Policy Recommendations to Improve Integrated Transportation Service for Korean Smart Mobility : MaaS(Mobility as a Service) Platform Application Plan

By

SON, Sumi

CAPSTONE PROJECT

Submitted to

KDI School of Public Policy and Management

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ABSTRACT

POLICY RECOMMENDATIONS TO IMPROVE

INTEGRATED TRANSPORTATION SERVICE FOR KOREAN SMART MOBILITY:

MAAS (MOBILITY AS A SERVICE) PLATFORM APPLICATION PLAN

By

SON, Sumi

Smart mobility is the most important part to build a smart city. This is because the city's population growth continues to intensify traffic congestion, and traffic infrastructure such as roads occupies large parts of the cities, making it difficult to realize a citizen-centric city.

This capstone project aims to study a plan to apply the Mobility as a Service (MaaS) Platform in Korea's smart mobility policies. First, to understand the status quo, Sejong's MaaS application plan was reviewed among domestic smart mobility policies. Second, in the literature review part, technical terms such as Smart Mobility, MaaS, innovation ecosystem, and data economy were defined, and domestic policy measures were suggested through the analysis of MaaS application cases in Finland and Singapore.

Compared to other countries, Korea is well-equipped with ICT infrastructure, and people adapt quickly to new technologies, making it suitable for applying Smart Mobility services. However, without a deep understanding of the domestic situation, it is not easy to apply the overseas MaaS model directly to Korea. To provide a sustainable Smart Mobility service, it is necessary to define a smart mobility strategy in Korea, build a mobility ecosystem, and increase data utilization to build a Korean-style MaaS platform model.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. Introduction

Since the Industrial Revolution, the global trend of urbanization has continued. According to the World Urbanization Prospect by the United Nations, 55% of the world's population lived in cities in 2018, and the number of the world's population living in cities is predicted that it will reach 68% of the total population by 2050 (United Nations, 2018). Therefore, as rapid urbanization makes city management more difficult, interest in smart and efficient cities is increasing, and various attempts are being made around the world.

In particular, in Korea, discussions on Ubiquitous City (U-City) have been actively proceeded since 2000, but the conversation has been developed around local informatization and infrastructure construction through the integration of Information and Communication Technology (ICT) and urban services, and it is supplier-oriented urban planning. On the other hand, the smart city concept focuses on how to efficiently solve urban problems with the existing urban infrastructure, and it is a policy that provides demand-oriented services through a shift from a top-down to a bottom-up method (PCFIR, 2018).

The biggest difference between the two solutions is their approach to urban transport problems. U-City focused on building additional infrastructure in new cities to mitigate traffic congestion regardless of the human-friendly environment, and related policies are operated individually for each function, so citizens must adapt to the urban operating system (ICEE, 2018).

However, transportation in a smart city is a means with which to efficiently manage and solve traffic problems, applied to both new and existing cities by utilizing advanced technologies such as Artificial Intelligence (AI), ICT, and big data (MOLIT, 2020). This concept is called Smart Mobility. It is a demand-oriented and eco-friendly solution, whereas the existing transportation policy was supplier-oriented.

Furthermore, digital technology, as Arun Sundararajan explained in his book 'The Sharing Economy,' changed the shape of the economy and consumption pattern of people from a traditional one

to a sharing economy after an emerging new style of companies such as Uber, Lyft, Airbnb and WeWork (Arun Sundararajan, 2016). In particular, the growth of car-sharing services such as Uber and Lyft raised the possibility of a change in existing transportation along with changes in people's consumption patterns.

Mobility is not only the basis of economic revitalization (Rossbach, Reinhold, Remané, Winterhoff, & Boekels, 2013), but also one of the most important parts of the smart city concept because ownership of vehicles or public transportation which causes traffic congestion problems is closely related to environmental issues such as climate change, a problem that has been steadily raised since the past (Kim, S.Y., 2018). In addition, the rise of mobile traffic volume increases the proportion of the area occupied by roads or infrastructures in the city, thereby reducing the space for citizens to live in.

A smart mobility system helps citizens to move seamlessly with advanced technology and infrastructure. Also, this intelligent transportation system can provide new solutions to environmental problems, and it is possible to help many people’s mobility with minimal time and cost by using AI technology. The development of the sharing economy also increases the need for smart mobility services, and it produces the data which is indispensable for building a Smart City because big data plays an important role in helping the city’s sustainable development and the growth of the mobility market (Kim, S.Y., 2018).

Recently, many countries, such as Finland and Singapore, are making various attempts to establish smart mobility services through cooperation between the public and private sector, and the governments are actively promoting policies to link smart cities and new mobility platforms. The Korean government also encourage the establishment of a smart mobility ecosystem centered on smart cities such as Seoul, Daejeon, Sejong, Daegu, and Busan.

The purpose of this Capstone Project is to review Korea's Smart Mobility policies through the lens of the smart city concept by comparing and analyzing the policies of Finland and Singapore that have advanced their smart mobility service platform, called Mobility as a Service (MaaS), and to make policy suggestions on how Korea should develop the MaaS platform which is necessary for building a

smart mobility ecosystem.

1.1 Statement of the policy problem

The problem that smart cities currently face is the government's sluggish response towards the smart mobility service platform because no revolution can succeed in the absence of adequate governmental policy.

According to the announcement of the Presidential Committee on the Fourth Industrial Revolution(PCFIR) regarding smart city strategy (PCFIR, 2018), there are three (3) policies for the transportation sector: Bus Information System (BIS), Intelligent Transportation System (ITS), and Traffic Signal System as shown in Table 1.

Table 1 Smart City Solutions: Transportation (PCFIR, 2018)

Policy	Description
Bus Information System	- Provide real-time information on bus locations and driving information to expand the use of public transportation - Encourage the creation of new services by disclosing collection information
Intelligent Transportation System	- Use big data for overload control to increase road management efficiency - Actively share public data such as accident information and construction schedules with the private sector
Traffic Signal System	- Improve signaling facilities of local governments so that the optimal signal cycle can be operated by analyzing traffic volume and their direction of movement during major times.

This policy is being developed mainly in smart cities such as Seoul, Daejeon, Daegu, and Busan, and there are some differences in policy based on each city's resources. However, in general, existing services such as BIS are expanded, and ITS provides more traffic information to citizens as quickly as possible before by using CCTV which are installed on the road and bus terminals (Lee & Cho, 2020). In other words, the policy continues as a one-way method in which citizens in the U-City act as information consumers, rather than an open governance method, which is the aim of smart city.

On the other hand, according to the report 'Sejong Smart City Implementation Plan,' Sejong has recently come up with a plan to provide mobility at the level of private vehicles by activating shared-

based mobility services, and has started devising policies ahead of other cities. In addition, the policy is planning to provide useful and inexpensive services to citizens by making plans to operate integrated mobility services and to build demand-responsive mobility services which are the key to the MaaS platform. Furthermore, it plans to introduce an autonomous driving shuttle in the Bus Rapid Transit (BRT) section (MOLIT, 2019).

Table 2 Mobility Policy in Sejong (MOLIT, 2019)

Policy	Description
Interactive Mobility Service	- Providing mobility at the level of owning motor vehicles through the activation of shared-based mobility services - Ensuring safe and convenient mobile services through the introduction of self-driving mobility - Provide uninterrupted passage through the operation of multi-level integrated mobility services - Building a safe and comfortable pedestrian environment by providing smart pedestrian safety service
Mobility Convergence Road and Space planning	- Planning of road networks and joint transit parking lots linked to land use - Providing human-centered walking space and walking system - Implementing mobility services establishing convergence space plan
Mobility Ecosystem Foundation Formation	- Building the foundation for mobility ecosystem through the introduction of a mobility ecosystem - Establishing a smart mobility governance - Smart mobility legal system foundation maintenance

However, there are three problems with Sejong's Smart Mobility policies.

First of all, there are few policies related to expanding public transportation. Smart mobility service is a solution for consumers to move efficiently and conveniently within a short time at a low price, so the connection with existing public transportation is essential. Sharing-based mobility services such as car-hailing and car-sharing can replace vehicle use, but in terms of price, they cannot replace public transportation.

According to the results of the survey on Happy City Sejong (MOLIT, 2019), the private car use rate reaches 70.7% of daily life, because it is inconvenient to use transportation such as city buses and taxis in Sejong. The survey also shows that 41.9% of respondents answered they were unsatisfied with the use of city buses, and the reasons were that the bus dispatch time is long (71.9%), and the distance from the house to the bus stop is far (10.5%). In addition, regarding the satisfaction of taxi use,

66.7% of respondents said they were unsatisfied, which was higher than that of city buses, due to lack of taxi (48.3%) and expensive fares (41.8%).

The reason why the government should directly operate public transportation or be involved in its operation is that the purpose of providing public transportation services is not only to secure profitability, but to provide freedom and convenient mobility services for the citizens at a low price. Therefore, a question remains as to whether this inconvenience of public transportation can be satisfied only by expanding car-hailing, car-sharing, and free-floating services without an efficient operation strategy for inexpensive public transportation.

Secondly, there is no systematic plan to introduce autonomous driving buses in the BRT section. According to a New Daily article in 2019, the policy is only at the basic plan level although a detailed implementation plan is needed to introduce unmanned autonomous buses in the BRT section at the end of 2021. In addition, when only some buses are replaced with autonomous driving one, there is no operation plan for linking with general buses. Moreover, if the adaption of the autonomous driving buses is pushed forward without forming a consensus with the existing bus operator, there will be a possibility to have great difficulties in the future (Lim, 2019).

Additionally, a lack of understanding of autonomous driving mobility is also a problem. Innovation in mobility services is completed from not only the MaaS platform, but also autonomous driving technology, which increases stability and can reduce transportation costs by reducing the role of drivers (Choi, 2018).

According to the 2030 Future Automotive Industry Development Strategy recently announced by the government (MOTIE, 2019), autonomous driving cars are divided into two types: the Vision-based and the Infrastructure-based. The Vison-based type operates by using a mounted sensor in a car and GPS, and the Infrastructure-based type is a system that supports autonomous driving with communication infrastructure. The former depends on the technology of the automobile company, and the latter could be applied faster than the former one if only communication facilities are equipped, but it takes high cost to build the corresponding communication infrastructure for each road.

Therefore, it may be possible to apply autonomous driving buses within 2021, but application roadmap is needed with the development of autonomous driving technology and the establishment of infrastructure to encourage a sustainable Smart Mobility system which is suitable for a smart city. Also, it is essential to plan in detail what type of autonomous driving bus to apply because the investment cost varies depending on it. Based on this, meaningful results can be achieved only when the profitability analysis and step-by-step bus fare reduction policy are discussed in advance by considering the rise in the cost of autonomous driving buses and infrastructure construction due to the introduction of autonomous driving and cost savings due to the absence of drivers.

Finally, there is a lack of analysis in terms of data. For example, how data is collected, what kinds of data can be collected, and how data is used through the deployment of integrated mobility services. Although the report shows that the local government will establish a blockchain-based contribution and compensation system for consumers to build a foundation for the mobility ecosystem (MOLIT, 2019), the policy just scratches the surface of the policy and not enough to induce consumer participation.

In addition, establishing a business model through data collection seems to be done only by private companies. However, it is hard to expect active participation from private sectors without demonstration of what data can be obtained from mobility services to devise business models, whether there are any concerns about personal information leakage, and the possibility that data sharing issues may conflict interests of private companies. Therefore, policies on mobility data will need to be further reinforced with specific strategies and detailed task output.

1.2 Research Questions

a. Why do the innovation ecosystem and data economy play an important role in smart mobility service?

b. What complement will be needed with the existing policies to implement smart mobility in smart cities using the MaaS platform?

1.3 Outline of the Paper

The rest of the paper is organized as follows. Section 2 offers a literature review for existing studies. Section 3 showcases document analysis and corresponding findings that were obtained by comparing the transportation environment, mobility ecosystem and regulation in Helsinki in Finland, Singapore, and Korea. Finally, Section4 offers recommendations on the Korea government's policies that how to establish a smart mobility system with the MaaS platform.

2. Literature Review

2.1 Smart Mobility

Recently, the mobility industry has changed from quantitative to qualitative. In other words, it is shifting from a transport mode-oriented competition to a mobility-oriented competition to choose the best way to travel more conveniently and comfortably, regardless of the means of transportation.

In particular, interest in smart mobility is also increasing as ICT advances. According to the reports published by McKinsey & Company (2018), many cities will adapt the smart mobility platform which could reduce commuting times around 15-20 percent on average by 2025. Therefore, Smart City policymakers are making an effort to establish infrastructures with advanced technology such as Big data, AI, and 5G.

For this reason, researches on smart mobility are being actively conducted, but a consistent definition of smart mobility has not yet been established, and its scope is also diverse. For example, from the narrow sense of dealing with the transportation system itself, it also covers a wide area that encompasses transportation infrastructure, including parking, electric vehicle charging, connectivity, and environmental aspects.

Frost and Sullivan (2013) argued that smart mobility is recognized as the core area of smart city projects, and that more than 50 percent of smart city projects are focused on innovating urban transportation and mobility. Therefore, Smart Mobility is seen as the overall concept of future transportation services that have become smarter and smarter as the advanced functions of the existing transportation system and smart devices are combined. Moreover, the mobility paradigm was shifting from a private transport hub to a door to door mobility (Kim S. H., 2018).

From the perspective of vehicle technology, Smart Mobility can be realized by fusion with four related technology trends: Connectivity, Autonomous, Shared & Service, and Electrification (CASE). This can realize the ultimate form of Smart Mobility when all four technologies are combined with the city's charging, sensor, and communication infrastructure (Hannon, Knupfer, Stern, Sumers, & Nijssen,

2019).

The Internet of Things (IoT) has changed the way of mobility in our life. Maintenance of transportation such as train and buses are more efficiently and easily because sensor could predict the replacement cycle of parts and helps to reduce costs by 10 to 15 percent based on the sensor data (Hannon et al., 2019). Autonomous technology improves not only safety to reduce accidents and efficiency of transportation operations. Similarly, a driverless shuttle can reduce transportation costs by lowering the cost for drivers.

In the case of Shared & Service mobility solution, which is currently actively engaged in the global mobility market-leading by Smart Mobility Service Provider (SMSP) such as Uber and Didi chuxing, it is creating a huge impact on the automotive industry and the future mobility ecosystem by using ride-sharing or car-sharing through a shared platform rather than using individual vehicles. Electrification is already applied in modern society in public buses and private vehicles. Environmental problems like climate change and air pollution accelerate electrification recently (Hannon et al., 2019).

In conclusion, the definition of Smart Mobility has a common meaning of effectively solving urban traffic problems (Hong & Park, 2020). In other words, there are three (3) directions for Smart Mobility. First of all, the benefits of mobility, the convenience of transfer, and reduced travel time could be obtained by bundling small traffic demands. Additionally, the second purpose of smart mobility is to improve traffic flow and reduce energy-saving environmental benefits by solving current urban problems. Finally, by recycling surplus assets from ownership to sharing, Smart Mobility aims to create new revenue models and resolve economic identity as well as further economic benefits that can spur consumption (Cho & Cho, 2019).

2.2 Mobility as a Service

Mobility as a Service (MaaS) is a concept that has recently emerged, and a clear definition has not yet been established such as Smart Mobility. Therefore, various types of attempts are currently being made to make new business models, and services that are mainly recognized as MaaS are divided into two concepts: combined mobility service or integrated public transport. However, the ultimate form of MaaS is the combination of these two (2) concepts. (Kim, S. H., 2018)

An article in *Deloitte Review* reports that the MaaS platform is the solution to support consumers' door-to-door travel by using a single app and various mobilities rather than using the mode of transportation independently. In addition, a smartphone app could provide real-time information of each transportation and mobile payment system is integrated among the mode of transportations, so people could enjoy the seamless mode of transportation and mobility services together with low cost, convenience and time-saving (Goodall, Dovey, Bronstein, & Bonthron, 2017).

The core of this service platform is that the transportation paradigm is shifted from supplier-centered to user-centered, and for this, it is a system that enables transportation service provision and improvement tailored to the needs of consumers by utilizing digital interfaces. Therefore, it is recognized as a user-oriented business model than existing services. (Kim, S. H., 2018).

In particular, the biggest feature of the mobility revolution is that ICT innovation that adds value by applying intelligently networked infrastructure to mobility. Even if there were existing mobility services, traffic congestion can be intensified because they are not connected, and there is a limit to introducing additional infrastructure due to lack of resources. However, MaaS has grown into a mobility platform that can be used quickly, conveniently, easily, and inexpensively to integrate these fragmented mobility services by adding value as a new business model and acting as a "mobility manager" (Rossbach et al., 2013).

The article also mentioned that there are two directions for the ultimate destination of the MaaS platform that policymakers need to know. In the first place, policymakers should avoid developing

infrastructure-oriented urban transportation planning to relieve congestion. In general, there are “more roads” or “more public transportation” in cities to mitigate traffic jams, and policies are implemented in the direction of expanding infrastructure. As Robert Moses, who is the legendary road builder in New York City, pointed out, whenever the policymakers decide to build new roads, they eventually accelerate more congestion. Based on the policy, the place will change a car-centric city rather than human-centric. Hence, the MaaS platform could be an alternative solution for traffic congestion with advanced technology such as ICT (Goodall et al., 2017).

Secondly, the final destination of the MaaS platform is to unify the full range of modes of transportation and flexible payment system (Goodall et al., 2017). When it comes to MaaS, many people usually expect ride-hailing, ride-sharing, car-sharing, car-hailing services a lot, and it means that MaaS has a strong position as a luxury good rather than a utility good.

However, MaaS is limited by shared services alone, and it can maximize its effectiveness by aiming for a government-level public service and municipal transportation should be included. In addition, the MaaS platform itself is difficult to implement Smart Mobility system, and it is necessary that integrated related technologies: big data analysis, optimization technologies related to mobile paths, vehicle dispatch and control, data communication with vehicles(V2X) and ICT technologies, the profit model structure such as billing and payment for continuous service maintenance (Cho & Cho, 2019).

Additionally, the convergence of connectivity, autonomous-vehicle technology, shared services, and electrification will have a disruptive impact on the mobility industry (McKinsey & Company, 2018). In particular, various attempts to develop autonomous driving technology are being conducted by governments and companies around the world (Goodall et al., 2017). For instance, Singapore, Japan has begun testing Robotaxi which is a driverless car with a very limited autonomous technology, and Uber also makes an effort to commercialize Robotaxi to reduce labor (driver) costs which account for 70 percent of total operation cost (Lee, 2016).

2.2.1 Innovation Ecosystem: Mobility Ecosystem

In “Innovation ecosystems: A conceptual review and a new definition,” Granstrand and Holgersson define innovation ecosystem as “the evolving set of actors, activities, and artifacts (products, services, resources, technologies, etc.) and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors.” (p.1) In other words, innovation ecosystem emphasize relations with “complementary/cooperative” and “substitute/competitive,” so the relationship could allocate rights properly and create positive network externalities among participants which are governed by the institution (Granstrand & Holgersson, 2020).

This concept is also needed to apply in the MaaS platform because it is easy to drive the “winner take most” situation (Terry et al., 2019) that we often find it in the ICT industry such as Google, Uber, Netflix and Kakao. Therefore, the role of the institution, which is director and mediator, in the MaaS ecosystem should be government because a well-established MaaS ecosystem could benefit all by enhancing competitiveness in a city.

As the article in the Deloitte Review also pointed out, the government has a crucial role in the MaaS platform to let everyone sit at the table (Goodall et al., 2017). In the future, cities are in a situation where they have missions to relieve traffic congestion with fewer resources, and the complexity of the platform is increasing as technology advances and new business models continue to be created. Also, since the purpose of MaaS is to integrate all transportation and link all service systems both public and private platforms into one app, it will not be easy to perform their mission unless the actors involved work together.

As presented in Table 3, the core elements of the MaaS platform are divided into four categories: infrastructure, data providers, transport operators, and trust mobility providers, and an environment, where players from all sectors can work together, is essential to create an effective the platform and benefit all participants (Goodall et al., 2017).

Table 3 Core elements of the MaaS ecosystem (Deloitte University Press, 2017)

Elements	Details	Actors
Infrastructure	- Smartphones on 3G/4G/5G networks - High levels of connectivity - Secure, dynamic, up-to-data information on travel options, schedules and updates - Cashless payment systems - Interchanges, stations	telecommunication companies, payment processors,
Data providers	- Managing data exchange between the multiple service providers by using API, analytics on usage, demand, planning, and reporting	mobility management players
Transportation operators	- Public transportation operators - Private mobility providers	public and private transportation providers,
Trusted mobility advisors	- Transparency for operation : security issues, private information usages, etc.	local authorities with responsibility for transportation and city planning

For instance, the European Union has established the MaaS Allians in 2015, the mission of the organization is "public-private partnership creating the foundations for a common approach to MaaS, unlocking the economies of scale needed for successful implementation and take-up of MaaS in Europe and beyond," according to its official website (European Union, n.d.). The organization is governed by a Board of Directors which have been composed of leaders with various experiences related to MaaS in Europe, and there are several working groups to manage legal/technical issues, user experience, social impact, and market development (Goodall et al., 2017).

Additionally, it is also essential to induce citizen's participation. Future developments in MaaS have difficulties for suppliers to provide quality services without citizen feedback, as they need to establish an integrated mobility system that provides more options for travelers to move from point A to B in an easier, faster, cheaper, and safer way than the current transportation, with supply tailored to actual demand (Goodall et al., 2017). Therefore, the participation of people is also a prerequisite for establishing a MaaS ecosystem.

2.2.2 Data Economy

Recently, the importance of using data as a power source of the 4th industrial revolution is increasing. The SITRA, which is the Finnish Innovation Fund, expected with an optimistic view that the value of the European data market could exceed 1 trillion euros in 2025 (Ilves & Osimo, 2018). The government can provide efficient national services by using people's data, and companies can conceive a profit model through a new business model based on consumer data. Individuals can also get the opportunity not only to obtain information based on data from governments or companies, but also to act as a monitor through transparent information disclosure.

In particular, discussions on data in Europe began quickly, and related projects are being promoted with a new concept of data economy. According to the report *A Roadmap for a Fair Data Economy*, European Union (EU) data market research defines the data economy "the overall impacts including direct, indirect, and induced effects of the data market on the economy" (p. 10), and the concept includes "generation, collection, storage, processing, distribution, analysis elaboration, delivery, and exploitation of data enabled by digital technologies" (p. 10). It means that data economy encompasses a wide range of players both existed and emerging data analytics companies. Therefore, the mission of a fair data economy is the broad circulation of data among data providers such as citizen, the public sector, and private companies (Ilves & Osimo, 2018).

To realize the data economy, as mentioned in this report, two goals must be pursued: the establishment of appropriate regulations on data use and maximizing the use of data. Since these two requirements are in a trade-off relationship, it is important to balance them properly by government policy (Ilves & Osimo, 2018).

First of all, to promote the use of data, appropriate regulations must be created to prevent misuse of data. As data usage has recently begun to increase, concerns over misuse of personal information have grown as new business models are being created. One study in the report shows that the biggest barrier to consumers' use of online services was the use of personal information. In 2013, 37 percent of European Internet users pointed out the problem, and in 2017, the rate rose to 45 percent (Ilves & Osimo,

2018).

Related to this situation, the term Mydata has emerged in the financial sector. The concept is defined as “a series of processes in which information owners actively manage and control their information and take the initiative in using it in life, such as credit management, asset management, and healthcare” (p. 2). For example, to illustrate, personal information held in various fields, such as banks, telecommunications, hospitals, can be collected in one place and used voluntarily to receive services that require detailed data analysis, such as credit or asset management consulting. In addition, discussions are actively conducted in areas such as telecommunications, medical services, and finance, where information owners cannot directly manage and control their information, which could minimize asymmetry of information between companies and information owners, thereby encouraging individuals to exercise their right to self-determination more actively (Kim, Y., 2018).

Secondly, the maximization of data utilization should be encouraged. According to Ilves and Osimo (2018), individual data trading has not yet been carried out on a large scale, because it is not easy to define the value of data individually. In general, the value of personal information is very ambiguous because researchers purchase datasets from which personal information is collected without paying separate fees for personal information (Ilves & Osimo, 2018).

Also, one of the important things in the data economy is that data is meaningful when it is used through analysis, not just collection. For example, the business model of ICT companies such as Facebook and Google is based on selling accurate message targets to desired viewers without including data resale (Ilves & Osimo, 2018). The situation could lead to data imbalances, increasing the power of data-owning companies, inducing monopoly concerns over related business, and losing opportunities for the utility that can be obtained from data.

Finally, the report advised that policymakers should move more decisively to settle the data economy. The world has recognized that Europe is timely and essential for its strong enforcement and ethical stance on data sharing issues. Individuals will have the ability and confidence to widely share personal data through consent and portability, which in turn will enable a new generation of

personalized services and greater competition for the benefit of consumers. Therefore, policymakers strive for more effective policymaking in preparation for the data economy era (Ilves & Osimo, 2018).

3. Government Policies on Smart Mobility

As interest in smart cities has recently increased globally, the importance of smart mobility is also increasing. In particular, since the connection with public transportation is essential for smart mobility, the importance of government policy also plays a large role. Also, the MaaS platform has been spotlighted as a key service for intelligent transportation system in conjunction with the development of ICT, so many cities around the world, including Helsinki, Paris, Eindboven, Gothenburg, Monpellier, Vienna, Hanover, Las Vegas, Los Angeles, and Singapore have developed MaaS through public and private partnerships (Goodall et al., 2017).

In this chapter, an analysis of each country's environment will be conducted such as transportation environment, smart mobility policy, and related regulations, centering on Helsinki, who is called the pioneer of the application of the MaaS platform, and Singapore, which is actively developing smart mobility business under the policy of Smart Nation, the first in Asia.

3.1 Finland (Helsinki)

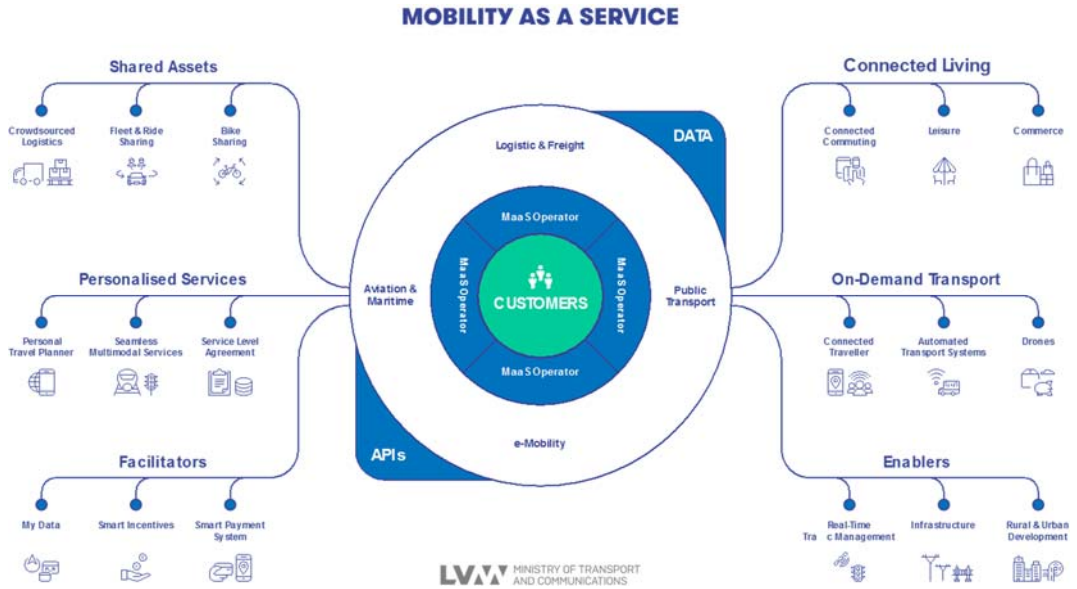
3.1.1 Smart Mobility Strategy

Finland became the first EU member to commercialize 5G and is pursuing a smart city project called ‘The Six City Strategy (6 Aika)’ by 2020 in the six major cities such as Helsinki, Espoo, Tampere, Vantaa, Oulu and Turku with more than 30% of Finland's population. The input budget is 100 million euros and one of the areas to promote the project is the policy on smart mobility (KOTRA, 2020a). For example, Robot Buses is a project to solve the urban mobility problem and is pursuing to create a new business by creating a fast lane of automated road transport systems in Finland (FORUM VIRIUM HELSINKI, 2016).

In particular, Helsinki, as a leader in the revitalization of mobility services, promoted “the world's first city where aims to car-free by 2025,” and public-private collaboration to build the MaaS platform by designating 600 parking spaces in Helsinki exclusively for car-sharing and making public

parking lots available. As part of the carbon dioxide reduction, major European cities are drafting laws preventing certain type of private vehicles from entering and leaving their cars, but Helsinki has chosen to increase public transportation use by providing more efficient and convenient mobility services the way to develop its mobility system rather than limiting the number of cars.

Figure 1 Mobility as a Service Framework (LVM, n.d.)



An article in Deloitte Review reports that Helsinki's mobility service was compared to Netflix. If Netflix's business model is applied to the urban transport system, it would be similar to the service offered through an app called “Whim” operated by MaaS Global in Finland (Goodall et al., 2017). MaaS Global was the world's first MaaS operator and started as a mobility startup in Finland. The Whim is a service created in cooperation with the Finnish government and Helsinki Transportation Information Administration HSL, which aims to share all transportation information in the Finnish capital of Helsinki. When a user enters a destination on the Whim app, the user can check the route using trams, subways, ferries, and car-sharing (MaaS Global, n.d.).

Whim was born based on the transportation environment in Finland. Due to cold weather conditions such as frequent heavy snow and strong winds, there are many restrictions on driving, traffic laws are very strict, and obtaining a driver's license is difficult. In the case of obtaining a driver's license,

a total of 9 steps must be passed, and it takes about two years to issue a formal license. Traffic regulations are also strict, and the fine system pays differentially in proportion to driver income (Yoo, 2016). Also, the cost of owning a car in Europe is more than 600 euros a month, and the monthly usage rate is minimal at around 4 percent. Therefore, the service was created by reducing unnecessary costs caused by car ownership and by paying attention to increased mobility using various means of transportation (Lee, Y., 2019).

Helsinki's vision has a completely different paradigm than the transportation system so far, as it represents the next step in Mobility as a Service platform. Maas Global has established a subscription-based integrated service through Whim, and users can plan the movement through the use of various transportation options such as taxi, car-sharing, public transportation and bikeshare. In addition, it intelligently suggests methods for mobility by learning users' preferences and synchronizing them with their calendars. There are two options for payment of expenses: monthly prepayment of the service as part of your mobility subscription, or pay-as-you-go (Goodall et al., 2017).

The goal of the Helsinki Maas platform is to go beyond conventional public transportation. Instead of giving up personal vehicles for commuting, they maximize convenience by offering a variety of cheap, flexible and well-coordinated transportation options for service users, allowing them to choose the easy-to-use Whim app (Green, 2014).

MaaS Global's business model has already been recognized worldwide, and is being expanded to include Turku (Finland), Antwerpen (Belgium), Vienna (Austria) and Birmingham (UK) in addition to Helsinki, and is also preparing for a pilot operation in Asia (MaaS Global, n.d.).

The government of Helsinki also operated on-demand bus service called ‘Kutsuplus,’ which is advanced services to calculate optimal route by calibrating supply and demand for each user based on collected data from consumer’s mobility information with a smartphone app. However, the bus services failed after two years (Green, 2014) due to the lack of scale, investment, and flexibility (Goodall et al., 2017).

3.1.2 Mobility Ecosystem

According to the Global Market Report, there are many opportunities for startups to expand their business in European Startup Market since Europe has recently grown into a “Tech Startup Hub” where global innovative startups gather. European countries strive to provide start-ups with opportunities through a business-friendly environment, revitalization of start-up clusters, and expansion of foreign entrepreneurship support measures (KOTRA, 2018).

One of the important startup markets is Finland. Finland has a population of 5.55 million, one of the least densely populated countries in Europe, so the market is very small. Industrial policy in Finland had centered on fostering ICT-oriented companies before “Nokia Shock,” but the crisis turned into an opportunity by changing its economic structure from large companies to leading startups. Furthermore, Finnish companies are already aware of the limitations on the small domestic market, so they actively consider entering the global market from the beginning.

Finland's startup culture is also one of the countries that has a well-established innovation ecosystem because it has a Nordic value and social responsibility management culture that values cooperation between private and public institutions, and infrastructure centered on higher education institutions, and sustainability (KOTRA, 2018).

KOTRA also introduced the Finnish government’s three key policies set as a goal for sustainable growth; achieving a carbon-neutral country (by the year 2035), repairing and expanding transportation and network infrastructure, and encouraging startups for the fourth industrial revolution to prepare for aging and high wages society. Based on the policies, the growth of the market will be accelerated.

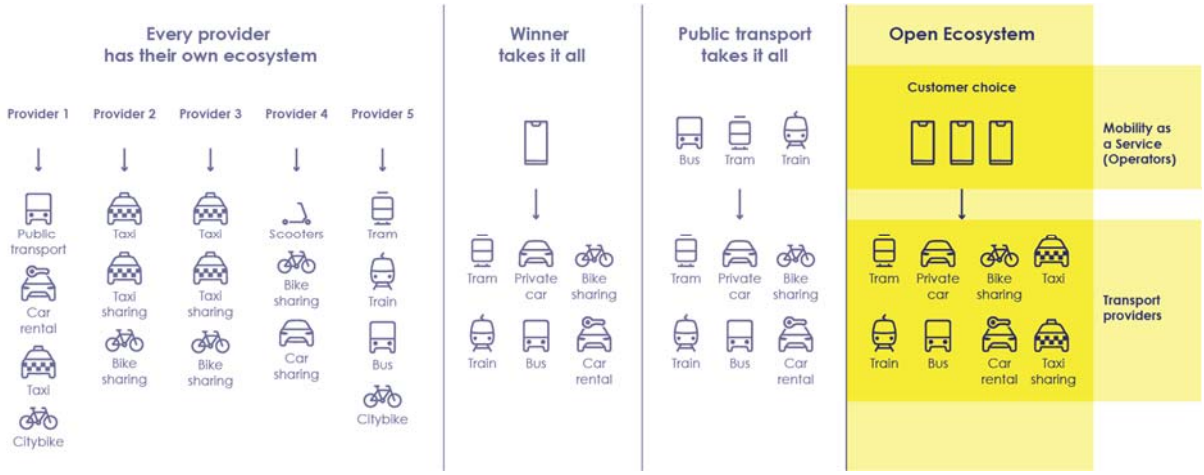
Based on the situation, MaaS Global also benefited from Finland's innovation system. When MaaS Global made a proposal to create the Whim service, big companies like Denso decided to invest, and the government gave the startup a chance to do a pilot test in Helsinki. Also, the government, which

operates public transportation exclusively, shared the right to sell transportation tickets through the agreement, which enabled it to provide the world's most advanced form of Smart Mobility service (Lee, 2019).

Secondary, the government's encouragement of data utilization, such as opening public data pursued by “The Six City Strategy (6 Aika),” was the policy to help companies generate revenue through new business models by using Application Programming Interface (API). The supports also have contributed greatly to pursue the sustainability of the MaaS platform (FORUM VIRIUM HELSINKI, 2016).

MaaS Global emphasized cooperation with partners to create an open mobility ecosystem, as shown in figure 2. As mentioned earlier, the MaaS platform through apps is easy to have a structure where winners take everything, but the startup tried to build the innovation and sustainability of the MaaS platform by leading all participants to open APIs created in the process of providing mobility services. Therefore, it is possible to provide more advanced mobility services by accumulating data related to users' preferences and applying the data to improving service quality for the convenience of users (MaaS Global, n.d.).

Figure 2 Whim Open Ecosystem (MaaS Global)



3.1.3 Regulation

According to the report written by Institute for International Trade (ITT), The Finnish government revised the Act on Transport Services to ease regulations on taxis to promote the mobility service market by easing regulations on taxi licenses and fares, thereby integrating regulations that had been fragmented by means of transportation into a single law and promoting new service reforms in response to consumer demands for movement. Therefore, the drastic easing of regulations on taxi operation facilitated service providers' entry into the taxi market and allowed them to diversify their services by inducing competition among companies. The major revisions can be found in Table 4 (ITT, 2019).

Table 4 New Act on Transport Services (ITT, 2019, p. 5)

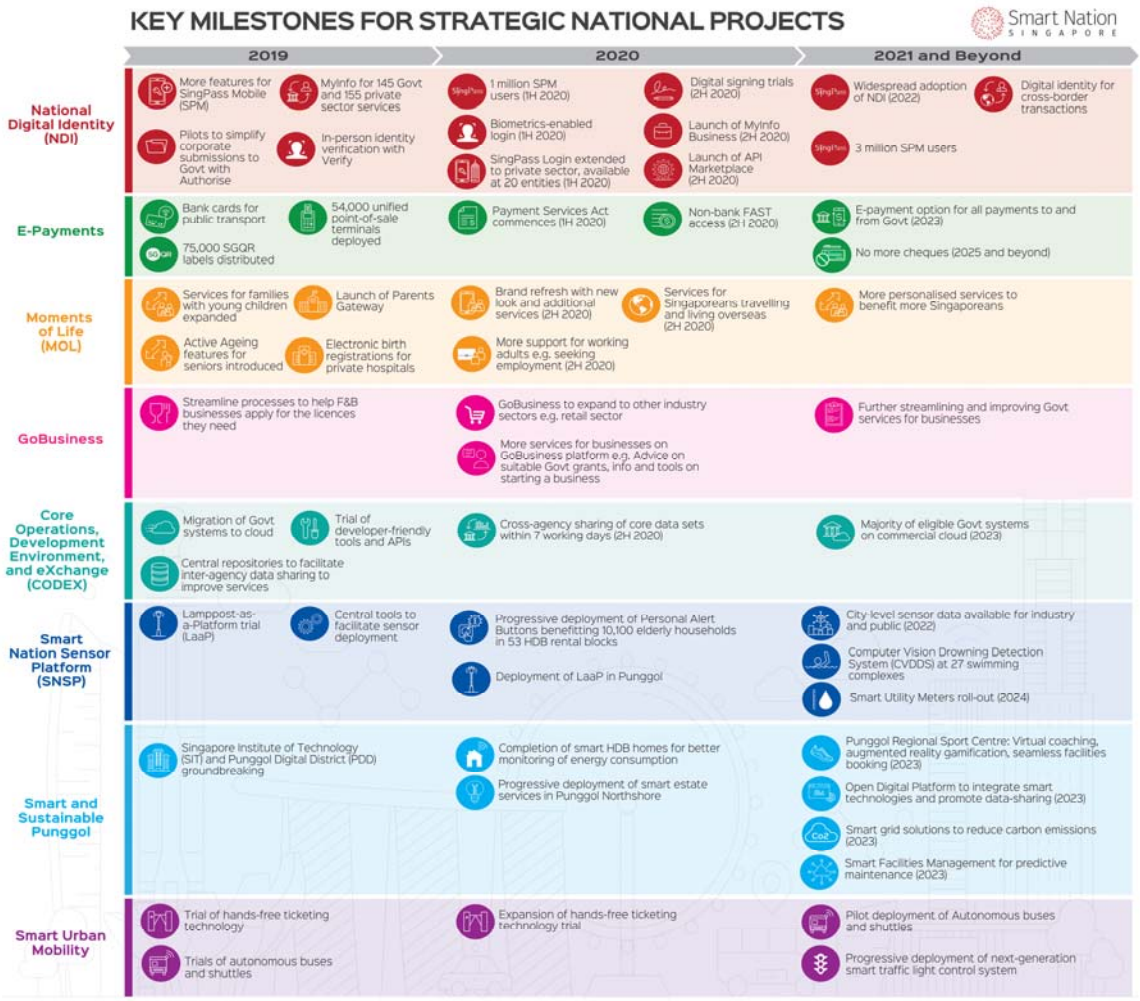
Regulation	Details
Deregulation on the total amount of taxi licenses	- Accepting new services and abolishing existing industry regulations for fair competition (legalizing Uber's ride-sharing service) - Provide licenses to all operators meeting the license terms
Expansion of operating area	- Permission to operate in areas with an insufficient supply of taxis outside of existing areas
Taxi fare liberalization	- Eliminating the price ceiling and allowing free pricing, instead of requiring the provision of pre-travel cost information
System opening obligation	- Open platform API between mobility companies to establish the basis for MaaS platform deployment to enhance DB mutual sharing and linkage such as reservation, payment, route data, etc.

3.2 Singapore

3.2.1 Smart Mobility Strategy

Singapore announced the next phase of a nation-building policy called “Smart Nation” in November 2014. It utilizes its development know-how acquired through the development of digital technology with the characteristics of Singapore's city-state and promotes smart city projects in various fields such as city transport and public data led by the state. The project aims to solve difficulties such as improving productivity, creating high value-added jobs, supporting the elderly, and strengthening national identity. In addition, the policy is promoting the expansion of open innovation in the fields of transportation and energy-smart nation through AI analysis of big data collected from all over Singapore through sensor networks (KOTRA, 2020b).

Figure 3 Key strategic of the Smart Nation (Smart Nation official homepage)



As shown in Figure 3, there are three policies for Smart Mobility: hand-free ticketing technology, autonomous buses and shuttles, and progressive deployment of next-generation smart traffic light control system (Government of Singapore, 2020). With regard to the smart city project, Singapore is focusing its efforts on introducing autonomous driving technology, especially in public transport such as taxis and buses. In 2017, the world's first unmanned autonomous taxi, NuTonomy, was introduced, and the Singapore Land Transportation Authority (LTA) established a long-term development plan called “Land Transport Master Plan(LTMP) 2040” following LTMP 2013, which ended in 2018 (KOTRA, 2020b).

The LTMP 2040 contains three mid- and long-term policy directions: 1) 20-minute towns and a 45-minute city, 2) transport for all, 3) healthy lives, safer journeys.

The first policy decided to push for the Transit Priority Corridors method, such as expanding two lines of railways called NSL and TEL and installing bus-only roads to shorten bus service time by up to 15 minutes to make commuting time within 40 minutes within 20 minutes of living areas. It also indicates plans to build an integrated transport hub linking bus stops to shopping malls or railway stations and a bicycle road of 1,000 kilometers by 2040, to build a seamless network of connections (LTA, 2019).

The second policy, transport for all. This measure will expand the Heart Zones Initiative program at Integrated Transport Hub to allow the elderly, pregnant women and the disabled to board first and to connect with volunteers who would support the weak during rush hour. It also indicates the installation of next-generation passenger information displays on all buses by 2040, which will provide detailed guidance on routes and stops (LTA, 2019).

The final policy, healthy lives, safer journeys. This focuses on the establishment of parking spaces for bicycles, and of sidewalks to promote bicycle use and walking, and will gradually expand electric or hybrid buses to install Silver Zone and expand low-carbon transportation to improve safety (LTA, 2019)

In countries with relatively high incomes and a significant portion of automobile supply, such as Singapore, population growth and demand for automobiles has been slowing down. In particular, Singapore is pursuing a vehicle restraint policy by lowering the increase rate of issuance of the Certificate of Entitlement (COE), which is a vehicle-owned license, to 0%. This is because traffic congestion is increasing due to high population density in narrow land even though it has a high transportation infrastructure. Also, air pollution in large cities is a serious problem now, so Euro 6 emission regulations are being applied. Moreover, due to regulations such as various taxes and registration fees, the price of a vehicle is one of the highest in the world. (KOTRA, n.d.)

For this reason, the nation has implemented public transportation-related policies for solving traffic problems through mobility innovation as well as increasing the use of public transportation in Singapore. According to the LTA (2016), travel by private car fell for the first time in 20 years in 2016, and public transportation travel hit a record high in the same year (URA, 2019)

One of the major roles in reducing the number of private vehicles is the MaaS platform. In addition to enhancing commuters' travel experience, MaaS can improve the city by reducing the need for vehicle ownership and parking lots, and public spaces can be redesigned as pedestrian-oriented bike-friendly spaces, which also help reduce CO_2 emission. Singapore is the second place where Finland's MaaS Global has applied the MaaS platform after its launch in November 2018. MaaS Global partnered with ComfortDelGro, Singapore's largest company, to promote the launch of Whim. The startup launched beta services that incorporate public transportation, car-hailing, rental service, car sharing, and micro-mobility (MaaS Global, n.d.).

In September 2019, Mobility X, a Singaporean emerging company funded by Japan's Toyota Trade and Singapore's public transport operator SMRT, began offering the MaaS smartphone app Zipster to the public. Users can take advantage of a variety of transportation options in Singapore, and this is the first time in Asia to offer this service. By the beginning of this year, MaaS was pioneered in Asia, including the launch of a monthly subscription system that integrates bus, rail, car-hailing, and bicycle sharing services. In the future, it has entered into business alliances with AXA, a French

insurance company, in addition, with Grab, a car hailing and sharing service company in Singapore, with Go-Jek from Indonesia, and with Blue SG, a car sharing service for electric vehicles (EVs) in Singapore (Lee, K., 2019).

Furthermore, Singapore's on-demand transport service is Beeline SG, which is similar to Helsinki's Kuktsuplus as part of its Smart Nation policy. They can make reservations and track their location, and operators can also activate new routes driven by community demand. Government agencies Infocomm Media Development Authority and LTA operate in partnership with transport operators, academia, and the private sector (Goodall et al., 2017).

3.2.2 Mobility Ecosystem

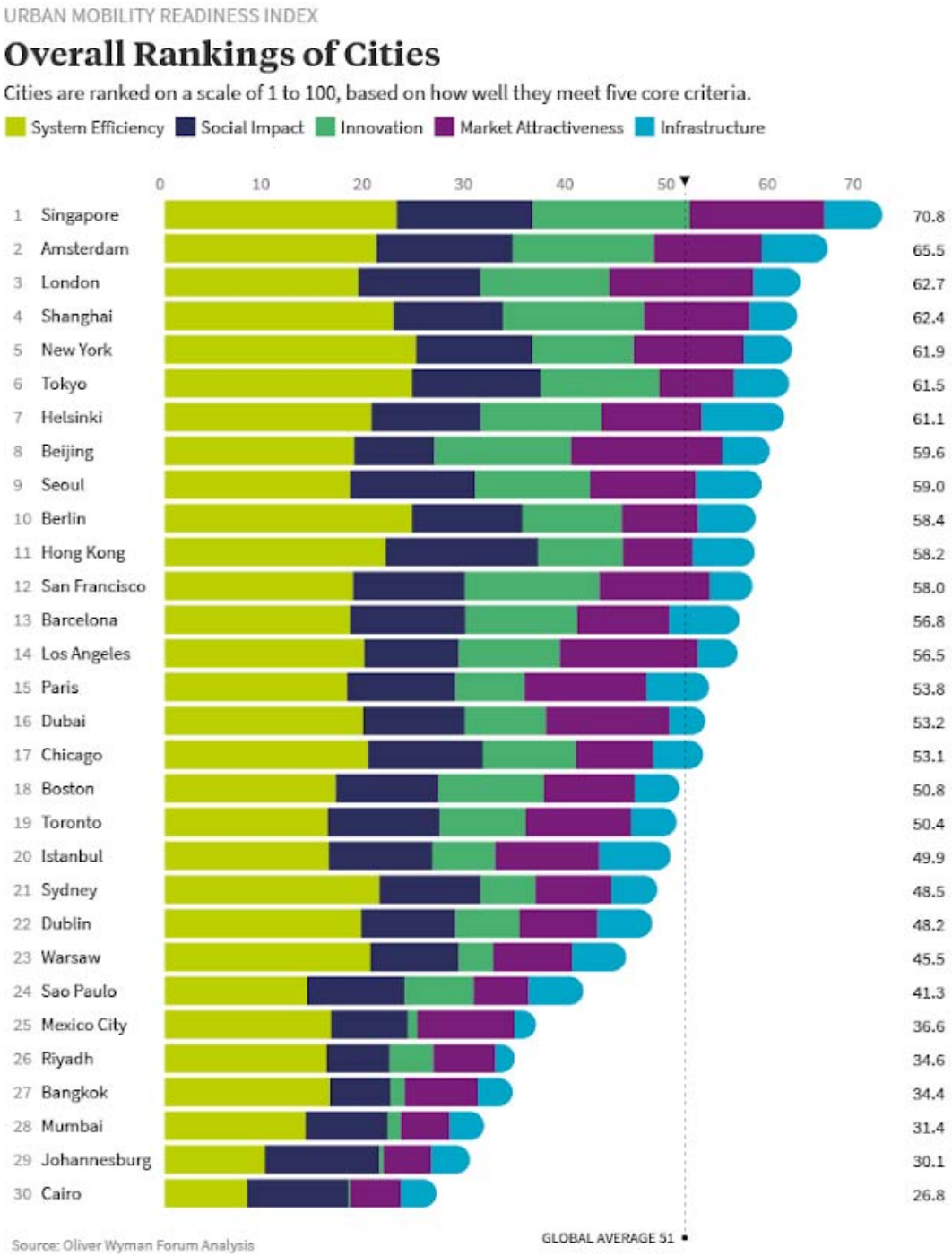
Singapore is also playing a pioneering role in building a mobility ecosystem. As shown in Figure 4, in the first Urban Mobility Readiness Index analyzed by Oliver Wyman Forum, it ranked first in How Cities Rank on Mobility Ecosystem Development. The index ranked 30 cities on their readiness to incorporate the latest mobility technologies and what they are doing to reshape urban mobility. It also analyzes existing public and private mobile networks, current regulations, policies and infrastructure, urban living possibilities, and the ability to absorb future technologies for each country (Mariano, 2019).

Singapore ranked first because it recognized the importance of building a mobility ecosystem, private sector and research partnerships, and infrastructure investment. It has played a pioneering role in reducing traffic congestion through various policies such as public transportation and infrastructure and is adopting an active approach that integrates advanced technology and progressive transportation policies. In addition, it leads to autonomous driving and real-time digitalized traffic management (Mariano, 2019).

The shuttle service for the expansion of public transportation was also introduced through cooperation with the government and companies. Grab, in collaboration with the Government Technology Agency of Singapore (GovTech), launched Grab Shuttle, a fixed-route shuttle service in

March 2017, and then launched Grab Shuttle Plus, a temporary shuttle service in November of the year. As a result of the test service, 70% of Grab Shuttle Plus users traveled more than 4 km, confirming that there is a need for a long-distance shuttle, and plans to reduce the travel time of users by more than 30 percent by expanding the service in the future (GOVTECH, 2017).

Figure 4 Urban Mobility Readiness index (Oliver Wyman Forum, 2019)



The LTA in cooperation with the US shuttle haling start-up Via, proved in December 2018 that the temporary bus service BusGo reduces mileage by more than 18% compared to the fixed-route bus after six months of operation. The official service launch was suspended due to high costs such as development costs (Via, 2018).

Moreover, data-related policies are also very active along with AI innovation. This is not a data policy that is directly linked to the mobility ecosystem, but it can be expected to generate synergy effects as the basis for it.

According to the analysis of the National Information Society Agency (NIA), Singapore recognizes the limitations of urban countries and actively encourages foreign companies to do business in the country. Similarly, Singapore has been preparing for an artificial intelligence revolution by utilizing data accumulated in major growth engines such as finance and logistics. Based on these policies, Singapore ranked first in the overall in the Global Cities' AI Readiness Index in 2019, which means that Singapore is best responding to changes in AI, and the Singaporean government used these benefits to build AI initiatives and governance (Jang, 2019).

The ‘AI Singapore’ initiative is designed to match AI technology suppliers in universities, research institutes, and other places that require artificial intelligence, including companies in Singapore, and has three (3) major initiatives: AI research, AI project support, and nurturing AI experts. AI governance refers to governance for implementing reliable AI by governments, private companies, universities and research institutes to reduce the risk posed by using artificial intelligence technology. Each body is trying to maintain its system centered on AI by clarifying its role (Jang, 2019).

3.2.3 Regulation

In Singapore, due to the characteristics of a city-state with a small national territory, the government also established related regulations as micro-mobility services with high convenience were rapidly spreading. Although the launch of the electric scooter and bicycle sharing service was active

due to lack of related regulations in the early stages, the market has grown again since 2018 due to stricter regulations such as the introduction of a licensing system for bicycle sharing projects and banning the delivery of electric scooters. The LTA has defined Personal Mobility Device (PMD) and established driving areas and safety regulations for each type (Zipidi, 2019).

Concerning car-hailing regulations, Singapore needs to acquire business licenses for more than 800 fleet operating companies from 2020, which is aimed at limiting their influence on the market of large companies and encouraging startups with innovative business models to emerge (Abdullah, 2020). Regarding driver regulation, it is necessary to have a service license, Private Hire Car Driver's Vocational License (PDVL), and issuance conditions include completion of training, basic English conversation, and felony crime. The PDVL license is issued immediately if the conditions are met without a total limit, and a fine of 7,500 USD or more is imposed for driving without a license (Grab, 2020).

Originally, when purchasing a vehicle, the amount of issuance of the vehicle-owned license COE was limited, so the incentive to use car sharing was high. In addition, in countries where rental car is more popular, the spread of car-sharing tends to be more active, such as in Singapore. According to the Public Transport Council of Singapore (PTC), the utilization rate of privately-owned car-sharing services, excluding taxis, increased from 50% in 2016 to 70% in 2017 during the week of July-August 2017 survey (Kim, H., 2019). As such, it grew under the influence of the policy to suppress the increase of vehicles in the early stages of the car-sharing market, but the narrow national territory is with high-convenience, inexpensive, and with advanced public transportation infrastructure that hinders the fleet expansion.

3.3 Analysis and Findings

Finland and Singapore are ahead of other countries in not only building smart cities, but also in transportation policies to implement Smart Mobility. In particular, Finland is the first country in the world to build a MaaS platform and is being benchmarked by many other countries. Singapore also applied MaaS the fastest in Asia, as well as the world's fastest introduction of autonomous driving systems.

There are several reasons why the application of the MaaS platform to the two countries can be faster than other countries: the size of the country is small, the regulation is difficult to drive a private car, and public transportation is cheaper and already well-equipped than other means of transportation. Although the two countries have adopted the transportation system for similar purposes, such as reducing traffic congestion and reducing CO_2 emission, there are differences in the method.

Finland is increasing the utilization rate of citizens by establishing MaaS that is more convenient than driving a private car without any restrictions on vehicle operation, but the country is complicating the process of obtaining a driver's license. However, Singapore induces the use of MaaS by making the car purchase method difficult, and not only introducing a licensing system for managing the number of vehicles operated but also encouraging public transportation by raising taxes to obtain car privately.

In addition, both countries have already established innovation ecosystems that are very easy to build a mobility ecosystem in, one of the most important roles of MaaS. In addition to cooperation between the government and the private sector, the government's support and active participation of related players are generating synergies to create destructive innovation by assigning their respective roles to universities and research institutes. The two (2) countries are more active than other countries in establishing an environment for beta testing and inducing foreign companies to participate in new trials. Especially, in Finland, a startup culture promotes private and public cooperation, and the Nordic value and social responsibility management culture that values sustainability and infrastructure centered

on higher education institutions also play an important role. It shows a big difference from Korea, which adheres to the industry promotion policy (KOTRA, 2018).

Furthermore, Finland and Singapore recognized the importance of data before other countries, and tried to apply it to the national system, and encouraged the provision of APIs to the private sector to support companies or start-ups to generate revenue through the establishment of new business models. In particular, data use is a sensitive issue linked to the problem of private information abuse, so it is also important to establish relevant regulations and guidelines to minimize risk. Since both countries are very advanced in establishing related laws, it is easy to realize a sustainable structure such as real-time data sharing and consumer preference identification, which are the core of the platform.

Finally, for the advancement of the MaaS platform, encouraging services such as car-sharing, ride-sharing, and car-hailing based on the shared economy, and as well as various public transportation, are some of the important factors. Despite concerns about backlash from the existing industry, it provides an advanced MaaS platform. Finland emphasized the illegality of Uber using unlicensed drivers, and there was a large-scale protest urging the government to respond. As a result, the government made it illegal for car-hailing business for unlicensed drivers, while at the same time inducing market revitalization by amendment of the transport law. In the case of Singapore, to prevent some fleet companies from monopolizing the market, policies such as limiting fleet operations per company to 800 units will be implemented.

Overall, although it is acknowledged that they are leading the Smart Mobility service because they had a very suitable environment for building MaaS platforms, such as small national scale, development of public transportation, and difficulty in using their cars, each government was able to speed up development by presenting policies and regulations suitable for each country. Also, building an innovative ecosystem or data economy also played a big role in the application of the MaaS platform.

4. Policy Recommendations

According to the article in Deloitte Review, five (5) proposals were made on the role of the government to build the MaaS platform: defining a vision for goals, encouraging investment, pursuing public interest and safety, transportation policies for the common people, and adequate regulations that are not excessive or insufficient. Since the government can use power in areas related to public interests such as transportation through its policies, it is necessary to encourage gains that may be biased by the initiative of private sectors to be returned to the whole (Goodall et al., 2017).

Korea has a very well established next-generation communication infrastructure, such as 5G and ICT, in comparison with other countries; open data also has the highest level (OECD, 2020). Therefore, advanced transportation systems such as BIS and ITS are also being expanded in many places in addition to major cities. However, when looking at the analysis of the requirements presented by Deloitte and the mobility policy in Finland and Singapore, there are additional considerations for establishing the MaaS platform in Korea.

Initially, before implementing a specific mobility policy, the Korean government should define and establish a strategy for smart mobility in Korea, which should be based on regional characteristics.

In a recent study, although local knowledge is critical in establishing smart city policies, many policymakers have overlooked this importance. Even in countries where ICT has developed, such as Korea, technology inequality is bound to exist among cities (Sepasgozar, Hawken, Sargolzaei, & Foroozanfa, 2019). Based on the data evaluated through the Smart Mobility Transportation System Level Assessment, it is necessary to set the target level and basic direction of smart mobility for the target city to implement policies and plans to meet the level of each city’s development of technology (Kim, T.,2019). Therefore, smart mobility can be expected only when policies based on citizen-centric technology are implemented, otherwise, it will be no different from the existing supplier-oriented U-city.

In the case of Finland or Singapore, they have policy direction based on each city's

characteristics: ‘the world's first city where aims to car-free by 2025’ in Finland or ‘Land Transport Master Plan 2040’ in Singapore. However, even Sejong, which has the most advanced form of smart city policy in Korea, seems to be aiming to provide the most advanced form of service among recent smart mobility trends, rather than to reflect the characteristics of the city. For example, Finland and Singapore are more economical and more widely used public transportation due to the difficulty of obtaining a driver's license or purchasing a vehicle, but Korea has a lower preference for public transportation than the countries because it is relatively easy to obtain a driver's license and a car. So, the policy is not appropriate to apply the MaaS model of the countries directly to Korea.

As mentioned in Section 1.1, the survey result of Sejong citizens expanded public transportation showcased citizens’ opinion that the use of public transportation is inconvenient due to the long bus stops and sections. However, the policy to reduce the use of private vehicles through the expansion of shared vehicles does not appear to be appropriate because the cost of using shared vehicles can be cheaper than taxis, but more expensive than public transportation. Transportation policies should be designed in a way that is cheaper and more convenient for both the rich and the poor.

Therefore, to reduce personal vehicles, it is necessary to increase the number of public transport and last mile mobility as in Finland and Singapore, and promote the use of existing public transport such as bus, subway, and bicycle sharing by establishing an environment in which MaaS can be used easily and conveniently with a smartphone app. Also, since there is a limit to operating MaaS centering on shared vehicles, it is necessary to maximize the effect by linking public transportation and shared services. For this, it is necessary to aim for public services at the government level rather than the unilateral transportation services of private companies (Cho & Cho, 2019). McKinsey & Company's Smart City Report also pointed out that the higher the use of shared cars, the lower the proportion of regular cars, which is good for reducing CO_2, but less effective than switching to a bus-based mode of transportation (McKinsey & Company, 2018).

In addition, strategies are needed to enable citizens to travel at low rates. As explained above, the main purpose of expanding autonomous mobility is not only to secure stability by minimizing

human errors, but also to minimize the cost of hiring drivers, thereby making public transportation operating costs and usage fees low. The reason why shared-based fleet operators such as Uber and Lyft are trying to secure autonomous driving technology is to increase profitability by reducing driver hiring costs and to increase utilization rates by lowering user costs.

Therefore, the government needs to establish a strategy step by step to impose transportation charges to a minimum. It is necessary to provide citizens with alternatives to realistic transportation problems by devising scenarios that take into account the timing of introducing autonomous driving technology into public transportation, the cost of building infrastructure related to autonomous driving such as vehicle dispatch and control, big data analysis and optimization technologies related to mobile routes, when transportation fares can be reduced based on the expected timing of achieving profitability, and the integration or reorganization of the fare system.

In the second place, to provide MaaS, it is essential to establish a mobility ecosystem. It is difficult for the government to promptly introduce smart mobility-related technologies on time because the speed of development of technology is very fast. As the importance of the active role of businesses and residents for urban development has been increasing, the need for a mobility ecosystem is also being emphasized (McKinsey & Company, 2018). However, it is not easy to apply Finland's advanced MaaS model right away, as Korea does not have an active innovation ecosystem with active public and private cooperation, and most of the policies are public-led (KOTRA, 2018).

Also, there is a reason why it is more difficult to realize the innovation system concerning the MaaS platform than in other fields. To provide MaaS to customers, collaboration is needed in various fields such as communication, payment system processing, mobility data management, public and private transport information. However, customer-related information is not fairly distributed to all players, but data tends to be concentrated on the companies that manage MaaS apps, so other participants are often subordinate to a particular company. Startup companies like Uber do not end up as a simple car-hailing platform, but ultimately to build a MaaS platform linking public transportation with other private operators because other participants are bound to be dependent on companies that

manage apps that respond to customers.

That's why many automakers, including Mercedes-Benz, BMW and GM, are jumping into the MaaS business. It is not easy for the existing automotive industry to collaborate with ICT companies because the sales of automobiles will inevitably decrease and customer data will also be secured around ICT companies (Ryu, 2019).

Therefore, to create a mobility system in Korea where the innovation system is not well equipped, it is important to have transparency in the data obtained from the MaaS platform. In addition, a framework is needed to adjust the level of information openness through consultation with entities that do not want to disclose specific information, such as corporate secrets, to other participants. Based on this, the key is to have a MaaS platform that is not subordinate to a particular company.

One of the ways to solve this problem is to apply blockchain technology to building a mobility ecosystem. Blockchain technology is defined as “distributed ledger technology in which participants jointly record, store, and manage transaction information data on P2P networks rather than central servers of a particular institution” (IBK Industrial Economics Research Institute, 2017, p. 2), and has advantages such as anonymity, stability, transparency, and security.

There are three (3) types of blockchain: public, private, and consortium (enterprise) blockchain, and it seems appropriate to adopt consortium blockchain technology to build the MaaS platform. This has the advantage that only pre-selected participants have the authority and security can be strengthened due to limited participants. In addition, it can solve the problem of slow speed and poor scalability of public blockchain, and there is little concern of being subordinated to one company with fair data accessibility (IBK Industrial Economics Research Institute, 2017).

In particular, information sharing between competing companies is more difficult, but sensitive information that cannot be shared can be supplemented by making related rules through mutual agreement so that they can be managed separately. In addition, because it is not easy to manipulate data due to the nature of the blockchain, it has the advantage of increasing the reliability of the participants'

data, and it is expected that cost reduction effects will be obtained because no intermediary is required (Kim, J., 2020).

Moreover, to build a mobility system, the city itself should be available as a testbed for the development of future mobility industries like Singapore, and the participation of foreign companies should be actively encouraged. To improve the level of MaaS in Korea, it is important to support and participate in domestic companies to improve their capabilities, but it is also necessary to expand the perspective of domestic startups and improve their competitiveness by creating a structure in which foreign companies collaborate and compete with local companies. Moreover, if it is difficult to launch new technologies and services due to regulations in Korea, ICT regulatory sandboxes should be actively utilized to verify projects.

Third, the utilization of data should be increased through the deployment of a mobility system. Korea is a country where data collection is very easy due to the development of ICT. However, it is not easy to expect creative services to use data so far, as the economic structure centered on large companies makes it difficult for various startups to emerge and it is not easy to win in the competition with large companies. Korea's conservative privacy law also hinders increased data utilization.

When the deployment of a mobility system provides fair data access to MaaS platform participants, the government should be able to help create new business models regardless of large companies and startups. In addition, appropriate legal measures should be supported to prevent personal information from being abused.

Lastly, concerning the introduction of a new industry in Korea, a compromise must be prepared due to conflicts with the existing industry. New business models in Korea were not always easy to innovate due to regulatory constraints. For example, the conflict between the existing taxi industry and the new car-hailing service Tada recently has intensified. Accordingly, the domestic startup industry expressed concern that the prosecution's judgment of Tada's illegality would lead to startup regulations to protect existing industries, and the startup ecosystem may collapse due to the regulations (Kim, B., 2019).

However, these conflicts are not unique to Korea. In Finland, conflicts with the existing taxi industry and concerns about the stability of car-hailing services have been raised over and over again, and the government has taken measures such as permitting the launch of new businesses within the scope of guaranteeing stability to come up with a compromise. In other words, it is a regrettable reality that new businesses cannot be introduced directly into Korea due to regulations, but because each country's environment is different, the unconditional acceptance of new businesses may not be the only solution.

To apply the MaaS platform, it would be great to have a variety of services from last-mile mobility to car-sharing and car-hailing, but these new services are not essential to the advanced form of MaaS. Therefore, it is necessary to first think about how to optimize the existing services by using them. As mentioned above, the problem of the absolute lack of bus dispatch can be supplemented by expanding buses.

At the same time, from a long-term perspective, efforts to introduce a new business model in Korea should be carried out. New means of transportation will emerge in the future, and the speed may not be able to keep up with the regulations. Therefore, the regulatory sandbox and special cases of the nature of special laws are strengthened, and private business owners are introduced by methods such as preliminary and post-implementation regulations as seen in advanced cases. To maintain the business rights of a company, there is a need for a policy back-end to induce industrial vitalization (Cho & Cho, 2019).

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