October 2013, the Ministry of Science and ICT (MSIT) announced the Mid- and Long-term R&D Strategy for ICT (2013–2017), which selected autonomous mobility service as one of the 15 future services. Two months later, in December 2013, the Ministry of Trade, Industry, and Energy (MOTIE), a ministry charged with the industries in Korea, announced one of its highest-level plans entitled the 6th Plan for Innovation of Industrial Technology (2014–2018). The plan chose 13 fields, in which the Ministry will run large-scale R&D programs for the next five years, and AD technology was included.

A substantial difference between 2012 and 2013 can be observed in the government plans for AV development. Although the 2012 policies deal with AV development as a subtask of other R&D tasks, the 2013 policies treat it as a major policy task of the Korean government.

In March 2014, AV development became a national-level strategic task because the inter-ministerial industrial growth strategy called Future Growth Engines (Future GE) was announced with 13 selected strategic fields. This selection means that massive government R&D investment and supportive regulatory changes will be implemented by relevant ministries to promote the growth of the selected fields. Selected as one of them, *smart car* mainly means AVs, including connected vehicles, C-ITS, and V2X communication technologies.

2.2.3. Planning Phase (2015–2016)

By 2015, the Korean government established detailed action plans for AV development and deployment. In March 2015, the Comprehensive Action Plan (CAP) of Future Growth Engines was announced. The CAP consists of the policy roadmaps and detailed policy tasks mainly in terms of R&D, infrastructure, regulatory framework, and international harmonization for the 13 strategic fields, including smart cars, of the Future GE initiative, announced a year ago. The Future GE initiative is basically an R&D plan; thus, the CAP of Future GE focuses on planning R&D investment in AV parts and technologies while other subjects such as infrastructure, regulatory framework, and international harmonization are addressed with less focus.

A seminal plan in Korean AV policy was announced three months later, in June 2015. Headed by the MOLIT, relevant ministries jointly announced the Plan to Support AV Commercialization. Not giving too much importance to R&D, this plan contains multifarious policy actions to prepare the future commercial deployment of AVs. The policy actions include establishing legal and regulatory frameworks for AV tests and deployment, R&D investment, building AV test facility and road and digital infrastructure for AV deployment. More importantly, the Korean government's goals on AV deployment was first revealed in this plan: Level 3 AVs in use on roads by 2020, Level 4+ infrastructure by 2022, and eventually Level 4+ AV deployment by 2030. The details of this plan are addressed by policy area in the following sub-sections in this chapter.

2.2.4. Acceleration Phase (2017–2019)

President Moon Jae-in's five-year term administration, which began in 2017, reaffirmed AVs as a national strategic field. The administration's Growth Engine (GE) initiative, which was announced in December 2017 and entitled Innovative Growth Engine (Innovative GE), selected 13 national strategic fields, including AVs, for Korea's future industrial competitiveness. The other fields include AI, renewable energy, personalized healthcare, and drone. The AV was a subfield of the smart car in the previous administration's GE initiative. This time, AV, which replaced the smart car, became an independent national strategic field.

Three months later, in February 2018, the Korean government proclaimed two plans regarding AVs at the same event. First, MOTIE announced a growth plan for the automotive industry entitled Future Car Industry Development Strategy, which was jointly established by relevant ministries. The strategy addressed two new paradigms, namely, electric vehicles (EVs) and AVs, in the automotive industry. In the plan, the part for AVs addresses policy actions to promote future AV deployment, which is an update of the Plan to Support the Commercialization of AVs announced in June 2015, for reflecting development in AV technology

and the government policy since then. The MOLIT announced the Plan to Establish Smart Transport Systems, which is an action scheme of the MOLIT in their policy areas, responding to the AV part of the Future Car Industry Development Strategy. The MOLIT's policy tasks presented in the Plan to Establish Smart Transport Systems include:

- building test facilities for AV development;
- establishing C-ITS, road infrastructure, and high-definition (HD) maps for future AV deployment;
- organizing a public-private consultative committee to support the industrial ecosystem of connected and autonomous vehicles (CAVs); and
- implementing AV pilots and trials to increase the public acceptance of AVs.

In October 2019, the relevant ministries jointly declared an elaborated version of the Future Car Industry Development Strategy with a slight change in its name to Future Car Industry Development Strategy 2030. The strategy outlines policy tasks to leap into a leading country in the future automotive industry by 2030. The strategy also includes a revision on AV deployment targets given that the AV technology advances slower than the previous expectations. Table 2.1 summarizes the development of the Korean AV policies in the 2010s and its four phases.

Over the evolution of the four phases, government actions have surged since 2015 when the third phase or the *planning phase* started. The amount of government spending on AV R&D has rapidly increased since 2015; such spending was gradually increased before 2015 (Figure 2.3 (a)). The share of the expenditure on AV development in the total R&D budget also presents the same trend, indicating that the trend in the amount of AV R&D spending is not caused by the increase in total R&D spending of the Korean government. Although AVs were selected multiple times as a national strategic item since 2013, or the second phase, securing R&D budget for AVs required some time given the government budgeting process. Accordingly, the surge in AV R&D spending occurred approximately one or two years later in 2015.

Figure 2.3 (b) presents the trend of the number of news articles that contain words "AV" and "government" in Korean in their title or body texts. Not precise though, this number roughly suggests the involvement of the Korea government in the topic of AVs.² Although these articles are not limited to articles on government's AV R&D, their trend is similar to that of the government's AV R&D spending both in absolute number and its share in the total number of news articles of the respective years.

2. This method does not exclude news articles in which word "government" means the government of other countries.

Table 2.1. Four Phases of the Development of the Korean AV Policies in the 2010s

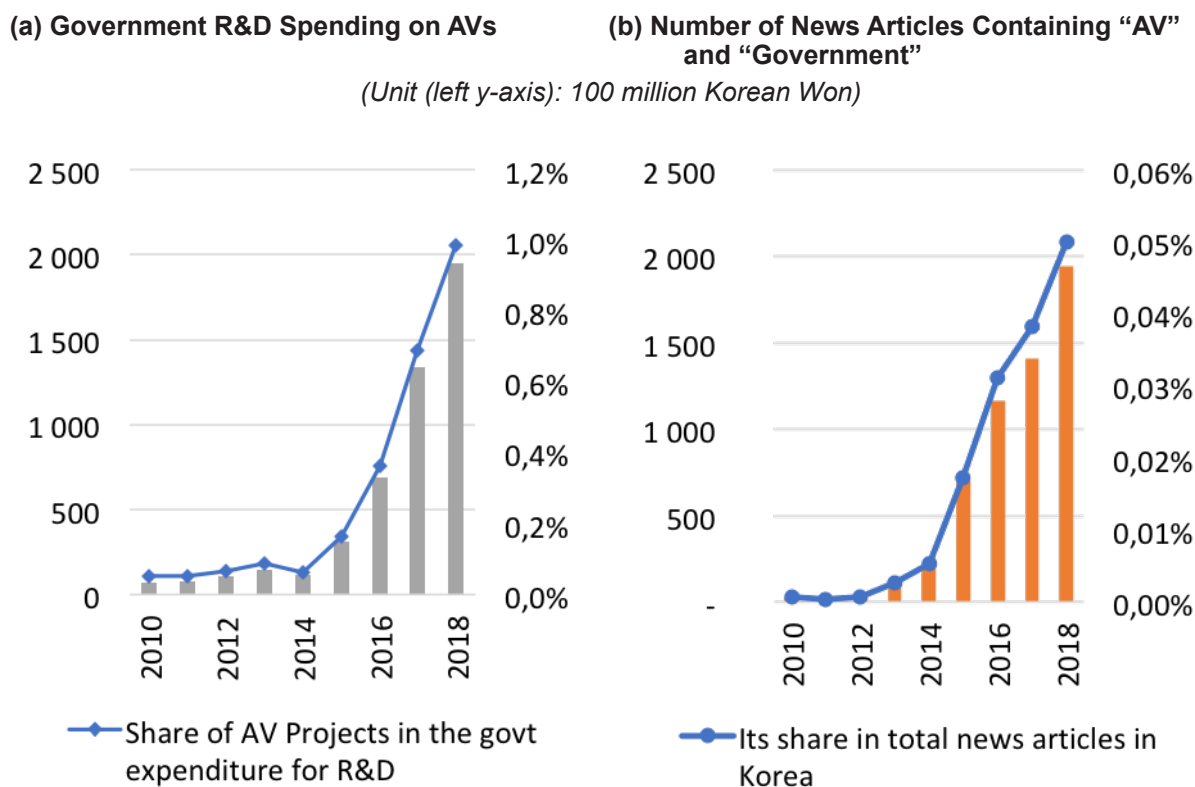
| Phase | Date | Policy/Plan | Ministry in charge ^{3,4} | Remarks |
|--------------------------|-----------|--|-----------------------------------|--|
| Recognition | Jun 2012 | 1st Master Plan for Motor Vehicle Policy (2012–2016) | MLTM | A minor focus on AV as an R&D subject |
| | Sep 2012 | Promotion Strategy for IT Convergence (2013–2017) | Relevant ministries (MKE) | AV mentioned as a form of convergence of IT and auto |
| Selection | Jul 2013 | 3rd Master Plan for Science and Technology (2013–2017) | Relevant ministries (MSIP) | 120 natl. strategic tech. (incl. smart cars) |
| | Oct 2013 | ICT R&D Mid- and Long-term Strategy (2013–2017) | MSIP | 15 future IT service (incl. driverless transport) |
| | Dec 2013 | 6th Plan for Innovation of Industrial Technology (2014–2018) | MOTIE | 13 fields of tech dev. (incl. AVs) |
| | Mar 2014 | Future Growth Engines | Relevant ministries (MSIP) | 13 strategic fields. (incl. smart cars) |
| | July 2014 | Mid- and Long-term R&D Strategy for Land, Infrastructure, and Transport (2014–2023) | MOLIT | 10 strategic R&D fields (incl. smart roads) |
| Planning | Mar 2015 | Comprehensive Action Plan for Future Growth Engines | Relevant ministries (MSIP) | Detailed R&D plans |
| | May 2015 | Plan to Support the Commercialization of Autonomous Vehicles | Relevant ministries (MOLIT) | Package of policy tasks |
| Acceleration & Expansion | Feb. 2017 | 2nd Master Plan for Motor Vehicle Policy (2017–2021) | MOLIT | |
| | Dec 2017 | Innovation Growth Engines | Relevant ministries (MSIT) | AV, reaffirmed as a strategic field |
| | Feb 2018 | Future Car Industry Development Strategy | Relevant ministries (MOTIE) | Updated AV action plan |
| | | Plan to Establish Smart Transport Systems | MOLIT | Plan for infrastructure and C-ITS |
| | June 2018 | Comprehensive Plan for Research and Development of Land, Infrastructure and Transportation (2018–2027) | MOLIT | 8 strategic R&D fields (incl. CAVs) |
| | Oct 2019 | Future Car Industry Development Strategy 2030 | Relevant ministries (MOTIE) | Revised roadmap to 2030 |

Note. Author's tabulation.

3. The ministry in the parentheses following “Relevant ministries” refers to the leading ministry.

4. MLTM: Ministry of Land, Transport and Maritime Affairs (now MOLIT); MKE: Ministry of Knowledge Economy (now MOTIE); MSIP: Ministry of Science, ICT and Future Planning (now MSIT)

Figure 2.3. Government Actions in Preparing the Future AV Era



Note. Author's visualization using search results from National Science & Technology Information Service (www.ntis.go.kr) (left) and Big Kinds (right).

The following are the three major ministries charged with AV policies: the MOLIT, MOTIE, and MSIT. The MOLIT establishes AV safety standards, legislative bills, and regulations for AV deployment and is also in charge of building road infrastructure for AVs and C-ITS. MOTIE supports R&D in AV parts, such as sensors and actuators. MSIT is in charge of R&D investment in AI and telecommunication technology for AVs and the establishment of data protection criteria for CAVs. The MOLIT serves as a leader when the Korean government establishes national level AV initiatives and inter-ministerial AV policies. Table 2.2 summarizes the roles of the three ministries.

Table 2.2. Major Actors in the Korean Government for AV Development and Deployment

| Ministry | Roles |
|--------------|---|
| MOTIE | · R&D investment in AV parts (sensor, actuator, etc.) |
| MOLIT | · AV safety standards · Road infrastructure, C-ITS · Legal system and regulations for AV deployment |
| MSIT | · R&D investment in AI, communication tech · Privacy protection criteria |

Note. Author's tabulation of the information from the websites of the MOLIT, MOTIE, and MSIT.

2.3. Korean Government's Goals in AV Deployment

As of January 2020, the Korean government has three goals in the deployment of AV. The first goal is to deploy NHTSA Level 3 vehicles in 2021 commercially.⁵ The second goal is to establish the world's first legal and regulatory framework, transport systems, and infrastructure for NHTSA Level 4 automation on major roads, such as expressways and roads in major cities, by 2024. Lastly, the government plans to roll out the world's first NHTSA Level 4 vehicles in 2027 on major roads commercially. These ambitious goals are set in the latest major AV policy Future Car Industry Development Strategy 2030, which was announced in October 2019.

The Korean government's AV deployment goals have evolved since 2015. The Plan to Support AV Commercialization, which was announced in May 2015, aimed to commercialize some features of Level 3 automation in 2020, which was the only goal of the Korean government then. Three years later, the government went one step further. The Future Car Industry Development Strategy, which was announced in February 2018, defined two additional goals: to build transport systems and infrastructure for NHTSA Level 4 automation on expressways by 2022 and launch Level 4 vehicles by 2030 commercially.

In comparison with the goals set in February 2018, the current goals, which were announced in October 2019, differ in three ways. First, the government postpones the commercial rollout of Level 3 vehicles from 2020 to 2021. Second, the establishment of transport systems and infrastructure for Level 4 automation on major roads has been also delayed for two years, that is, from 2022 to 2024. This delay is due to later-than-expected development of CAD technology. Lastly, the government advanced the goal of Level 4 commercialization by three years, that is, from 2030 to 2027. Table 2.3 summarizes these changes.

Table 2.3. Changes in the Korean government's Goals for AV deployment

| Plan | Plan to Support AV Commercialization (May 2015) | Future Car Industry Development Strategy (February 2018) | Future Car Industry Development Strategy 2030 (October 2019) |
|------|---|--|---|
| 2020 | Partial Level 3 AVs | Level 3 on expressways | |
| 2021 | | | Level 3 AVs |
| 2022 | | Transport systems and infra for Level 4 on expressways | |
| 2023 | | | |
| 2024 | | | Legal and regulatory framework, transport systems, and infra for Level 4 on major roads (world's first) |
| 2025 | | | |
| 2026 | | | |
| 2027 | | | Level 4 AVs (world's first) |
| 2028 | | | |
| 2029 | | | |
| 2030 | | Level 4 AVs | |

Note. Author's visualization.

5. The Korean government used NHTSA's levels of automation in its goal setting of AV deployment. NHTSA Level 4 is equivalent to SAE Levels 4 and 5.

To achieve these goals, the Korean government established strategies and policy actions. The author divides them into four categories: R&D and tests, legal and regulatory changes, transport systems and infrastructure, and social acceptance and elaborate them respectively in Sections 2.4 to 2.7.

2.4. Policy Area 1: R&D and Tests

Announced in June 2012, the First Basic Plan for Automobile (2012–2016) aims to create safe and convenient car-using environment for the people. The strategies for this vision include promoting R&D for automobile safety, eco-friendly cars, C-ITS, and connected vehicles. In this 2012 plan, AD is not a major R&D topic and is presented as an application of connected vehicle technologies. In the Promotion Strategy for IT Convergence, which was announced in September 2012, the development of AVs is selected as a policy action to promote the convergence of automotive and IT.

The Science and Technology Basic Plan is a five-year plan and the top-level government plan in the field of science and technology. The 3rd Science and Technology Basic Plan (2013–2017) was passed by the National Science and Technology Council in July 2013. The plan proposed five strategies, one of which was to develop national strategic technologies. These technologies refer to those that require strategic acquisition at the national level to promote economic revival and improve the quality of life of the people. One hundred twenty technologies, including *smart cars* and intelligent transport systems (ITS), are selected. Smart cars are vehicles that dramatically improve safety and convenience by transmitting and processing various data by using advanced computer control systems and IT technology. In this basic plan, the AD and V2X communication are included as a component technology of smart cars. The plan specifies a transport system that supports urban autonomous platooning as a component of the ITS.

In the same year, 2013, similar selections followed the 3rd Science and Technology Basic Plan by the three ministries in charge of AV development and deployment. The Ministry of Science, ICT and Future Planning (MSIP) (now MSIT) announced the ICT Mid- and Long-term R&D Strategy (2013–2017), which selected 15 future IT-based services. Driverless transport service is one of the services. MOTIE, a ministry charged with the development of technologies necessary for the industry, announced the 6th Plan for Innovation of Industrial Technology (2014–2018) in December 2013, which is MOTIE's top-level plan of technology and innovation. The five-year plan proposed its initiative to design 13 large-scaled R&D programs, one of which is for the development of motorway AD technology. MOTIE managed to launch a five-year R&D program of motorway AD technology in 2017 after passing a feasibility study over two years from 2014 to 2016.⁶ Lastly, in July 2014, another ministry, or the MOLIT, also selected C-ITS and road infrastructures for AD and automated platooning, which is dubbed as

6. Under the National Finance Act, a national R&D program with a total cost of at least 50 billion Korean won, at least 30 billion Korean won of which is to be subsidized by the State, shall be examined for feasibility. For this purpose, the Preliminary Feasibility Study on national R&D programs is conducted by MSIT, a ministry in charge of the management of national R&D programs, entrusted by the Ministry of Economy and Finance, which is responsible for budgeting.

smart roads, as one of its 10 strategic R&D fields in its Mid- and Long-term R&D Strategy for Land, Infrastructure and Transport (2014–2013).

The administration at that time, Park Geun-hye Government, announced its flagship industrial growth strategy entitled Future GE at the start of the second year (March 2014) of its five-year presidential term. The initiative selected 13 promising technologies or industries, including smart cars. This selection means that relevant ministries such as the MOLIT, MOTIE, and MSIT will give high priority of R&D investment to the 13 selected fields and thus increase their R&D spending. That smart cars are selected as one of 13 strategic fields in Future GE initiative is the main reason that the government R&D spending on AVs has skyrocketed since 2015 (see Figure 2.3 (a)).

The CAP of the Future GE, which was announced a year later in March 2015, presented a detailed roadmap of various policy actions for the selected 13 fields. The policy actions include R&D investment, establishing law and regulation, infrastructure construction, and manpower cultivation. The CAP of the Future GE has two meanings in AV R&D planning of the Korean government. First, the CAP is the first plan that sets out a division of roles among the R&D programs of relevant ministries. For example, MSIP's R&D program Technology Development for IT and SW Convergence Industry take on development of CAD SWs and communication security technology. The MOLIT's R&D program Transportation and Logistics R&D undertakes the development of transport system for CAD. Second, the CAP of Future GE contains budget planning for the selected fields while the previous plans that choose strategic technologies or fields did not. This fact implies that the former is more realistic than the latter ones. The CAP presents the estimation of necessary budgets of 5.7 trillion Korean won from 2015 to 2020 for the 13 selected fields, including 164 billion Korean won for smart cars (Minister of Science, ICT and Future Planning, 2015, p. 20).⁷

Further detailed plans for AV R&D, tests, and trials are revealed two months later in May 2015. With the leadership of the MOLIT, MOLIT, MOTIE, and MSIP jointly announced the Plan to Support AV Commercialization. The plan proposed 11 policy actions in three strategies to promote commercial deployment of AVs, some of which are about AV R&D, tests, and trials. The temporary operation permit system of AV tests, which started a year later in 2016, was first announced in this plan.

The importance of AVs for the Korean economic growth is reaffirmed by the next administration led by Moon Jae-in that started in May 2017. The government's flagship industrial strategy entitled Innovation Growth Engines (Innovation GE) reselected AVs as one of the 13 growth drivers of the Korean future economy in December 2017. However, Future GE in 2014 and Innovation GE in 2017 differ in the strategy for AVs. Although the former focuses on R&D investment, the latter expanded its focus to regulatory changes, tests and trials, and digital and road infrastructure. This expansion shows that the sectoral systems of AV innovation have evolved over the three years. Specifically, the government's behavior, AV policy planning, has moved on to the next stage as AV technology, and relevant industries have advanced closer to the commercial deployment of AVs. The detailed policy measures

7. Actual budgets are subject to change during the budgeting process of Ministry of Ministry of Economy and Finance.

and their roadmap were presented in the Implementation Plan of the Innovation GE in May 2018 approximately five months later.

The ministries involved in the development and deployment of AVs jointly and separately announced their plans. First, in February 2018, MOTIE announced the Future Car Industry Development Strategy, which was jointly established by relevant ministries. The MOLIT also announced the Plan to Establish Smart Transport System on the same day.

In October, about a year and a half later, the government updated its master initiative for the future automotive industry, or Future Car Industry Development Strategy and rebranded it as Future Car Industry Development Strategy 2030. This updated plan advanced one step further than the previous one of February 2018, including policy tasks to expand autonomous transportation pilots and develop the applications and services of AVs, such as robo-taxis, autonomous shuttles, truck platooning, and driverless patrol cars.

The evolution of the Korean government's AV policy from 2012 to 2019 shows a *tech-push* approach. Early AV policies around 2012 and 2013 focused on the R&D of AV parts and AD features; then, around 2015, its focus has expanded to promoting tests and establishing digital and road infrastructure and regulatory systems for the future deployment of AVs. Finally, in 2019, AV policies include plans to promote services and applications based on AVs.

The Korean government's major policy actions for AV R&D and tests presented in the above-mentioned plans includes:

- (1) R&D investment
- (2) Establishing temporary operation permission system of AVs
- (3) Building AV test facilities

2.4.1. R&D Investment

The government's investment on AV R&D has increased with some characteristics. First, although the investment was small and stable until 2014, it began to soar since 2015 (see Figure 2.3 (a)). AV R&D projects were inserted into existing national R&D programs to rapidly initiate the projects. In the national R&D system of Korea, large-scaled R&D programs must pass a feasibility assessment, which takes several months at least. Second, the major ministries in AV R&D investment are the MOTIE, MOLIT, and MSIT, and their roles are different. The MOTIE's R&D funding focuses on the development of AV components, such as low-cost LiDARs, multi-band radars, and computer vision sensors. In 2019, the National Policy Agency (NPA) first launched some R&D projects on AVs, for example, a project to develop traffic control systems for AVs.

The MOLIT's projects for C-ITS development and test have started to include connected autonomous driving (CAD) technologies, considering CAD as one of the major applications of C-ITS. In 2015, the MOLIT launched a large-scaled C-ITS R&D project entitled Cooperative-Automated driving Road System. The five-year project aims to develop digital and road infrastructure that supports CAD, including local dynamic map, V2X communication systems, localization technologies, and relevant road infrastructure.

2.4.2. Temporary Operation Permission of AVs

In February 2016, the MOLIT launched a temporary operation permission system for AVs, and thereby AV test on public roads became possible on designated roads. Near Seoul, a 41-km section of an expressway and five sections of the national highway totaling 319 km were designated. The maximum term of the temporary operation permit is five years. Hyundai Motor Company was the first to obtain the permission in March 2016. As of November 2019, 82 AVs obtained temporary operation permission (Table 2.4).

Table 2.4. Number of AVs to Which Temporary Operation Permission is Granted (by Year)

| Year | 2016 | 2017 | 2018 | 2019 (as of Nov.) | Total |
|---------------|------|------|------|----------------------|-------|
| Number of AVs | 11 | 19 | 30 | 22 | 82 |

Note. Author's tabulation by using MOLIT (2019) for 2016–2018 and- Park (2020) for 2019.

Automotive firms, including Hyundai Motor Company's 16 AVs, have 25 AVs to which temporary operation permission is granted (Tables 2.5 and 2.6). Tech firms follow with 10 units, including five AVs of Samsung Electronics.

Table 2.5. Number of AVs to Which Temporary Operation Permission is Granted (by Owner Type, as of December 2018)

| Type | Automotive firms | Tech firms | SMEs and startups | Research institutes | Universities | Total |
|---------------|------------------|------------|-------------------|---------------------|--------------|-------|
| Number of AVs | 25 | 10 | 6 | 9 | 10 | 60 |

Note. Author's tabulation by using MOLIT (2019).

Table 2.6. Top Five Organizations in the Cumulative Number of AVs to Which Temporary Operation Permission is Granted (as of December 2018)

| Organization | Org. type | First permission | Units | Remarks |
|---|-----------------------|------------------|-------|---|
| Hyundai Motor Company | Auto company (OEM) | March 2016 | 16 | First org. that obtained the permission |
| Samsung Electronics | Electronics company | May 2017 | 5 | |
| Seoul National University | University | March 2016 | 5 | |
| Advanced Institutes of Convergence Technology | Research institute | March 2018 | 3 | Two shuttles |
| Hyundai Mobis | Auto company (tier 1) | May 2016 | 3 | |

Note. Author's tabulation by using MOLIT (2019).

A regulatory framework for the temporary operation permission system was established through a partial amendment of the Motor Vehicle Management Act (MVMA) and its subordinate laws, which include Enforcement Decree of the MVMA and Enforcement Rules of the MVMA, and the enactment of Regulations on the Requirements for Safe Operation, Test Operation, Etc. of Autonomous Vehicles. The respective laws were sequentially promulgated from the higher laws in six months from August 2015 to February 2016.

The temporary operation permission system for AVs has evolved since its implementation. The major changes include:

a) Deregulation of test operation areas (November 2016)

With an amendment of the Enforcement Rules of the Automobile Management Act, AV test runs have been made possible on nearly all roads throughout the country, including city streets, except for protected areas for children, older persons, and persons with disabilities.

b) Improvement of the Regulations on the Requirements for Safe Operation, Test Operation, Etc. of Autonomous Vehicles (March 2017)

The original regulation was first amended in March 2017, approximately a year after it was enacted in February 2016. The key changes are presented as follows.

- The original regulation did not specify who is liable for the damages caused by AVs, although it had a provision that the applicant for the temporary operation permit for an AV shall purchase an insurance policy under paragraphs (1) and (2) of Article 5 of the Guarantee of Automobile Accident Compensation Act. In the partial amendment in March 2017, the provision specified that an AV owner who applies for a temporary operation permit of the AV, or a person who has the right to use the AV, shall be liable for damages caused by the vehicle's operation.
- The March 2017 amendment specified the verification methods and criteria of the performance test of an AV, which applies for a temporary operation permit, while the original regulations did not have them.
- The original regulations stipulate that at least two test personnel, including the driver, shall be aboard the AV during its test runs for safety. The amendment of the regulations eliminated the need for the second personnel. Instead, the qualifications and duties of the driver were specified.

c) Deregulation of the permission of identical vehicles (April 2018)

If the identical applicant applies for additional temporary operation permits for AVs of the same specification, then the applicant does not need to submit the real vehicles to apply for permission. For this simplification, the Regulations on the Requirements for Safe Operation, Test Operation, Etc. of Autonomous Vehicles was partially amended in April 2018.

d) Establishment of duty to report (April 2018)

A provision on duty to report has been newly inserted in the Motor Vehicle Management Act. A person who has obtained temporary operation permission shall report information on operation, such as changes in main systems and functions, operation records, and information on traffic accidents, to the MOLIT to ensure the safe operation of AVs.

2.4.3. Building AV Test Facilities

K-City (Figure 2.4) is a mock city built for testing AVs, located on the proving ground of the Korea Automobile Testing & Research Institute (KATRI) in Hwaseong-si, Gyeonggi-do, 60 km from south of Seoul.⁸ The construction plan was announced in March 2015, and the construction was completed in December 2018. The 12.5-billion Korean won mock city financed by the MOLIT replicates almost all environments that AVs might experience. The existing ITS testing area of 320,000 m² has been upgraded to contain a short expressway with junctions and toll gates, urban and suburban blocks, residential area (e.g., school zone), and various forms of parking lots. The expressway section was constructed and opened first in November 2017, about a year earlier than the completion of the whole test bed, to support the achievement of the government's goal of commercializing Level 3 AVs by 2020. In addition to WAVE and LTE-V2X, the proving ground is capable of 5G-V2X testing, which was the first in the world as of its opening moment in December 2018.⁹ The K-City provides 15 virtual C-ITS features compliant with domestic standards (Kim, 2019). The MOLIT will carry out the K-City Enhancement Project 2019–2021 to provide harsh test environments, such as traffic congestion, bad weather conditions (e.g., rainfall and fog), and communication disturbance, including GPS jamming (Kim, 2019; Joint related ministries, 2019, p. 23).

Figure 2.4. Layout and Features of K-City



Note. A figure in Jung (2017).

8. KATRI is an automobile safety research institute affiliated with the Korea Transportation Safety Authority under the MOLIT. The institute aims to promote the development of the Korean automobile industry through various projects, including the automobile performance test.

9. WAVE: wireless access in vehicular environments, LTE: long-term evolution

Some AV test beds have been constructed on real roads in recent years. Seoul constructed a CAV test bed in June 2019, and it is capable of 5G testing. In the same month, a test bed for autonomous shuttles, including a control center, began its operation in technology cluster Pan-gyo's Techno Valley, which has been touted as Korea's Silicon Valley. A test bed for AD and platooning of commercial vehicles, such as trucks, will be constructed for two years, starting in 2020 in Gunsan, a manufacturing industrial city in North Jeolla Province. Daegu Metropolitan City has also been constructing an AV pilot zone, including various digital and road infrastructure for AVs since 2016. The construction of these test beds is co-financed by the MOLIT and respective local governments.

2.5. Policy Area 2: Legal and Regulatory Framework

In November 2018, the government announced a roadmap of regulatory changes for AVs. The joint working group of relevant ministries, companies, and research institutes headed by the Office for Government Policy Coordination under the Prime Minister drew up the roadmap, which the government says *anticipatory*. Considering the future advancements of the AD system from SAE Levels 2 to 5 and the timing of their arrival, the working group derived eight future AV use cases. Based on these scenarios, the working group identified 30 regulatory issues in four areas and proposed necessary changes in laws and regulations by issue and the time to implement them in advance before problems occur as AVs develop toward Level 5. The four areas correspond to driver; vehicle and device; driving; and infrastructure. For example, the current Road Traffic Act prohibits driving while intoxicated. Level 5 AVs can safely drive when its human driver is intoxicated. Thus, this prohibition has a room to be eased when full automation arrives. The roadmap plans to revise the relevant provisions after 2025 in the era of Level 4 in advance before the next and final automation era arrives. Figure 2.5 presents the summary of the roadmap.

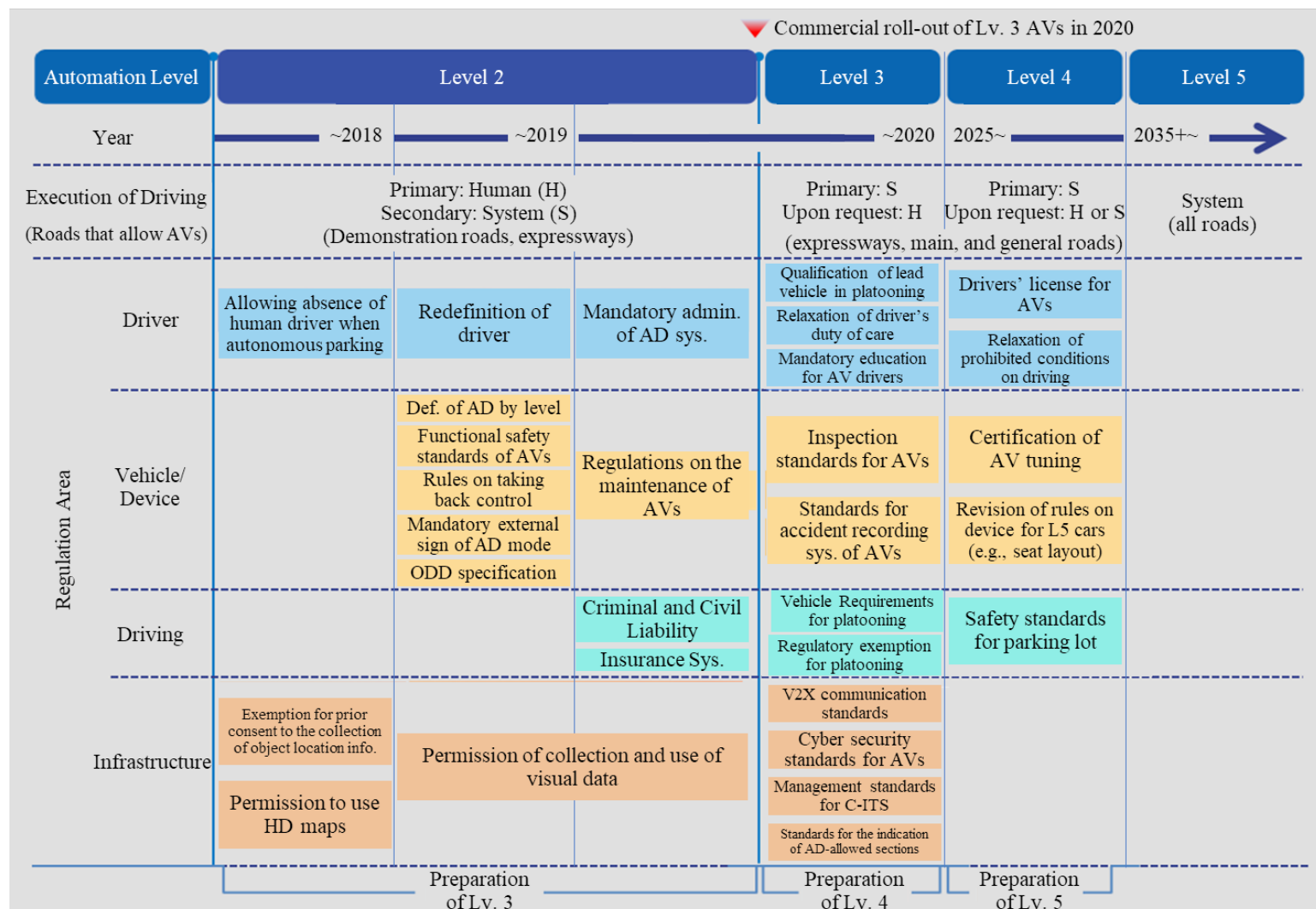
Before the roadmap is established, two changes in the Korean law regarding AVs have been carried out since 2015. The first one is to establish a legal basis for AV tests on the public streets. The other one is to establish a regulatory framework for deployment of AVs in the future. Below are the major changes in the Korean law regarding AVs, which have been carried out by February 2020, when this report is written.

2.5.1. Motor Vehicle Management Act¹⁰

From August 2015 to February 2016, the Motor Vehicle Management Act and its subordinate laws were amended to provide legal framework for the temporary operation permission system for the AVs. This revision is the first-ever change in the entire Korean law with respect to AVs, thereby creating the definition of AVs in the Korean law for the first time. The details of this amendment are found in Subsection 2.4.2) of this chapter.

10. The *Motor Vehicle Management Act* aims “to manage motor vehicles efficiently and secure the performance and safety of motor vehicles by prescribing the matters concerning the registration, safety standards, self-authentication, correction of manufacturing defects, inspection, maintenance, testing of motor vehicles, and motor vehicle management business, etc., and thereby contributing to promoting public welfare” (Motor Vehicle Management Act, 1995 & rev. 2018, December 31, Article 1).

**Figure 2.5. Roadmap of regulatory changes for AVs of the Korean Government
(Announced in November 2018)**



Note. Author's translation of the original diagram in Office for Government Policy Coordination (2018).

In December 2019, the safety standards for *partial* AD systems, equivalent to SAE Level 3, were established through the addition of new provisions to the Rules on Performance and Standards of Motor Vehicles and Their Parts, which is a subordinate law of Motor Vehicle Management Act. The safety standards are not for all but for some features of Level 3 AVs: lane keeping system, driver monitoring system, and reactions to the breakdowns and errors of the Level 3 AD system. AVs with these Level 3 features will be available on the roads from July 2020, when this revision enters into force. This amendment includes the classification of the levels of AD among *partial*, *conditional*, and *full* AD systems, equivalent to SAE Levels 3, 4, and 5. This classification is the first in Korean law.

2.5.2. Road Traffic Act

The Road Traffic Act, enacted in 1962, aims to ensure the safe and smooth flow of traffic by preventing and removing all dangers and obstacles to traffic on roads. The main contents of the Act include ways for motor vehicles to pass through roadways, obligations of drivers and employers, and use of roads. The NPA under the Ministry of the Interior and Safety manages the Act. The first revision relating to AVs was made in March 2018. The partial amendment allows a motor vehicle to be equipped with devices for the development of new technology for AVs; these features may disturb the function of traffic law enforcement devices or make it possible to impede safe driving.¹¹ The regulation that requires the driver to switch off the vehicle when leaving the driver's seat was relaxed to taking measures to prevent traffic accidents when a driver leaves any vehicle, thereby implying that autonomous parking is allowed by law. These two revisions entered into force on the date of the promulgation of the amended Act in March 2018.

2.5.3. Act on the Promotion and Support of Commercialization of Autonomous Vehicles (Autonomous Vehicles Act)

The Act was enacted in April 30, 2019 and takes effect a year later (May 1, 2020). This Act provides the legal basis, to name a few:

- a) to enable the MOLIT to formulate a master plan for autonomous-driving-based transport and logistics every five years;
- b) to enable the MOLIT to designate *autonomous driving safety areas*, which refers to sections on motorways in which AVs can safely drive. The quality of road infrastructure of the sections should be maintained for AD, and the sections have priority in the installation of C-ITS;
- c) to designate pilot zones for AVs, where various regulatory exemptions are granted to ensure the trials and launching of new business using AVs;

11. The relevant provision in the Road Traffic Act is as follows:

Article 49 (Matters to be Observed by Every Driver)(1) Every motor vehicle or tram driver shall observe each of the following matters:

4. No driver shall drive any motor vehicle equipped with devices that disturb the function of traffic law enforcement devices or other apparatuses that make it possible to impede safe driving, in unconformity with the standards prescribed by Ordinance of the Ministry of the Interior and Safety: Provided, That the same shall not apply where a device for the development of new technology for autonomous driving motor vehicles under subparagraph 1-3 of Article 2 of the Motor Vehicle Management Act is installed on a motor vehicle; (Road Traffic Act, 1961 & rev. 2018, May 27, Article 49)

- d) to ease regulations related to information privacy for anonymized personal information; and
- e) to support technological development, manpower cultivation, and international cooperation related to AVs and C-ITS for AD.

2.5.4. Other(s)

As of February 2020, the amendment of the Guarantee of Automobile Accident Compensation Act is awaiting review of the Legislation and Judiciary Committee of the National Assembly (MOLIT, 2020). The amendment includes liability standard, obligation to attach AD data recorder, and establishment of accident investigation committee.

2.6. Policy Area 3: Infrastructure for AV Deployment

The Future Car Industry Development Strategy 2030, jointly proclaimed by ministries concerned in October 2019, aims to establish the world's first infrastructure for Level 4 automation on major roads nationwide by 2024. The strategy classifies infrastructure for AV deployment into four types: 1) communication infrastructure, 2) HD maps, 3) traffic control system, and 4) road infrastructure. The following sub-sections present policy tasks specified in the strategy for each category.

2.6.1. V2X Communication Infrastructure

The Future Car Industry Development Strategy 2030, which was announced in October 2019, presents a plan to build vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication infrastructure on major roads, such as highways, national roads, and metropolitan areas, by 2024. Before that, the infrastructure will be first constructed from 2020 in *autonomous driving safety sections*, defined in the Act on the Promotion and Support of Commercialization of Autonomous Vehicles, which will be implemented in May 2020. Meanwhile, the MOLIT and MSIT will decide on the V2X communication method by 2021 among WAVE, 5G-V2X, and a mixture of both, considering international standards and other major countries' selections.

2.6.2. HD Maps

The government's plan to create 3D HD maps was first presented in the Plan to Support the Commercialization of Autonomous Vehicles, which was announced in May 2015. The government planned to generate HD maps of the designated roads of the temporary operation permission system for AVs first and then gradually expand their coverage to all roads throughout the country in line with the government's schedules for the commercialization of AVs. The National Geographic Information Institute under the MOLIT took charge of this project. By the end of 2015, HD maps were first generated for 277 km of roads, of which 227 km were approximately two thirds of the initially designated roads of the temporary operation permission system for AVs, and the remaining 50 km was the advanced proving ground of KATRI.

In the Plan to Establish Smart Transport Systems, which was announced on February 2, 2018, the MOLIT presented their targets in AV deployment in line with the government's goals to roll out Levels 3 and 4 AVs, which are declared in the Growth Strategy for Future Automotive Industry announced on the same day. Specifically, as the first target, the MOLIT plans to create HD maps of expressways nationwide and some urban areas, which are approximately 5500 km long, by 2020, when the Growth Strategy for Future Automotive Industry aimed to deploy Level 3 automation. The MOLIT plans to develop HD maps for all roads across the country, totaling 100,000 km, by teaming up with the private sector by 2030 as a preparation for the rollout of Level 4 AVs in 2030. The Level 4 deployment in 2030 is one of the goals of The Growth Strategy for Future Automotive Industry. The first target was achieved a year earlier in 2019 (Yoon, 2020). Figure 2.6 presents the roads where HD maps are created from 2015 to 2019. They cover all national expressways, some general national highways, and diverse AV test beds and demonstration areas for C-ITS. Table 2.7 shows the annual progress in developing HD maps by 2019. These 3D HD maps are being distributed for free by the National Geographic Information Institute for use by private companies, research institutions, and universities.

Figure 2.6. Cumulative Coverage of HD Maps from 2015 to 2019



Note. Figure 2 in Yoon (2020) with the translation of the legend.

Table 2.7. HD Map Creation by Year

| Year | New lengths with HD maps (km) |
|-------|-------------------------------|
| 2015 | 277 |
| 2016 | 194 |
| 2017 | 880 |
| 2018 | 1296 |
| 2019 | 2933 |
| Total | 5580 |

Note. Author's tabulation of data in Figure 2 in Yoon (2020).

The Future Car Industry Development Strategy 2030, which was proclaimed in October 2019, elaborated policy tasks for creating 3D HD maps. Prior to covering 110,000 km of roads nationwide by 2030, the MOLIT aims to create HD maps of general national roads and metropolitan areas by 2024. Public-use facilities, such as parking lots, will be covered by 2030. In 2020, the MOLIT will establish a special-purpose entity for the continuous updating, management, and distribution of the maps.

2.6.3. Traffic Control System

The NPA aims to create an integrated system that will provide traffic signals to vehicles in real time and control traffic flows according to the Future Car Industry Development Strategy 2030. A total of 10 sites in Seoul metropolitan area will be established by 2020, additional 34 sites in Seoul metropolitan area and key areas will be established by 2024, and finally nationwide coverage will be achieved by 2030.

2.6.4. Road Infrastructure

The Future Car Industry Development Strategy 2030 presents a policy action to harmonize traffic lights and safety signs on roads nationwide by 2030 to improve the perception capabilities of vehicle sensors. The government will conduct pilot projects by 2022, cover 30% of roads nationwide by 2024, and eventually reach harmonization across the country by 2030.¹² In 2020, the MOLIT will initiate projects to design new components of roads and buildings optimized for AVs, such as special lane markings for AV computer vision and indoor GPS for autonomous parking.

12. The Future Car Industry Development Strategy 2030 does not specify the ministry that will assume this task. I conjecture the NPA will assume the task given that it manages the traffic safety facilities.

2.7. Policy Area 4: Social Acceptance

Various policy measures are directly and indirectly related to social acceptance. For example, building road infrastructure and institutional frameworks for the AV era contributes to improving public acceptance of AVs. One of the most direct policy means is AV trial runs that are normally in the form of autonomous shuttles. People can hands-on experience the new technology by taking the autonomous shuttles and sharing roads with them. This section presents the trial runs of autonomous shuttles in Korea.

The first test operation of AVs, which is open to the public, began in September 2018, when the local government of Gyeonggi Province, a Province surrounding Seoul, launched an autonomous shuttle test operation in their smart city entitled Pangyo Zero City. The autonomous shuttle runs a 5.8-km fixed route in the Pangyo Techno Valley.¹³ The shuttle runs eight times on weekdays with up to five passengers with a maximum of 25 km/h. One-way non-stop operation on the 5.8-km route takes approximately 20 min. The shuttle was developed by Advanced Institutes of Convergence Technology (AICT) in collaboration with various automotive and tech companies.¹⁴

In 2015, with financial support from the central government, the MOLIT, specifically, the Gyeonggi-do Provincial Government, set a plan to build a smart city and provide the above-mentioned autonomous shuttle service within this smart city, which includes a part of the Pangyo Techno Valley. Accordingly, the Provincial Government had its own research institute AICT develop the shuttles. The development of the first unit took three years from 2016 to 2018.

Several domestic companies participated in this AICT-headed autonomous shuttle project. Specifically,

- Shuttle frame: Dae-Chang Motors (<http://www.dacmotors.co.kr/main>)
- Communication tech: KT, formerly Korea Telecom, the second-largest Korean mobile telecom operator (<https://corp.kt.com/eng/>)
- AD solution: Unmanned Solution (<http://www.unmansol.com/>)
- Vision data analysis: Nexreal (<http://www.nexreal.com/>)
- V2X system: Suh-dol Electronics & Communication (<http://www.suhdol.co.kr/index.php>)
- V2X device: CHEMTRONICS (<http://www.chemtronics.co.kr/kr/>)
- Radar: Mando Corp., the largest Korean Tier 1 supplier to the auto industry (<https://www.mando.com/eng/>)
- Foreign technology is also used:
 - LiDAR: Velodyne, SICK, and Ibeo Automotive Systems
 - Differential Global Positioning System: NovAtel
 - Inertial navigation system: Oxford Technical Solutions
 - Front and rear cameras: Mobileye

13. Gyeonggi-do (pronounced as gyeong-gi-do) is the province surrounding Seoul and is the most populous one in South Korea. Pangyo (pronounced as pan-gyo) is the name of a region in Seoung-nam, a city in Gyeonggi-do Province.

14. Established in 2008, AICT, is a research instituted financed by Gyeonggi-do Provincial Government.

Another trial operation was implemented in Daegu Metropolitan City, which has been promoting the AV parts industry. Since August in 2019, French Navya's autonomous shuttles ran a 2.5-km designated section in Daegu at approximately 15 km/h with necessary traffic controls. This test run was not open to the public. The local government plans to launch commercial autonomous shuttle services in April 2020 (Ryu, 2020). Another local government, Sejong, has a similar plan of autonomous shuttle services; however, Sejong has no trial operation yet.

One-time events are being held increasingly, where ordinary people can ride in AVs and shuttles. For example, Pangyo Autonomous Motor Show has been taking place every November since 2017 as of April 2020, hosted by Gyeonggi-do Provincial Government and sponsored by the MOLIT, MSIT, and MOTIE. This event includes AD demonstrations, trial rides, industry fair, and a conference on AV technologies.

Compared with French and Japanese cases on AV trials, which are addressed in Sections 3.3 for France and 4.3 for Japan, AV trials in Korea are less active than the two countries. According to KPMG (2019), the proportion of national population living in the cities carrying out AV tests are only 2.0 percent in Korea, while 20.9 percent in France and 30.1 percent in Japan. This indicator reflects an idea that “the more people see AVs on the road, the more comfortable that they are likely to use them when they become available” (KPMG, 2019).

The Future Car Industry Development Strategy 2030, announced in October 2019, contains the government's latest major plan for AV deployment (see Section 2.2 and Table 2.1). The Strategy strengthened policy measures to improve public acceptance of AVs, compared with its previous version, announced in February 2018. First, the central government plans to expand pilot programs of autonomous transportation in various areas in cooperation with local authorities. In specific, the government is going to supply 50 units of autonomous shuttle busses to cities and towns by 2022, including sparsely populated areas, which are expected to increase mainly due to depopulation. Second, the government plans to develop and pilot public services utilizing autonomous driving technologies from 2021, such as autonomous mass transit, street cleaning cars, autonomous patrol cars, etc. The Strategy reaffirmed that relevant ministries are going to establish a data protection plan for CAV services from 2020.

Taking effect on May 1, 2020, Autonomous Vehicles Act provides a legal basis for the government to designate AV pilot zones (see Section 2.5). The zones exempt autonomous mobility businesses from various regulations. As these businesses grows, social acceptance will become a more important policy topic in Korea.

2.8. Implications from Korean AV Policy

A case study on the Korean AV policy leads us to the following implications. First, the Korean government's AV policy has been established mainly for economic growth and industrial development. The massive R&D funding began in 2015 after Future GE initiative, which was declared in March 2014, selected the AV as one of its 13 strategic fields. The Future GE initiative set the goal of taking the leap toward the top three country in the future AV industry. The first comprehensive AV plan of the Korean government or the Plan to Support

the Commercialization of Autonomous Vehicles states its purpose as to improve traffic safety and create new growth engines by AV deployment. This statement explicitly includes economic purpose. By contrast, social and environmental issues, such as sustainability, urban congestion, and aging society, are seldom addressed at such a top level (e.g., vision, purpose) in major AV policy planning.

Second, the Korean AV plans focus more on *commercializing* autonomous car product and components than implementing AV-based services and applications. This tendency is reflected in the fact that, as of the end of February 2020, only one autonomous shuttle test operation is open to the public since 2015, when the Korean government began to formulate AV policies in earnest.

3. Japanese Case of AV Policy

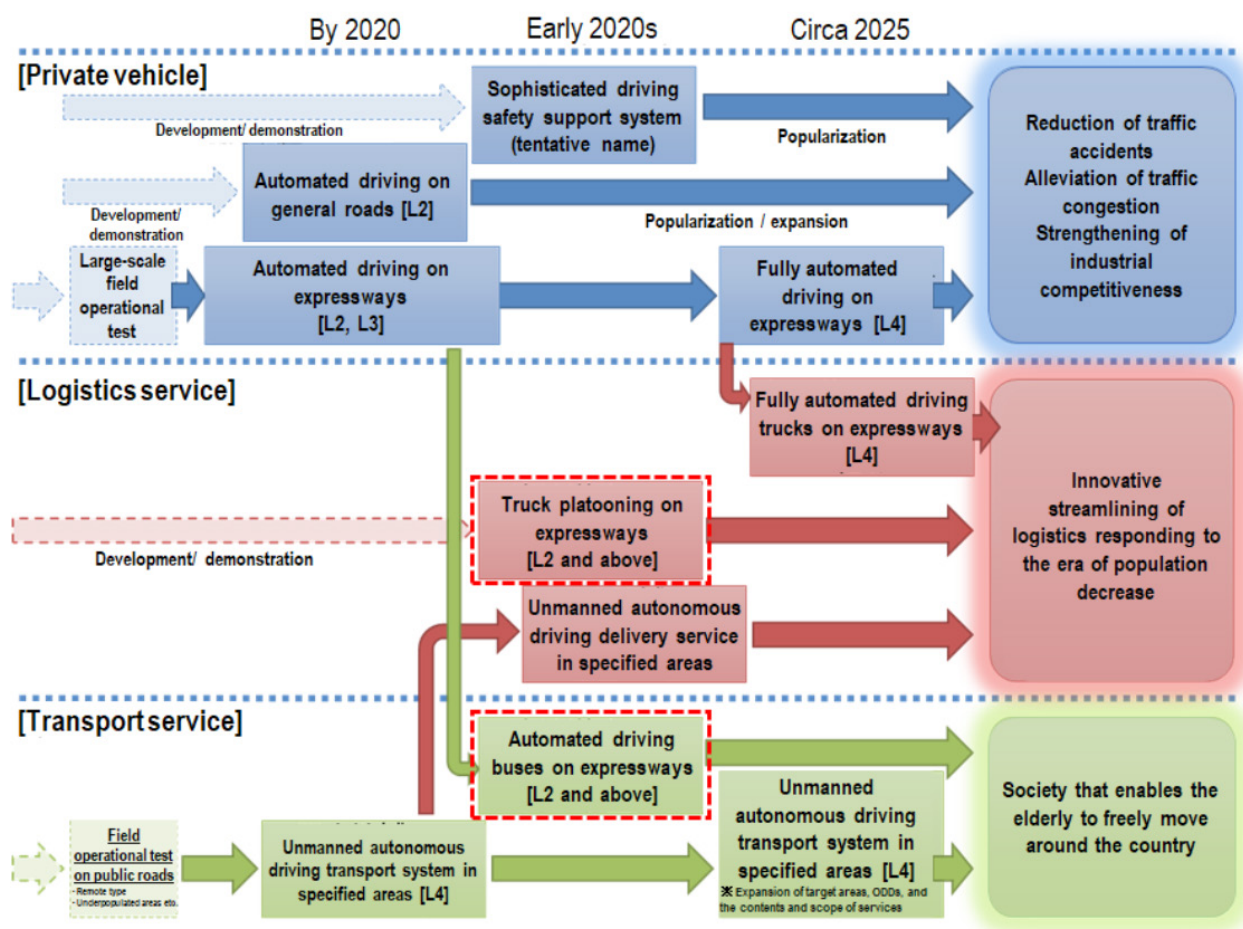
3.1. Milestones in AV Policy Making in Japan and Major Governmental Players

In October 2013, a roadmap for the introduction of automated driving systems was announced by the Autopilot System Council under the Ministry of Land, Infrastructure, Transport, and Tourism (MLIT), which is the ministry in charge of transport in Japan. The roadmap's goal is to deploy automated driving technologies on highways by the early 2020s. In the following year (June 2014), Public–Private ITS Initiative/Roadmaps (ITS Initiative), in which the Japanese government's introduction plan of automated driving system was integrated, was announced. The Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society or IT Strategic Headquarters, which was established in January 2001 within the Cabinet, established the ITS Initiative (IT Strategic Headquarters, n.d.). The ITS Initiative, including the Japanese roadmap of AV development has been updated annually since its first establishment in 2014. Figure 3.1 presents a simplified version of the latest roadmap as of February 2020 as announced in the ITS Initiative 2019 in June 2019.

A feature of the Japanese AV deployment roadmap is its respective scenarios and targets for three types of AV applications, namely, passenger vehicle, logistics service, and transport service. For example, by 2020, the automation of private vehicle is expected to reach Level 2 automation on general roads, whereas transportation service in specific areas targets to reach Level 4, considering the differences in technological requirements for the respective applications.

With regard to R&D plans, in May 2014, the Japanese government initiated a cabinet-level AV R&D program entitled Strategic Innovation Promotion Program—Automated Driving for Universal Services (SIP-adus), which is addressed in detail in the following section or Section 3.2.

Figure 3.1. Japanese Roadmap for the Introduction of AVs

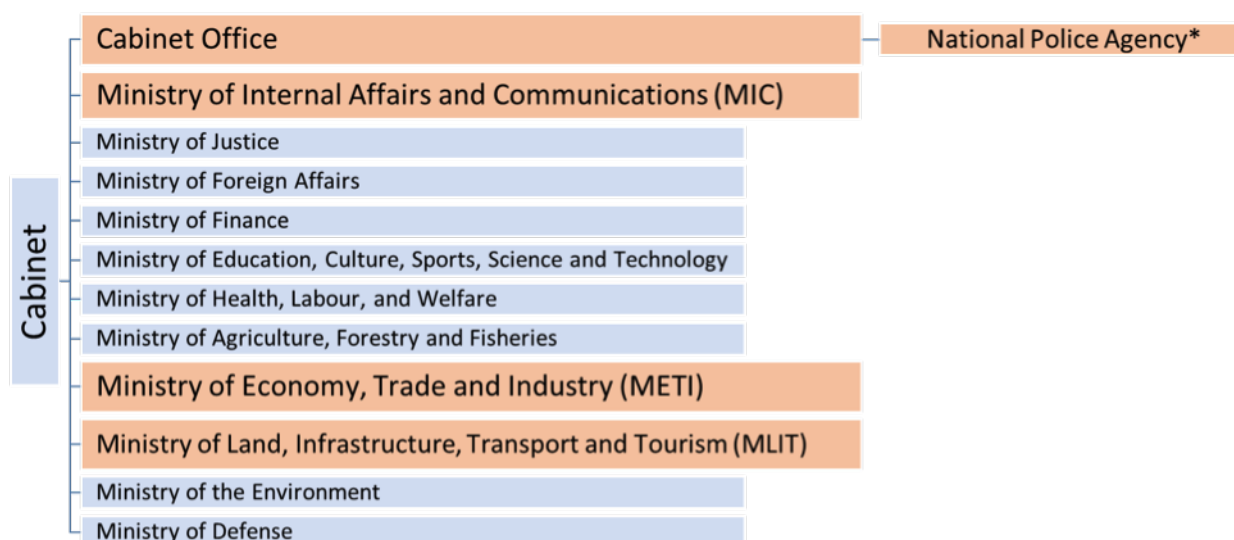


Note. Figure 7 in Strategic Conference for the Advancement of Utilizing Public and Private Sector Data (2019, p. 21)

In 2015, the administration of Japanese Prime Minister Shinzo Abe announced the 2015 revision of Japan Revitalization Strategy. The national growth strategy, which is announced annually since 2013, included AVs as a strategic item for the first time in 2015. The Panel on Business Strategies in Automated Driving was established by the Ministry of Economy, Trade and Industry (METI), and MLIT in February 2015. The panel aims to analyze the current problems and draw necessary actions to secure Japan's competitiveness in the field of AD systems and solve various societal problems (e.g. traffic accidents) worldwide (Panel on Business Strategies in Automated Driving, 2018). The panel released Action Plan for Realizing Automated Driving versions 1.0 and 2.0 in 2017 and 2018, respectively.

The major governmental players in the Japanese AV policy making include the Ministry of Internal Affairs and Communications (MIC), METI, MLIT, and National Police Agency. These players are almost identical to those of Korea. Figure 3.2 shows the Japanese government structure, and the major players in AV policy are marked in light orange boxes.

Figure 3.2. Ministries Involved in AV Policy



Note. Author's visualization.

* Not directly administrated by the Cabinet Office but via the National Public Safety Commission

3.2. National-level AV R&D Program: SIP-adus

The SIP is the Japanese government's cross-ministerial R&D program launched in 2014. This project aims to facilitate seamless R&D from basic and applied research to commercialization with cross-ministerial cooperation. The SIP consists five-year phases. The first phase ended in 2018, and the second phase is from 2019 to 2023. In Phase 1, 11 R&D themes were selected, one of which is automated driving system (ADS). Table 3.1 presents the 11 themes of the SIP and their objectives.

The ADS project is called SIP-adus. The objectives of SIP-adus are as follows:

- (1) To reduce traffic accidents and alleviate traffic congestion
- (2) To roll out ADS early
- (3) To develop an advanced public bus system for elderly and disabled people

SIP-adus was reselected when SIP Phase 2 started in 2019 with 12 themes. Thus far, SIP-adus have had two program directors, and both are from Toyota Motor Corporation.¹⁵ Figures 3.3 presents the target areas of SIP-adus Phase 1. SIP-adus is a joint industry–academia–government collaboration; its promotion structure is in Figure 3.4.

15. Hiroyuki Watanabe (Toyota Motor Corporation, Advisor) (2014–2016) and Seigo Kuzumaki (Toyota Motor Corporation, Executive General Manager) (2016–present, as of June 2019).

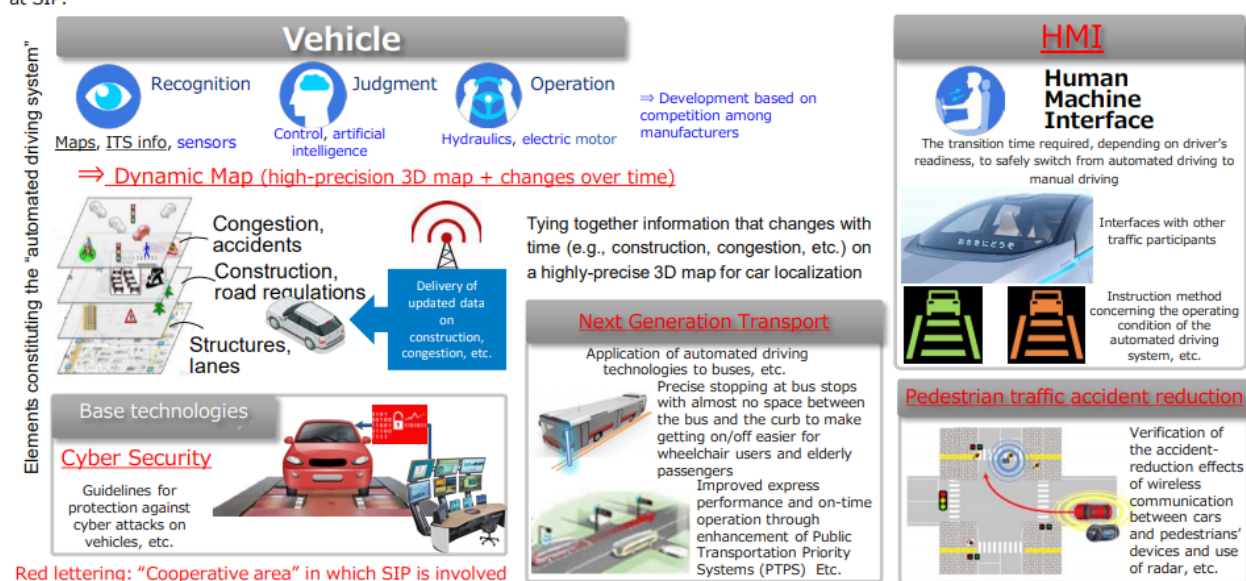
Table 3.1. 11 R&D Themes of the SIP

| Priority policy issues | Themes | Objective |
|--|---|--|
| Energy | Innovative Combustion Technology | Improving fuel efficiency of automobile engines |
| | Next-Generation Power Electronics | Integrating new semiconductor materials into highly efficient power electronics system |
| | Structural Materials for Innovation (SM ⁴ I) | Developing both ultra-strong and -light heat-resistant materials for airplane such as CFRP, alloys, intermetallic, and ceramic-coatings and Materials integration system to predict performance of materials. |
| | Energy Carriers | Promoting R&D to contribute to the efficient and cost-effective technologies for utilizing hydrogen |
| | Next-Generation Technology for Ocean Resources Exploration | Establishing technologies for efficiently exploring submarine hydrothermal polymetallic ore |
| Next-generation infrastructures | Automated Driving System | Developing new transportation system including technologies for avoidance accidents and alleviating congestion |
| | Infrastructure Maintenance, Renovation and Management | Developing low-cost operation & maintenance system and long life materials for infrastructures |
| | Enhancement of Societal Resiliency against Natural Disasters | Developing technologies for observation, forecast and prediction of natural disasters |
| | Cyber-Security for Critical Infrastructures | Development of technologies that monitor, analyze, and defend control and communication system as well as confirm integrity and authenticity of system components to protect critical infrastructures against cyber threats. |
| Local resources | Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries | Realizing evolutionary high-yield and high-profit models by utilization of advanced IT etc |
| | Innovative Design/Manufacturing Technologies | Establishing new styles of innovations arising from regions using new technologies such as Additive Manufacturing |

Note. SIP (n.d., p. 2).

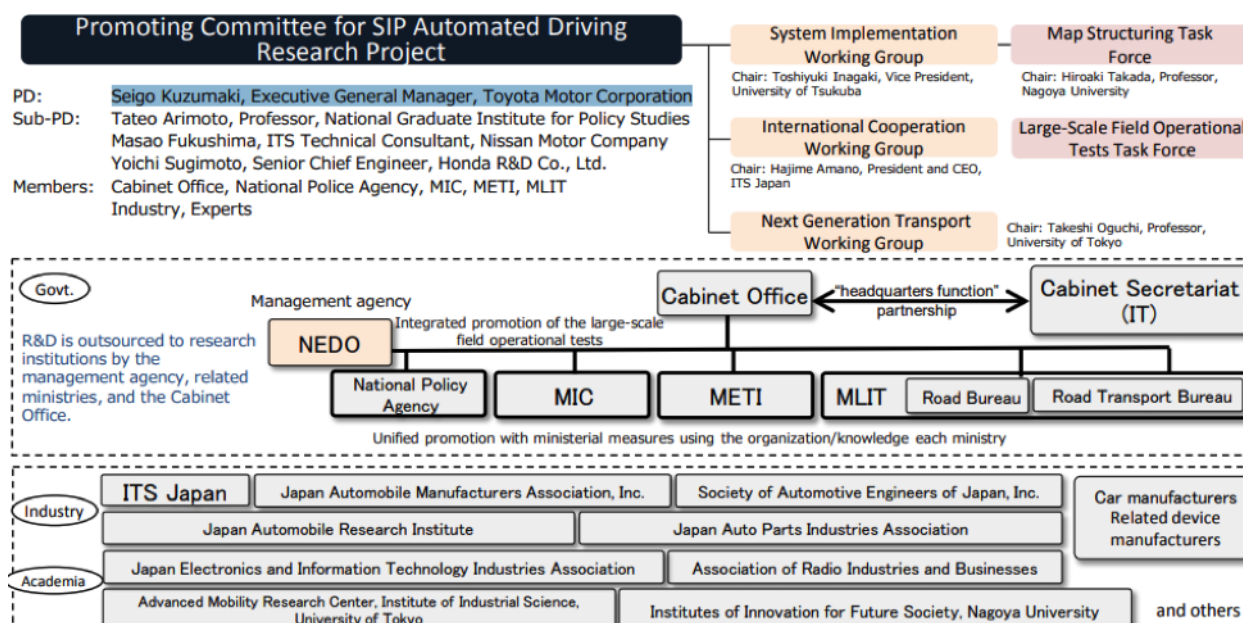
Figure 3.3. Target Areas of SIP-adus (Phase 1)

Promoting R&D focused on topics for technical fields (cooperative fields) that require a joint industry-academia-government collaboration at SIP.



Note. The SIP (n.d., p. 2).

Figure 3.4. Promotion Structure of SIP-adus



Note. The SIP (n.d., p. 3). The New Energy and Industrial Technology Development Organization, or NEDO is Japan's largest public management organization promoting R&D.

SIP-adus shows two differences in AV R&D between Korea and Japan. First, AV-based services are explicitly included in SIP-adus. *Adus* is an abbreviation of automated driving for universal services. The name of the national AV R&D program contains *services* in its name. In addition, one of the objectives of the SIP-adus is to develop a transport system for the elderly and the disabled. By contrast, Korean R&D programs mainly focus on AV technologies and parts development with less focus on the applications of such developments. Second, the program director of SIP-adus has been from Toyota, implying that Japanese auto giants play an important role in the national AV R&D program. In Korea, Hyundai Motor Company has not taken on such a position in national R&D programs on AVs.

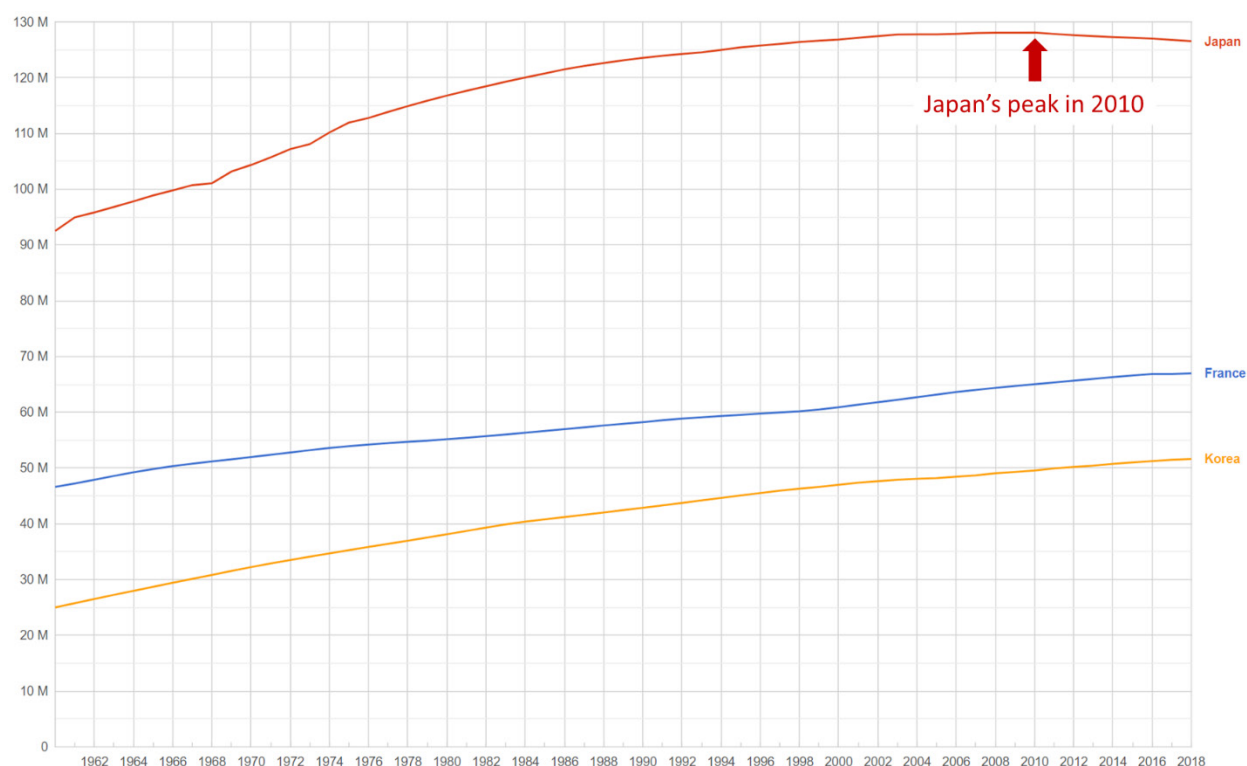
3.3. Trials of Autonomous Shuttles in Japan

Japan is now the most aged country, and this is expected to continue in the future (Table 3.2). In addition, the Japanese population has been declining since reaching its peak in 2010 (Figure 3.5). Meanwhile, "[a]s a result of deregulation in public transport, many private operators have ever abolished many bus lines and some rail lines in province. After abolishment, municipalities have begun to operate substitutional mobility service" (Minami & Higashi, 2018). Against this backdrop, the Japanese government is actively testing autonomous driving technologies to provide transportation services in rural areas.

Table 3.2. Ten Countries with the Largest Share of Persons Aged 60+ Years

| Rank | 1980 | | 2017 | | 2050 | |
|------|-----------------|----------------------------------|-----------------|----------------------------------|---------------------------------|----------------------------------|
| | Country or area | Percentage aged 60 years or over | Country or area | Percentage aged 60 years or over | Country or area | Percentage aged 60 years or over |
| 1 | Sweden | 22.0 | Japan | 33.4 | Japan | 42.4 |
| 2 | Norway | 20.2 | Italy | 29.4 | Spain | 41.9 |
| 3 | Channel Islands | 20.1 | Germany | 28.0 | Portugal | 41.7 |
| 4 | United Kingdom | 20.0 | Portugal | 27.9 | Greece | 41.6 |
| 5 | Denmark | 19.5 | Finland | 27.8 | Republic of Korea | 41.6 |
| 6 | Germany | 19.3 | Bulgaria | 27.7 | China, Taiwan Province of China | 41.3 |
| 7 | Austria | 19.0 | Croatia | 26.8 | China, Hong Kong SAR | 40.6 |
| 8 | Belgium | 18.4 | Greece | 26.5 | Italy | 40.3 |
| 9 | Switzerland | 18.2 | Slovenia | 26.3 | Singapore | 40.1 |
| 10 | Luxembourg | 17.8 | Latvia | 26.2 | Poland | 39.5 |

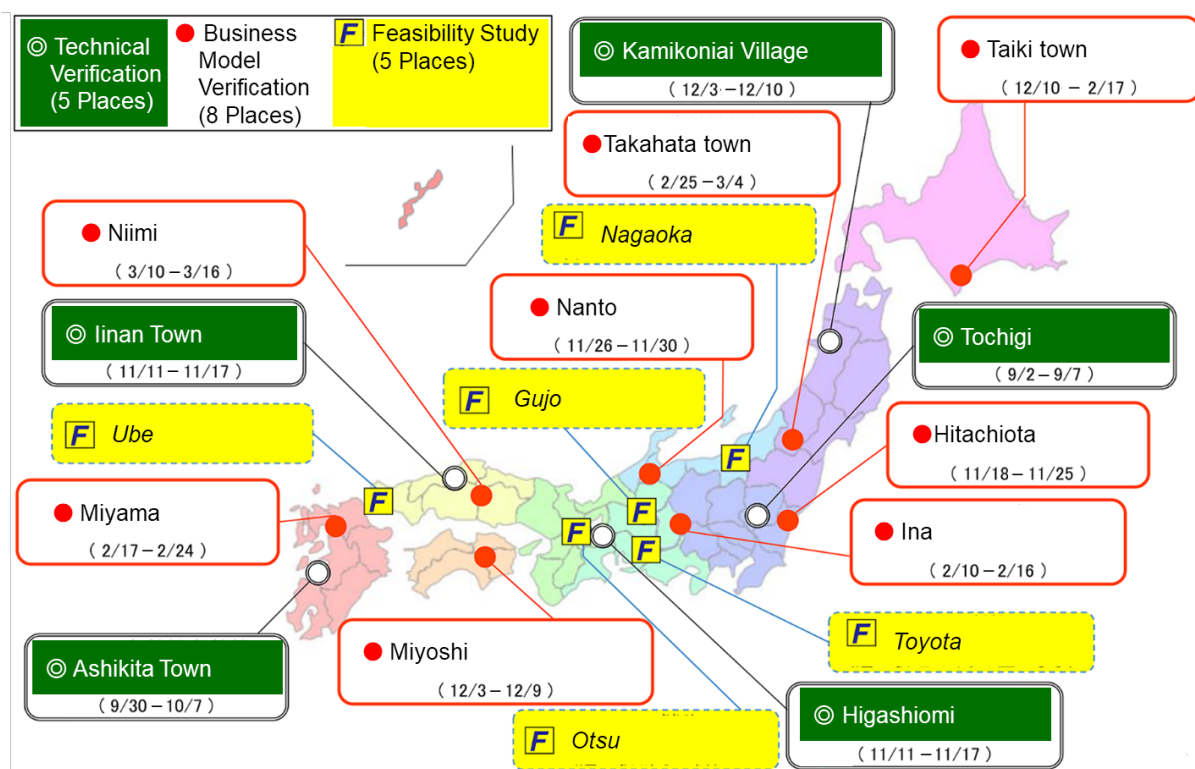
Note. Table 2 in *Population Division* (2017, p. 9). For France, percentage aged 60 years or over was 25.7% in 2017 and is expected to reach 32.2% in 2050 (*Population Division*, 2017, p. 34).

Figure 3.5 Population Changes in Japan, France, and Korea

Note. Adaptation of Google Public Data: Population (2020).

In 2017, the MLIT launched trials of autonomous transportation services in mountainous regions (Ministry of Land, Infrastructure, Transport and Tourism [MLIT], 2018, p. 357).¹⁶ The trials aimed to test autonomous mobility services centered on a local base, such as roadside stations, to secure the flow of people and logistics in the mid-mountainous region where the population is aging.¹⁷ The trials consisted of three types: 1) technical verification, 2) business model verification, and 3) feasibility study of business models. A total of 18 locations across Japan were selected, and trials for approximately one week were implemented in 13 places between September 2017 and March 2018. Only preselected people could use the vehicles. Four type of Levels 2 and 4 vehicles were used in the trials. See Figure 3.6 and Table 3.3 for the details. The trial project continues as of February 2020 with longer period tests such as more than a month.

Figure 3.6. Locations of Autonomous Minibus Trials in Fiscal Year 2017



Note. Adapted from S. Minami (personal communication, June 20, 2019).¹⁸

16. This paragraph draws on Chūsankanchiiki (n.d.) and Minami and Higashi (2018).

17. A Roadside Station (Michi-no-Eki) “is a roadside rest area for those driving across Japan. Michi-no-Eki are located along national highways and provide free parking space, restrooms, and regional and tourist information for road travelers. There are currently over 1,000 locations throughout Japan” (Michi-no-Eki, n.d.).

18. An equivalent Japanese version of Figure 3.6 is found at Road Bureau (2018, p. 4).

Table 3.3. List of Autonomous Transport Trials in Mountainous Areas by the MLIT in Fiscal Year 2017

| Prefecture | Municipality | Type* | Period (mm/dd) | Service length | Num. of participants |
|------------|-------------------|-------|-------------------|-------------------|-------------------------|
| Aichi | Toyota City | FS | | | |
| Akita | Kamikoani Village | TV | 12/3–12/10 | 3.2 km | 100 |
| Fukuoka | Miyama City | BM | 2/17–2/24 | 10 km | 80 |
| Gifu | Gujo City | FS | | | |
| Hokkaido | Taiki Town | BM | 12/10–12/17 | 7.6 km | 120 |
| Ibaraki | Hitachiota City | BM | 11/18–11/25 | 3.2 km | 160 |
| Kumamoto | Ashikita Town | TV | 9/30–10/7 | 6.3km | 100 |
| Nagano | Ina City | BM | 2/10–2/16 | 5 km | 160 |
| Niigata | Nagaoka City | FS | | | |
| Okayama | Niimi City | BM | 3/10–3/16 | 2.2 km | 200 |
| Shiga | Higashiomi City | TV | 11/11–11/17 | 4.6 km | 120 |
| Shiga | Otsu City | FS | | | |
| Shimane | Iinan Town | TV | 11/11–11/17 | 5.7 km | 60 |
| Tochigi | Tochigi City | TV | 9/2–9/7 | 2.0 km | 70 |
| Tokushima | Miyoshi City | BM | 12/3–12/9 | 7.2 km | 80 |
| Toyama | Nanto City | BM | 11/26–11/30 | 16 km | 70 |
| Yamagata | Takahata Town | BM | 2/25–3/4 | 20 km | 90 |
| Yamaguchi | Ube City | FS | | | |

Note. Adapted from Minami and Higashi (2018).

** TV: Technical verification, BM: Business model verification, FS: Feasibility study of business models at desk (without road tests).*

3.4. Implications from the Japanese AV Policy

In AV policy, the Japanese government emphasizes both industrial competitiveness and solving societal problems. For example, the objective of Panel on Business Strategies in Automated Driving, jointly established by METI and MLIT in February 2015, is to explore necessary actions to secure Japan's competitiveness in the field of ADS and solve various societal problems (e.g., traffic accidents) in the world. In addition, the Japanese AV policy regards the development of AV-based mobility services as an important topic in their policy making. This intention is reflected in the objectives of the national AV R&D program SIP-adus, which include "realization of an advanced public bus system for elderly and disabled people" (The SIP, n.d., p. 1). Numerous tests on autonomous shuttles that were conducted in rural areas also reflect this intention. Compared with Korea, which focuses on AV technologies and components development, the Japanese AV policy deals more with applications and the use of future AVs.

4. French Case of AV Policy

4.1. Milestones in AV Policy Making in France

In September 2013, the French President François Hollande and the Minister of Industrial Renewal Arnaud Montebourg jointly proclaimed the New Industrial France (la Nouvelle France Industrielle, NFI, in French) initiative.¹⁹ The industrial policy aims to build new and competitive industries in France, which will be able to win market share domestically and abroad and thereby create jobs (Organisation for Economic Co-operation and Development [OECD], n.d.). The NFI selected 34 sectors to strategically promote, one of which is driverless vehicles. As a following step, action plans for each were launched in July 2014. Table 4.1 presents the summary of the NFI action plans for AV development. The AV development project in the NFI was headed by Carlos Ghosn, then CEO of the Renault–Nissan–Mitsubishi Alliance.

About a year later, in May 2015, the second phase of the NFI program was launched by Emmanuel Macron, Minister for the Economy, Industry and Digital Affairs. NFI Phase 2 is embodied in the Industry of the Future project, a new matrix for French industrial strategy, which was officially launched by French President Hollande in April 2015 (La nouvelle France industrielle, 2017). The project is based on five pillars and is structured around nine industrial solutions. One of the nine solutions is eco-mobility, which includes vehicles that are economical, connected, and autonomous, combined with deployment of relevant infrastructures (Gouvernement de la République française, 2016, p. 76). Meanwhile, in July

19. The Ministry of Industrial Renewal (Ministère du Redressement productif, in French) was merged into the Ministry of Economy, Industrial Renewal and Digital Sector in April 2014, which was also merged into the current Ministry of Economy and Finance in August 2016. The Ministry of Economy, Industrial Renewal and Digital Sector changed its name to the Ministry of Economy, Industry and Digital Affairs in August 2014.

Table 4.1. Summary of NFI Action Plans for AV Development

| Action | Pilot | Calendar | Finalities/deliverables |
|---|---------------------------------------|------------------------------|---|
| 1) Coordinate autonomous vehicle initiatives | | | |
| Identification and coordination of local initiatives | DGCIS | 2015 | Pilot areas for the autonomous vehicle |
| Organization of international cooperation or exchange | DGCIS | 2015 | Cooperation with China and Korea |
| 2) Demonstrate the socio-economic, safety, and acceptance of the autonomous vehicle | | | |
| Study of socio-economic and security impact and acceptability | PFA, Renault Trucks, RATP | 2015–2020 | Experiments, impact studies, and acceptability studies for targeted use cases |
| 3) Invest in key technological areas of autonomous vehicles | | | |
| Launch of targeted R&D projects in the field of embedded intelligence, IHMs, human factors, and connectivity | ITE Vedecom, MEIN | 2014 2015–2018 | Call for projects dedicated to “autonomous vehicle” (December) Launch and realization of R&D projects |
| 4) Demonstrate the improvement in safety by the autonomous vehicle in targeted use cases | | | |
| Launch of targeted R&D projects in the field of security | IRT systemX, MEIN | 12/2014 2015–2018 2016 | Dedicated project called “autonomous vehicle” Launch and realization of R&D projects Urban and peri-urban test center |
| Provision of appropriate test facilities and demonstrations of safety improvement | Test Infrastructure Manager, Builders | 2016–2018 2015–2018 | Autonomous driving zones Tests in real situation on separated pavement, followed by urban and peri-urban sites |
| 5) Develop the regulatory and normative framework with a view to testing and then integrating the autonomous vehicle on the market | | | |
| Evolution of the regulatory and normative framework for experimentation and then for integration on the market | Inter-Administration | Dec. 2014 | Regulatory text authorizing open road experimentation |
| | Group (DGEC, DGCIS, | 2015 | Proposed standards and regulations for experimentation |
| | DGTIM, DSCR, DAJ | 2017/18 | French label “safe autonomous vehicle” |
| | MEDDE) | 2019 | Standards on processes and definition of standards of test rules |
| Adaptation of infrastructures based on context | DGITM | 2018 | Adaptation of necessary infrastructure, excluding connectivity equipment |
| | | 2020 | Deployment of necessary roadside equipment for connectivity |

Note. Translated and adapted from the table on p.14 of *La nouvelle France industrielle* (2014).

2015, a document specifying research objectives of AVs in the NFI was announced.²⁰ The document aims to achieve the following:

- to present the roadmaps of the use of AVs in areas of private vehicle, industrial vehicle, and public transport systems; and
- to present the research objectives formalized by these roadmaps in the following fields: embedded intelligence, connectivity, human factors and human-machine interface, and security.

In May 2018, Anne-Marie IDRAC, the Senior Head of the National Strategy for the Development of autonomous vehicles, presented the report Development of Self-Driving Vehicles – Strategic Orientation of Public Action to the Minister of the Interior, Economy and Finances, and Transport and the Secretary of State for digital affairs (Présentation du rapport, 2018).²¹ This report is officially regarded as the national strategy for the development of autonomous vehicles of the French government (Les véhicules autonomes, 2020). Addressing the full range of issues regarding AVs, the 96-page report provides “the strategic framework that will structure the French government’s policy actions dedicated to the development of automated or driverless vehicles” (Development, 2018, p. 2). The strategic framework has five areas:

- (1) Legislative and regulatory framework
- (2) Experiments, innovation, and research
- (3) Digital aspects and data
- (4) Links to infrastructure, connectivity, and mapping
- (5) Economic and societal aspects, governance, and frameworks

The report set goals of AV uses as follows (Development, 2018, p. 8):

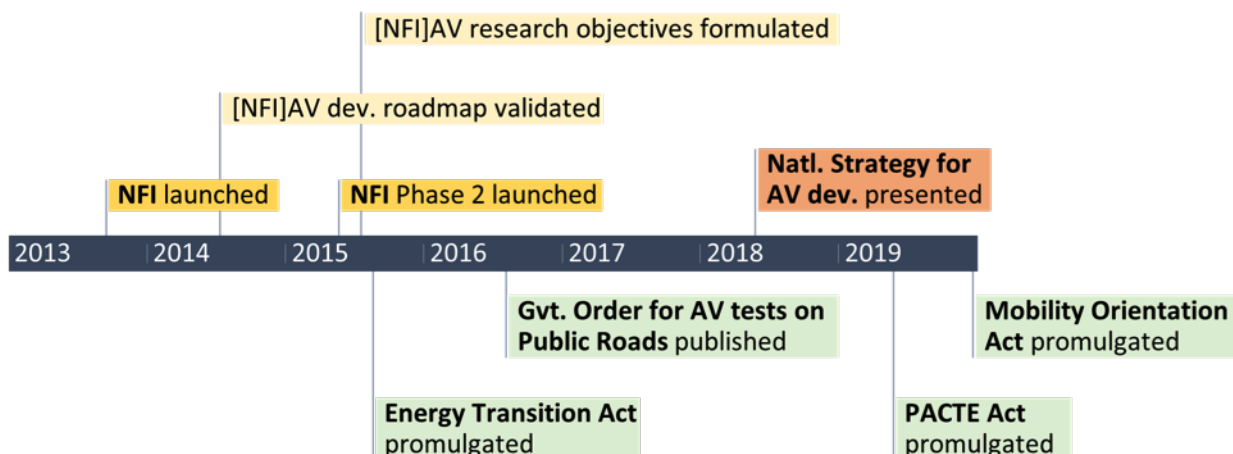
- In 2020:
 - “Supervised autonomous public transport services”
 - “Level-3 automated vehicles in use on roads”
- In 2022:
 - “Level-4 automated vehicles in use on roads”
 - “Development of use cases for logistical operations and automated freight movement”

Figure 4.1 summarizes the French government’s major policies for the development of AVs. Milestones in legislation in France are also included, which are addressed in the following section.

20. The title of the document is “Objectifs de recherche Nouvelle France Industrielle «Véhicule Autonome».” The document is available at https://pole-moveo.org/wp-content/uploads/2015/07/Objectifs_de_recherche-Veh_Auton_V1.2.pdf

21. The Ministers and the Secretary are Gérard COLLOMB, Bruno LE MAIRE, and Elisabeth BORNE; and Mounir MAHJoubi, respectively.

Figure 4.1. Milestones in Policy Making and Legislation for the Development of Autonomous Vehicles in France



Note. Author's visualization.

4.2. Key Legislation for AV Development and Deployment

4.2.1. Energy Transition for Green Growth Act (LTECV)²²

The LTECV was enforced in August 2015, following its adoption by the French Parliament in July 2015. This law incorporates “not only matters relating to climate change mitigation, but detailing policy pathways towards low-carbon economic development” (Hölscher & Jensterle, 2018, p. 1). The vast legal document covers eight topics, such as energy efficiency in the building sector, clean transportation, waste management and the circular economy, renewable energies, and so on (Hölscher & Jensterle, 2018, p. 2). As for AVs, LTECV (article 37.IX) provides a legal basis for the test of partial or full AVs on public roads as one of the measures to develop clean transport. As a follow-up, government order no. 2016-1057 on AV experimentation on public roads was published in August 2016.²³

22. The original title of the Act in French is “Loi no 2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte (LTECV).”

23. The original title of the government order in French is “Ordonnance n° 2016-1057 du 3 août 2016 relative à l'expérimentation de véhicules à délégation de conduite sur les voies publiques.”

4.2.2. Plan d'Action pour la Croissance et la Transformation des Entreprises (PACTE) Act

Following its adoption in April 2019, the PACTE Act was promulgated in May 2019. *PACTE* is officially translated by the French government to Action Plan for Business Growth and Transformation. Heralded as a “new step in France’s economic transformation,” the PACTE Act “aims to liberate companies from the burden of certain obligations and ensure they are better funded, more innovative and fairer” (Gelpi & Guillemare-Grilo, 2019). Consisting of 221 articles, the act establishes a comprehensive list of measures to achieve the above-mentioned objectives.²⁴ As a measure to release experiments of companies and thereby to facilitate their innovations, the PACTE Act (article 125) clarifies the experimentation conditions and the criminal liability rules applicable to AVs (Giono, 2019). Giono (2019) introduces the relevant provisions as follows:

The article 125 of the PACTE law amends the ordinance No. 2016-1057 dated 3 August 2016 on the experimentation on public roads of vehicles with driving delegation.

This article specifies the conditions for the experimentation of vehicles with driving delegation. The necessary authorisation for the use of vehicles with driving delegation for experimental purposes on the public road is only granted if the driving delegation system can be neutralized or deactivated by the driver at any time. If the driver is located outside the vehicle, he/she must be ready to take control of the vehicle at any time.

The PACTE law specifies that only vehicles with driving delegation used for a public passenger transport service may operate on collective transport lanes. For other vehicles, this possibility is subject to the assent of the competent traffic police authority and of the transport organizing authority.

The PACTE law also clarifies the criminal liability regime applicable to vehicles with driving delegation.

When the vehicle’s driving delegation system is activated and operates properly, the driver is not criminally liable for offences that he/she commits in the driving of the vehicle within the meaning of Article L121-1 of the French Highway Code.

However, the driver becomes criminally liable again following the solicitation of the driving system and at the end of a period specified in the experimentation

24. The official website of the French government selectively introduces 10 measures of the PACTE Act:

1. Simplifying thresholds applicable to SMEs
2. Abolishing corporate contributions to employee incentive schemes and profit sharing
3. Rethinking the role companies play in society
4. Setting up a company 100% online at less cost
5. Facilitating entrepreneurs’ recovery
6. Bringing public research closer to the business world
7. Facilitating business transfers
8. Simplifying and ensuring portability of pension savings products
9. Supporting SMEs’ export initiatives
10. Protecting strategic companies (PACTE, n.d.)

authorisation to take back control of the vehicle. The driver is also liable when he/she ignored the obvious circumstance that the conditions for using the driving delegation system were not or no longer met when it was activated.

If the driving of the vehicle, whose driving delegation system is activated, violates rules the breach of which constitutes a contravention, the holder of the authorisation shall be financially liable for the payment of fines.

If the driving caused an accident resulting in personal injury, the holder of the authorisation shall be criminally liable for the offences of involuntary offence to the life or physical integrity of the person, if a fault is established, within the meaning of Article 121-3 of the French Criminal Code, in the implementation of the driving delegation system. (Giono, 2019)

4.2.3. Mobility Orientation Act (Loi d'Orientation des Mobilités, LOM)

LOM was published at the end of December 2019, following its adoption in November 2019. The act aims to make everyday transport easier, cheaper, and cleaner (La loi mobilités, 2020). The LOM has three pillars (La loi mobilités, 2020):

- (1) To invest more and better in everyday transport
- (2) To facilitate and encourage the deployment of new mobility solutions for all
- (3) To initiate the transition to cleaner mobility

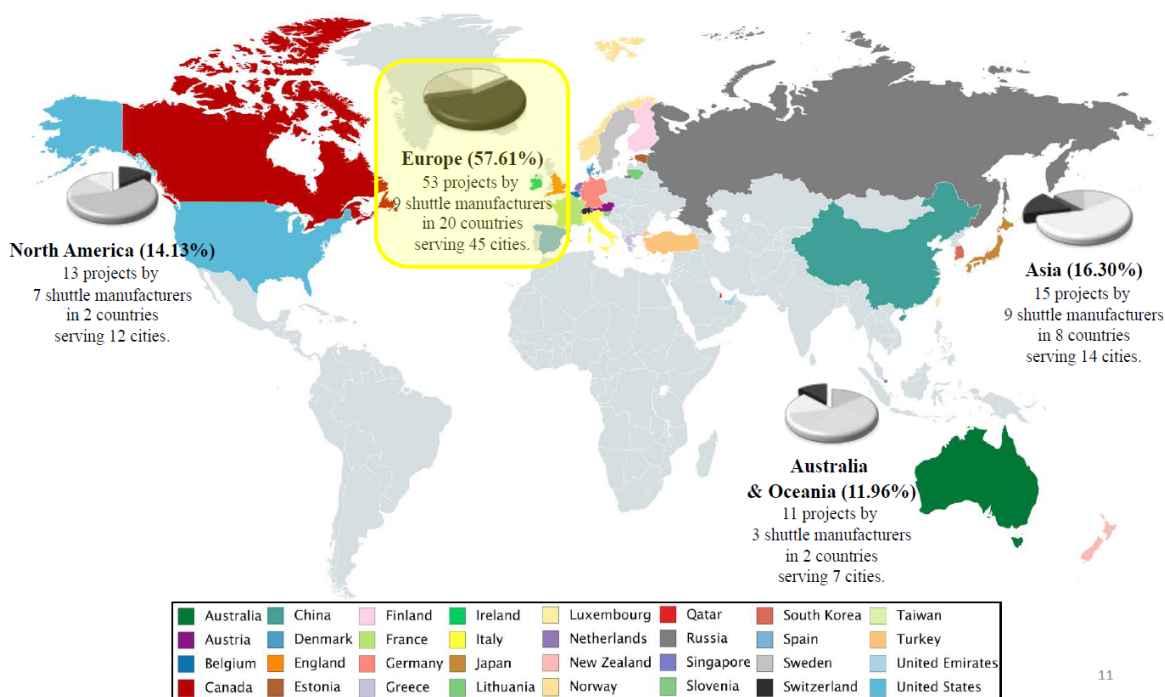
The French government targets the deployment of driverless public shuttles from 2020 and Level 4 autonomous private vehicles from 2022 (Development, 2018, p. 8). The act creates the legal framework for this deployment plan. Article 31 of the act empowers the French government to have recourse to an order to take any measure within the domain of law to adapt the legislation to the case of circulation of partial or full AVs on public roads (des Grottes, 2020). Certain provisions of the Highway Code (Code de la route, in French) and on the liability regime are specifically affected (des Grottes, 2020). The act also authorizes the government to issue orders to take any measures to make relevant data from the AV systems accessible to road infrastructure managers, relevant authorities, and so on for various purposes, as specified in the Article 32 of the act.

4.3. Autonomous Shuttle Experiments in France

Europe is the most active place in the world for autonomous shuttle experiments for collective transport. Antonialli (2019) identified 92 autonomous shuttle experiments worldwide by carrying “on-line query from September 3rd to September 18th, 2018 on both Google and on academic databases (Web of Science, Science Direct, Scopus and, Google Scholar)” (Antonialli, 2019).²⁵ Out of the 92 projects, Europe holds 53 projects, accounting for more than half of all the tests (Figure 4.2). In Europe, France leads with eight projects, followed by Germany with seven projects and Switzerland with six projects (Table 4.2).

25. The 92 samples of Antonialli (2019) were “not limited to the current (ongoing) experimentations; finished projects, as well as projects yet to be started were also considered in the sample” (Antonialli, 2019).

Figure 4.2. Autonomous Shuttle Tests Worldwide



Note. Adapted from Figure 1 of Antonialli (2019).

Table 4.2. Number of Autonomous Shuttle Tests in Europe

| | City | Country | Num. of projects | Total |
|----|----------------------|-------------|------------------|-------|
| 1 | Salzburg | Austria | 1 | 2 |
| 2 | Vienna | | 1 | |
| 3 | Brussels | Belgium | 1 | 2 |
| 4 | Han-sur-Lesse | | 1 | |
| 5 | Aalborg | Denmark | 1 | 2 |
| 6 | Copenhagen | | 1 | |
| 7 | London | England | 3 | 3 |
| 8 | Tallinn | Estonia | 1 | 1 |
| 9 | Espoo | Finland | 1 | 5 |
| 10 | Helsinki | | 2 | |
| 11 | Tamper | | 1 | |
| 12 | Vantaa | | 1 | |
| 13 | Civaux | France | 1 | 8 |
| 14 | La Rochelle | | 1 | |
| 15 | Lyon | | 1 | |
| 16 | Paris | | 4 | |
| 17 | Sophia Antipolis | Germany | 1 | 7 |
| 18 | Bad Birnbach | | 1 | |
| 19 | Berlin | | 1 | |
| 20 | Enge-Sande | | 1 | |
| 21 | Frankfurt | | 2 | |
| 22 | Hamburg | | 1 | |
| 23 | Lahr | | 1 | |
| 24 | Trikala | Greece | 1 | 1 |
| 25 | Dublin | Ireland | 1 | 1 |
| 26 | Oristano | Italy | 1 | 1 |
| 27 | Vilnius | Lithuania | 1 | 1 |
| 28 | Luxembourg | Luxembourg | 1 | 1 |
| 29 | Amsterdam | Netherlands | 1 | 4 |
| 30 | Delft | | 1 | |
| 31 | Rotterdam | | 1 | |
| 32 | Wageningen | Norway | 1 | 3 |
| 33 | Kongsberg | | 1 | |
| 34 | Olso | | 1 | |
| 35 | Stavanger | Russia | 1 | 1 |
| 36 | Russia | | 1 | |
| 37 | Ljubljana | Slovenia | 1 | 1 |
| 38 | San Sebastian | Spain | 1 | 2 |
| 39 | Talavera de la Reina | | 1 | |
| 40 | Stockholm | Sweden | 1 | 1 |
| 41 | Fribourg | Switzerland | 1 | 6 |
| 42 | Geneva | | 1 | |
| 43 | Lausanne | | 1 | |
| 44 | Neuhausen Rheinfalt | | 1 | |
| 45 | Sion | | 1 | |
| 46 | Zug | | 1 | |

Note. Table 1 of Antonialli (2019).

The French government plans to deploy autonomous shuttles in the public transport system of France in 2020 (see Section 4.1).²⁶ In French areas with few travelers, the possibility of offering regular bus solutions is often lacking. The French government expects that autonomous shuttles will bring new mobility solutions, particularly in rural areas where they believe autonomous shuttles will be perfectly suited to the small number of travelers. They also plan to use autonomous shuttles for regular lines over a short distance, for example, between a town center and the nearest station. To accelerate the deployment of these solutions, the government is investing 42 million euros in 16 concrete experiments with autonomous vehicles. The Communauté de communes Cœur de Brenne (Indre) will test a shuttle circulating through three villages throughout the day.

5. Concluding Remarks: Comparison of Korea, Japan, and France

5.1. Similarities and Differences in the Autonomous Vehicle Policies among Korea, Japan, and France

Autonomous vehicles are expected to transform the landscape of the global automotive industry and the use of cars in our society substantially. Governments in numerous countries have been implementing national initiatives for AV development and deployment to embrace this emerging technological paradigm. Government policy tends to play a key role in socioeconomic transformation especially when a new paradigm emerges. Such policy provides the *rules of the game*, which affect the practices and behaviors of consumers, producers, and intermediaries in a sector. This study comparatively analyzes national AV policies in Korea, Japan, and France. Similarities contribute to shedding light on the common components of general policy for AV development and deployment, whereas differences indicate the uniqueness of the policies of the respective countries, reflecting their country-specific context of society, governance, industry, and so on.

The similarities of Korea, Japan, and France found in this study include the following:

- (1) The AV was selected as a national strategic field in around 2013 and 2014 with a large-scale R&D investment plan (see Table 5.1).
- (2) One of the most important reasons for the government to develop AVs is to promote industrial competitiveness and create jobs.
- (3) Ministries in charge of industry, transportation, and information and communications technology and the national police agency are mainly involved in policy formulation for the development and deployment of AVs. The leading role has shifted from a ministry in charge of industry to a ministry in charge of transportation because road infrastructure and changes in transportation systems have become increasingly important topics as AV technologies have advanced toward AV deployment.

26. This paragraph draws on Ministère de la Transition écologique et solidaire (n.d.).

Table 5.1 summarizes flagship policies and R&D programs for the development and deployment of AVs of Korea, Japan, and France.

Table 5.1. Milestones of Government Policy for AV Development and Deployment in Korea, Japan, and France

| Year | Korea | Japan | France |
|------|---|--|--|
| 2013 | | A roadmap of AV dev. by Autopilot System Council of MLIT | New Industrial France |
| 2014 | Future Growth Engines initiative | SIP-adus (Phase 1, 2014–2018) Public-Private ITS Initiative/ Roadmap | |
| 2015 | Plan to Support the Commercialization of Autonomous Vehicles Massive investment on AV dev. starts. | Japan Revitalization Strategy (2015 Revision) | New Industrial France (Phase 2) and Industry of the Future project |
| 2016 | | | |
| 2017 | Innovation Growth Engines initiative | | |
| 2018 | Future Car Industry Development Strategy | | Natl. Strategy for AV dev.* |
| 2019 | Future Car Industry Development Strategy 2030 | SIP-adus (Phase 2, 2019–2023) | |

Note. Author's tabulation.

* Contained in the report entitled *Development of Self-Driving Vehicles – Strategic Orientation of Public Action* (see Section 4.1).

The differences include:

(1) The purposes of AV development

- France: to improve mobility for commute trips in sparsely populated areas around major cities
- Japan: to improve the mobility of the elderly and in the rural area, which lacks public transportation services, given that population aging and depopulation are progressing nationwide
- Korea: to promote industrial growth and create new jobs

(2) Innovation strategy: tech-push vs. demand-pull

- France takes a demand-pull approach, in other words, focuses on *making AVs socially acceptable*.
- Korea, by contrast, takes a technology-push approach, focusing on *making AVs technologically available*.

- Japan takes a mixed approach, focusing on both technology and applications given its strong automotive industry and aging and decreasing population.
 - See Section 5.2 for a bibliometric analysis that supports this difference.
- (3) Focus on AV experiments
- France and Japan: highly active in autonomous shuttle tests with many pilot programs
 - Korea: very few autonomous shuttle pilot programs
- (4) International standards activity
- Among the three countries, France is the most active in formulating international standards/regulations, followed by Japan and then Korea (see Section 5.2).
- (5) Preference for connectivity
- France prefer *connected* AVs or CAV. Thus, C-ITS development plans have integrated with AV development plans in France. This preference is relatively not strong in the AV strategy of Korea.

These findings contribute to advancing our understanding the different trajectories of the socioeconomic transformation of the three countries in the coming era of AVs. A bibliometric analysis in the following section provides additional basis for the abovementioned findings on the differences among the three countries.

5.2. A Bibliometric Analysis of AV Policy Documents

5.2.1. Methodology




The abovementioned comparative characteristics of France, Japan, and Korea in AV policy are supported in a bibliometric analysis. Specifically, the author chooses terms related to certain subjects of AV development or deployment and then compares the normalized frequencies of these terms found in the official documents of the flagship plans of the three countries. One official document was selected for each country, and the selected documents share two commonalities to improve the validity of the comparison. First, all three documents are action-plan level comprehensive documents that cover major topics related to the development and deployment of AVs. Second, all of them were announced in spring 2018, a similar time.

For France, the author has chosen the report, Development of Self-Driving Vehicles – Strategic Orientation of Public Action, which contains the national strategy for the development of autonomous vehicles of the French government.²⁷ Announced in May 2018, the 96-page report presents a comprehensive framework for the policy actions of the French government for AV development (see Section 4.1). The author translated the original report in French into English by using translation feature of Microsoft Office and then corrected minor errors of the

27. You can find the document at the website of the French Ministry for the Ecological and Inclusive Transition (Ministère de la Transition écologique et solidaire in French), or <https://www.ecologique-solidaire.gouv.fr/vehicules-autonomes> (accessed on February 28, 2020). The direct link to the PDF file of the report is <https://www.ecologique-solidaire.gouv.fr/sites/default/files/90p%20VDEF.pdf> (accessed on February 28, 2020).

machine translation. The resultant English version has 31,993 words. For Japan, the study report Action Plan for Realizing Automated Driving (Version 2.0), released in March 2018, has been selected for this term frequency analysis.²⁸ The report was written by a private–public panel entitled Panel on Business Strategies in Automated Driving, jointly established by Japanese METI and MLIT (see Section 3.1). The report has an official English version, which is 58 pages with 17,922 words. Lastly, for Korea, section “Appendix 4. Autonomous Vehicles” of the official document of Action Plan for Innovation Growth Engine, published in May 2018, was used for the analysis.²⁹ Consisting of 19 pages from page 85 to page 103 of the whole document, Appendix 4 contains the comprehensive policy tasks for AV development and deployment. The original Korean document was used in the analysis given that the native language of the author is Korean. Table 5.2 presents the characteristics of the selected documents.

Table 5.2. The Description of the Selected Documents for Term Frequency Analysis

| | France | Japan | Korea |
|-------------------|---|--|---|
| Document title |  <p>Development of Self-Driving Vehicles – Strategic Orientation of Public Action</p> |  <p>Action Plan for Realizing Automated Driving (Version2.0)</p> |  <p>Action Plan for Innovation Growth Engine (Appendix 4. Autonomous Vehicle)</p> |
| Document type | National level plan | Study report by a private–public panel of METI and MLIT | National level plan |
| Announcement date | May 2018 | March 2018 | May 2018 |
| Total pages | 96 | 58 | 19 (pp. 85-103) |
| Total word count | 31,993 | 17,922 | 3,138 |
| | (English-translated doc.) | (Official English doc.) | (Official Korean doc.) |

Note. Author's tabulation.

28. You can find the report at https://www.meti.go.jp/english/policy/mono_info_service/connected_industries/adms_2018.html. A direct link to the PDF file of the report is https://www.meti.go.jp/english/policy/mono_info_service/connected_industries/pdf/ad_v2.0_hokokusho.pdf. Both links were accessed lastly on February 28, 2020.

29. A link to the PDF file of the Action Plan is <http://rnd.inha.ac.kr/schedule/download.do?id=20538> (accessed on February 28, 2020).

Given that the selected documents have different lengths, normalizing these term frequencies is necessary to compare each other. The number of words “autonomous” or “automated” in each document is used for this purpose, as these terms are the most important keywords and appear most frequently in the selected documents.³⁰ That is, the number of a term of interest is divided by the number of these terms to calculate normalized term frequencies. Table 5.3 shows an example of calculating the normalization of term frequency for words starting with “technolog” (e.g. technology, technologies, and technological) (technolog*, hereinafter).³¹ In calculating term frequencies in the Korean document, Korean terms that have the same or almost the same meaning were used after some modification given the linguistic characteristics of Korean, taking advantage of the mother tongue of the author.

Table 5.3. Example of Normalizing Term Frequencies in This Analysis

| | France | Japan | Korea |
|--|------------------|-------------------|------------------|
| Total word count of the document | 31,993 | 17,922 | 3,138 |
| Term frequency of “autonomous” or “automated” (A) | 284 | 267 | 103 |
| Term frequency of “technolog*” (B) | 72 | 131 | 91 |
| Normalized frequency of “technolog*” in the document (C=A/B) | 72/284 = 0.25 | 131/267 = 0.49 | 91/103 = 0.88 |

Note. Author’s tabulation.

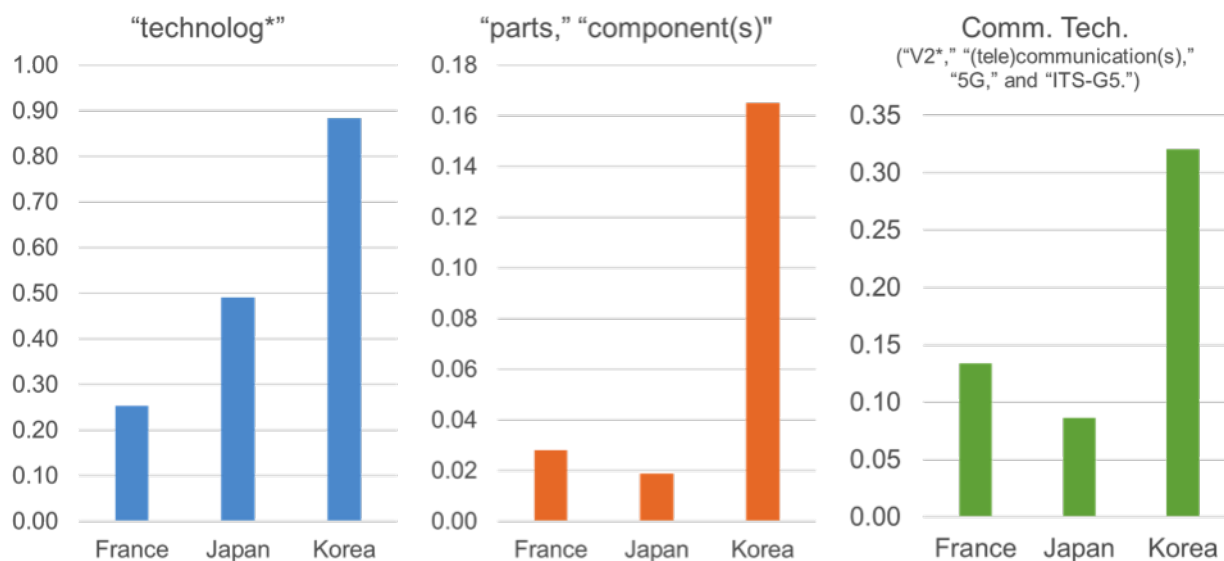
5.2.2. Results

The first result, shown in Figure 5.1, supports the technology-push approach of Korea, especially focusing on the development of AV parts and communication technologies (e.g., 5G-V2X). Among the selected documents of these countries, the Korean document has the highest normalized frequency of terms technolog*, which suggests that Korean AV policy is more focused on developing AV technology than France and Japan. In addition, Korea has much higher normalized frequencies in terms “parts” or “component(s)” and in terms related to communication technology than France and Japan.³² These results allude to what areas of technology development of AVs the Korean government aim to focus on.

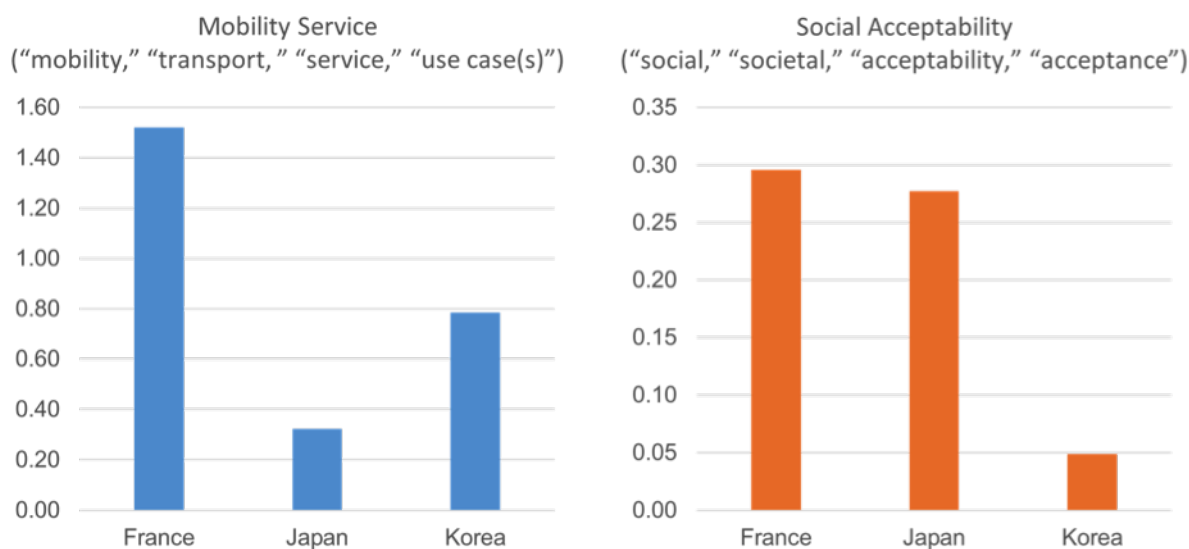
30. For the Korean document, the Korean term “ca-yul-cwu-hayng,” which means autonomous driving, is used for this purpose.

31. For the Korean document, the Korean term “ki-swul,” which means technology, is used.

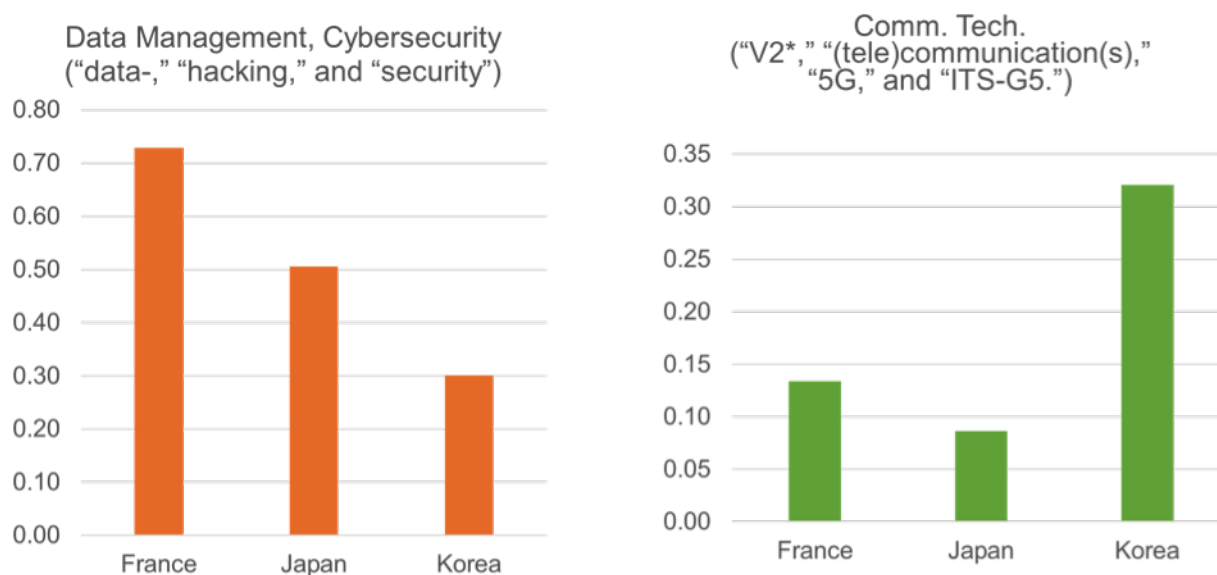
32. The specific terms related to communication technology of AVs include “V2*,” “(tele)communication(s),” “5G,” and “ITS-G5.” “V2*” indicates terms starting with “V2” such V2X and V2I. ITS-G5 is intelligent transport system which operates in the 5GHz range. It is an adaptation of the widely used IEEE 802.11 standard for Wi-Fi to incorporate Wireless Access in Vehicular Environments (WAVE) (Sens, 2016).

Figure 5.1. Normalized Frequencies of Terms Related to AV Technology

The results shown in Figure 5.2 imply the demand-pull approach of France. The French document has the highest normalized frequency of terms associated with mobility services, specifically, "mobility," "transport," "service," and "use case(s)." The terms related to social acceptance, or "social," "societal," "acceptability," and "acceptance" also have highest frequency in the French document.

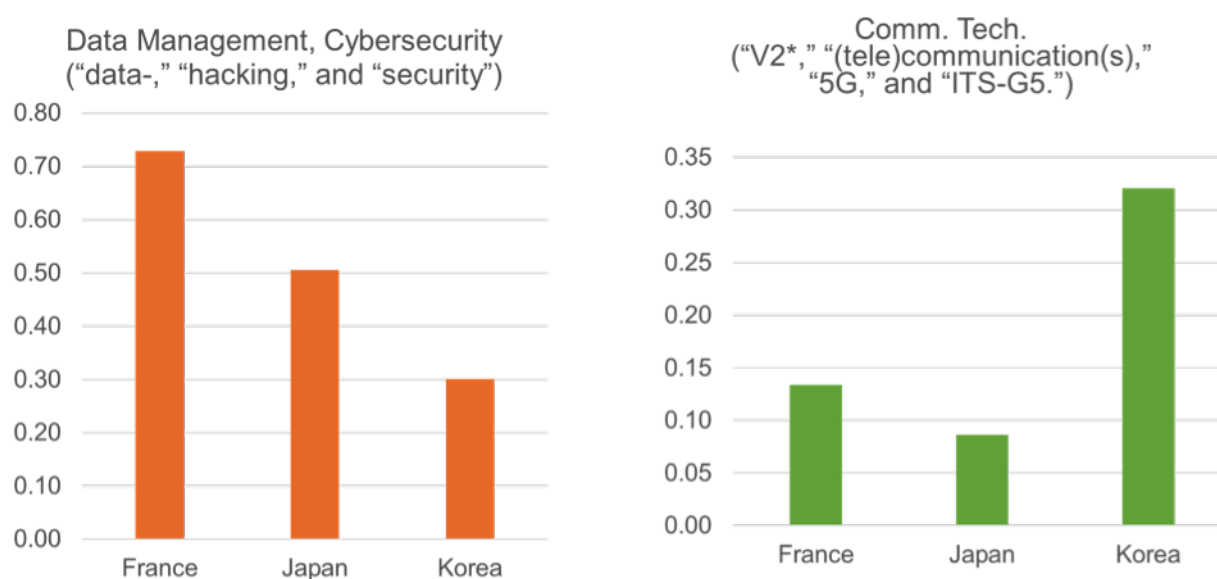
Figure 5.2. Normalized Frequencies of Terms Related to AV Application

The normalized frequencies of terms related to the connectivity of AVs suggest that France and Korea have different areas of interest on this topic. The French document has the highest normalized frequency with terms associated to data management and cybersecurity, or "data*," "hacking," and "security." In contrast, the Korean document has the highest normalized frequency with terms related to communication technologies. Meanwhile, the Japanese document presents mixed results compared with the other two countries. Figure 5.3. shows these results.

Figure 5.3. Normalized Frequencies of Terms Related to the Connectivity of AVs

As shown in the figure on the left in Figure 5.4, the French document holds the highest normalized frequency of terms related to CAV and C-ITS, specifically, "connected," "connectivity," and "ITS." This result implies that France focuses on the development of connectivity-based AVs, or CAV more than Japan and Korea.

The figure on the right in Figure 5.4 shows that the French document has the highest normalized frequencies in terms "international," "internationally," "Europe," and "European," followed by Japan and Korea. This result implies that France has the highest intensity in international and regional activities, such as standardization and regulatory harmonization, while Japan and Korea attempt to expand their activities in these areas.

Figure 5.4. Normalized Frequencies of Terms Related to CAV and C-ITS

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