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A Case Study of the Korean Government's Preparation for the Fourth Industrial Revolution: Public Program to Support Business Model Innovation

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Abstract: The Fourth Industrial Revolution caused by innovative technologies is an irresistible megatrend, and many companies, institutions, and major countries are making efforts to participate. The World Economic Forum took the lead in discussing the Fourth Industrial Revolution, adding the issue to its 2016 agenda, and found that many governments, including that of Korea, were concerned about how to support their nation's participation in the Fourth Industrial Revolution and were pursuing programs to support such efforts. In this study, we describe one of those programs, the Korean government's Flagship Project Support Program (FPSP), which supports latecomers in creating open platforms and creating new business ideas in innovative technological industries. The program helps businesses overcome entry barriers to existing business ecosystems established by big technological players in growing fields such as smart cars, the Internet of Things (IoT), virtual reality (VR), etc. The purpose of this study is to determine whether latecomers and small- and medium-sized companies that are experiencing difficulties in their own innovation can succeed in innovation through the Korean government's FPSP. This study performed a comprehensive and qualitative analysis based on the Logic Model Framework consisting of an investigation of business ecosystems before and after the FPSP, assessment of outcomes, and evaluation of the effectiveness of the FPSP. This study shows that open platforms resulting from the FPSP successfully innovated business models in Korea. Our study, therefore, has implications for other governments seeking to play a role in supporting the Fourth Industrial Revolution.

Keywords: fourth industrial revolution; business model innovation; open platform; smart car; Internet of Things; virtual reality

1. Introduction

A global era of low economic growth has led to sluggish demands, which have become a threat to corporate management [1]. A fusion of emerging technologies is pushing to change the structure of the social system and create new markets and demands. Thus, many companies worldwide are attempting to pivot during this period of the Fourth Industrial Revolution, which could overcome the present global economic difficulties. Government support is also crucial to generating new business areas from emerging technologies [2,3].

Major developed countries have instituted multiple policies to adapt to these new technological and business paradigms. The United States, for example, promotes its manufacturing industry by focusing

on Advanced Manufacturing Partnerships (AMPs), an innovative project based on public–private partnerships, and the government-led Networking Information Technology R&D (NITRD) [4–6]. Germany, meanwhile, upgraded its Industry 4.0 strategy to the Platform Industry 4.0 strategy, and is supporting the construction of the Cyber Physical System (CPS) [7].

Japan has established a Future Vision 2030 plan, which includes specific technological strategies for mobility, supply-chain, healthcare, and living technologies. Future Vision 2030 includes seven strategies for establishing new economic and social systems, more sophisticated rules, innovation ecosystems, economic rejuvenation systems, human resources development/utilization systems, social security systems, regional/SMEs (small- and medium-sized enterprises) systems, and overseas businesses [8].

China's State Council recently announced its Made in China 2025 plan, which aims to change the emphasis from "Made in China" to "Made by China". Made in China 2025 intends to boost manufacturing innovation and promote the deep integration of IT and industrialization. The plan presents breakthroughs in 10 key technological sectors, including new-generation information technology, high-end digitally controlled machine tools and robots, aviation and aerospace equipment, etc. China also announced the Internet Plus Initiative to boost its internet-based economy [9].

Innovations are essential for successful entry into the era of the Fourth Industrial Revolution and many governments try to promote innovation. However, corporate leaders cannot easily determine innovative initiatives, as they are time consuming, costly, and likely to fail, which is referred to as a "leadership gap" [10]. Government policies can directly or indirectly help innovative efforts by reducing the difficulties of companies [11,12], and thus, corporate leaders can strengthen their leadership skills to take risks and innovate.

The Korean government is considering the role it will play in the era of the Fourth Industrial Revolution by helping companies to promote innovative activities. Technological innovation can induce sustainable growth, and thus it attempts to support the creation of new markets and jobs through technology-based innovations. It is important in Korea that the government provides customized support to companies who face difficulties transitioning from industrialization to technological development [13]. As part of these efforts, the Korean government has developed the Flagship Project Support Program (FPSP) aimed at supporting small- and medium-sized companies in promising technology fields.

The first two projects supported by FPSP were terminated and the government needed to confirm the performance and effectiveness of FPSP and to make sure public funds could promote technology-based innovations. This is the motivation for this study. This study examines the Flagship Project Support Program and its performance analysis based on the detailed information of the two projects supported by FPSP. We present the effects of FPSP on business model innovations and the implications of FPSP for the government's role in the era of the Fourth Industrial Revolution.

This paper presents a literature review, research design, and an introduction to FPSP, then explains the results of the FPSP performance analysis. Finally, the paper concludes with a discussion and a conclusion.

2. Literature Review: Fourth Industrial Revolution and Business Model Innovation

2.1. The Fourth Industrial Revolution

During its 2016 annual meeting, the World Economic Forum (WEF) defined the Fourth Industrial Revolution as "a fusion of technologies" that blurred the boundaries of the physical, digital, and biological spheres [14]. The WEF argues that the current technological revolution will fundamentally change the way we live and work, and adopted the Fourth Industrial Revolutions as its global agenda for the coming years. Scholars are taking this seriously and are struggling to respond appropriately [15].

The Fourth Industrial Revolution is caused by our current technological revolution, which in turn, will inevitably have an effect on industry and impact the global economic structure. The WEF posits that new platforms and business models are changing talent, culture, and organizations, and

therefore, fundamentally changing how we do business. It predicts that emerging technologies will create a completely new way of delivering goods, thus, destroying existing industrial value chains. The heart of this trend is technology-enabled platforms that disrupt existing industry structures, a feature that combines traditional demand and supply, which means that the Fourth Industrial Revolution will create new markets that have not existed before, and will create new demand, new supply, and new value.

2.2. Changing Platforms

Parker et al. [16] refers to these new structures as "digital platforms": they affect how consumers are engaged, how their behavioral patterns and opinion data are gathered, and how these data are used to design, produce, and distribute products and services. This means that technology is adding new digital capabilities to the supply of goods and services to create new value. These platforms are "business platforms" that cover the business itself rather than the technology platforms which was a component of business in the past. Of course, it is still clear that technology is very important because the digital business platform is based on technology.

Porter and Hepplemann [17] make similar claims about technologies mentioned by the WEF. They focus on changes in the value chain caused by smart, connected products and industry redefinitions. In the past, IT innovation was mainly about improving business processes such as value chain automation or integration. However, the changes happening with today's smart, connected products are different. These technologies are embedded in the product itself and change the method of value creation, enabling a good to have new capabilities. In this regard, research has also been conducted on how innovation concepts change with technology [18].

Because smart, connected devices and technologies have completely changed the existing value chain, companies must adapt their organizational structure and way of collaboration to accommodate these changes, including instituting new products, services, and business models. Porter and Hepplemann [17] argue that "the entire system and platforms" are now the centerpiece of the industry, while in the past, most industries sold single-purpose products. They explain that the combination of technology and industry is breaking traditional boundaries, using the example of farm equipment: the farm equipment industry was extended to the farm management system industry by combining tractors with smart and connected devices.

2.3. Business Model Innovation

Particularly noteworthy is Porter and Hepplemann's discussion of the new business models that occur as a result of this adaptation [17]. This is in line with the WEF's discussion of the Fourth Industrial Revolution. According to Chesbrough [10], a *business model* is a way for a company to sustain itself by producing a product or service and earning profit. He also explained the business model as follows: every company has its own business model, and the core functions of the business model are value creation and value capture. The generation of profit through value creation and value capture is the most fundamental condition for a company to be sustainable. Business models exist in a wide variety of forms depending on the product type and depending on the industry. Linder and Cantrell [19] typified business models into eight categories according to a company's profit strategy: price models, convenience models, commodity-plus models, experience models, channel models, intermediary models, trust models, and innovation models. Examples of each category are shown in Table 1. Recent literature suggests a framework for classifying business models on a few factors instead of classifying them as fixed types. These business model frames have the advantage of being able to handle various business models including cases of new products and services. For example, Grossmann et al. [20] proposed the St. Gallen business model navigator (Figure 1a) and Taran et al. [21] the five-V framework for business model configuration (Figure 1b).

Table 1. Linder and Cantrell's (2000) [19] eight categorizations of business models.

Business Model	A Few Examples
Price models	One-stop low-price shopping, under the umbrella pricing
Convenience models	One-stop convenient shopping, comprehensive offering
Commodity-plus models	Low-price reliable commodity, reliable commodity operations
Experience models	Experience selling, experience destination
Channel models	Channel maximization, cat-daddy selling
Intermediary models	Market aggregation, open market-making
Trust models	Trusted operations, trusted advisor
Innovation models	Incomparable products, incomparable service, breakthrough markets

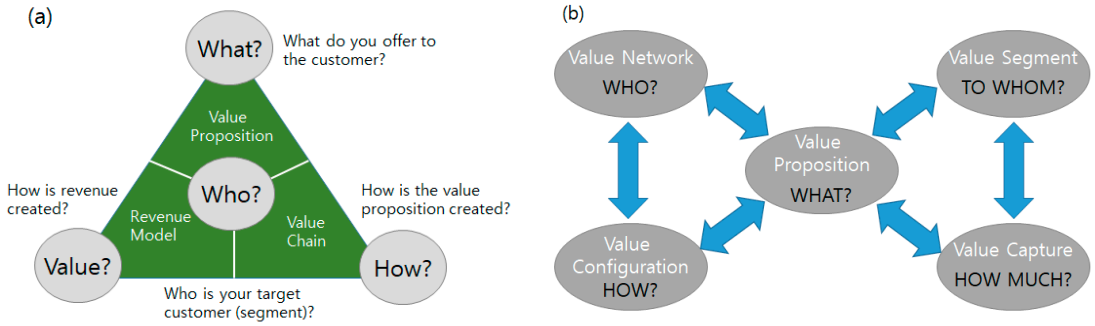

Figure 1. (**a**) The conceptual triangle for the St. Gallen business model navigator by Grossmann et al. [20] and (**b**) the five-V framework for business model configuration by Taran et al. [21].

If a company's profits are declining or if a company wants to move up to the leading position in the market, it is time for the company to try its business model innovation. *Business model innovation* means a new model that generates profit in a different way from the existing model, and therefore, changes the rules of the market [22]. Business model innovation means creating and capturing values by doing things differently from existing business models. Successful business model innovation can provide products or services that did not exist or create new consumer channels. Companies with successful business model innovation create new markets that never existed before and become game changers. There are several types of business model innovation, including regular business model innovation, in which new products and services occupy some market shares while existing products are maintained, and revolutionary business model innovation in which powerful new products and services emerge to make existing products less competitive.

Amit and Zott [23] also explain that it is important for business model innovation to create new value. In particular, they mention Apple's case, well-known to us as an example of business model innovation. While Apple developed and sold a suite of personal computers until the 1990s, it also showed a new kind of innovation when it introduced the iPod and iPhone. The MP3 players that existed at the time were just hardware, but Apple combined iTunes, an online download service, with the iPod, the hardware, to present a business model that had not heretofore existed. This newly constructed model directly connected the music producer and consumer, and completely changed how people consumed music. Using business model innovation, Apple was able to create new value and become a game changer that impacted the market, industry structure, and value. However, not every company can succeed in business model innovation like Apple.

2.4. Difficulty of Business Model Innovation

There is no doubt that business model innovation is important, but only few companies have succeeded in realizing it and creating new value. So why is business model innovation difficult?

The clue can be found in Chesbrough [10,24], who describes the importance of internal and external cooperation, i.e., open innovation for securing technology. He argues that innovation should not be limited to technology and R&D, but that, indeed, business model innovation is even more crucial. A company's innovation does not depend only on securing technology and/or producing products; it must affect all production and marketing processes, including creation, development, distribution, etc. This, however, is not easy to do, and many companies fail.

Chesbrough refers to the "leadership gap" as the cause of these difficulties: there is no one who can take responsibility for making all the necessary changes for business model innovation in a company. As described in the previous paragraph, business model innovation should be attempted in relation to all of the company's activities, from procuring raw materials to satisfying the final consumer. However, there are few in the company who understand the series of activities the company engages in in depth and who can implement and account for changes needed for business model innovation. There are managers and chief officers who are responsible for their respective division, but no single division can drive business model innovation. In addition, "business model experiments", that try new business models and obtain, interpret, and understand the results, take a relatively long time with little payoff, and few managers can afford to take these risks, especially when so many experiments fail. The person driving business model experiment must be somehow in a position to look at the entire business, who has time for a business model experiment, and can take charge to promote business model innovation based on leadership. CEOs are, therefore, often the first people to come to mind. However, corporate CEOs typically delegate responsibility for the entire business model to managers, and therefore, it is not easy even for CEOs to take responsibility if the business model fails. The "leadership gap" refers to the difficulty in finding people who have the appropriate leadership skills and experience for business model innovation. There are not many appropriate leaders who can take risks in the company, hence, the company commonly fails to innovate a business model. Companies would innovate if they were able to take all the risks associated with changing their business models. If the company decides that it cannot cope with the risks, the innovation is not promoted. Companies try to cooperate with or be supported by entities outside of the company in order to reduce the risks that come with innovation. Will the government help to reduce the risk and increase the likelihood of success in business model innovation? Based on the literature findings so far, we came up with the following research question:

> *Research question: Can the government fill this leadership gap, i.e., can the government share the risk of companies that lack the leadership to take risks and can the government help companies to conduct business model innovation and new platform development?*

A study from Cornell University, INSEAD, and WIPO [12] presented the results of a questionnaire survey on the importance of policies to corporate innovation. The EU Commission [11] noted that the policy environment could serve as a catalyst for business model innovation. Recently, Niosi and McKelvey [25] and Tian [26] presented a case study of the government's contribution to innovation activities. Similarly, we hypothesize that sharing the risks of business model innovation with the government can reduce the burden on companies and promote the business model innovation of an entire society. As shown in Figure 2, the purpose of this study is to verify whether the government support can expand the possibilities of business model innovation and the new business opportunities.

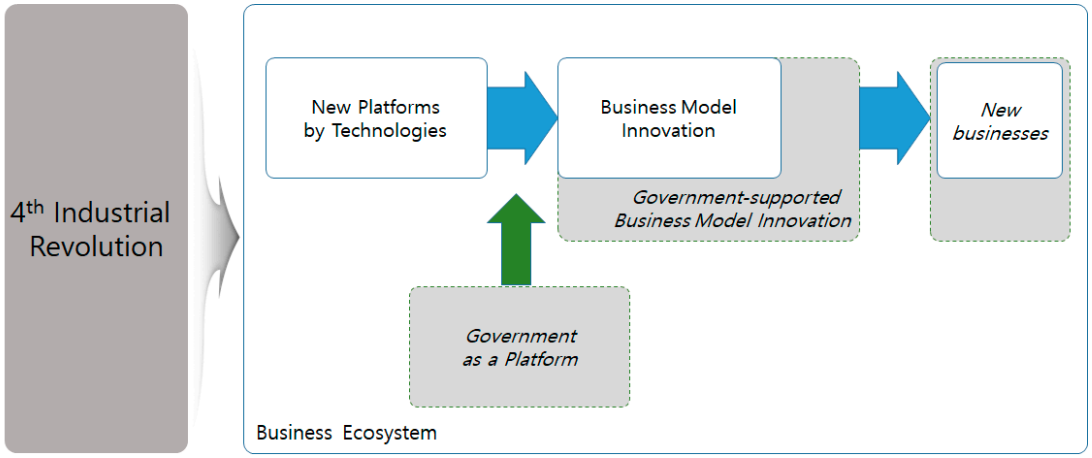

Figure 2. Expansion of possibilities for business model innovation and new business by government support.

2.5. Government as a Platform

O'Reilly [27] addresses the role of platforms and governments in business model innovation using Apple as a case study. According to O'Reilly, Apple's introduction of the iPhone and the iPhone application developer platform was once again a complete business model innovation, on par with the introduction of the iPod and iTunes. Apple has expanded the market to allow anyone to participate as an iPhone developer through the App Store, creating innovations with this new business model. However, they have not opened the platform completely, but have presented clear rules and managed the platform while encouraging innovation. O'Reilly calls Apple's policy "an effective balance between control and generativity".

With reference to Apple, O'Reilly [27] proposes a model of "Government as a Platform," arguing that the government should change from a government providing routine services to taxpayers as "vending machine government" [28] to a government as "a convener and an enabler" for the new age of civil society. O'Reilly claims that Apple's App Store, neither a completely open platform nor a strictly regulated platform, is the most comfortable platform for the government to serve as a platform for innovation: clear rules exist and there is some oversight, but everyone can participate freely. The App Store characterizes "an effective balance between control and generativity", and thus, it can be applied to the public domain. It could be compatible with the nature of the government, even though it is an innovative platform for private companies. The government's role in the era of the Fourth Industrial Revolution is better to maximize the creativity of the players while minimizing interference as "a convener and an enabler" rather than applying standardized support or regulation as "vending machine government".

In addition, several researchers suggest that innovation can only occur when several external factors are in play. Isenberg [29] proposes an "entrepreneurship ecosystem strategy" as a pre-condition for innovation systems and national competitiveness policies. Isenberg pointed out that the issue of public priority for entrepreneurship is too low. Since corporate activities have a socio-economic spillover effect, policy makers and public leaders argue that institutional and cultural efforts should be made to create a virtuous circle of business ecosystems. Here, the business ecosystem shows the networking environment of the enterprise and the relationship with a focal firm, suppliers, its complementor firms, and customers. The business model can be embodied on a business ecosystem [30]. Likewise, Florida et al. [31] argued that innovation cannot be done at the level of individual business units, but that cities are the sources of innovation and stages where interactions between companies can take place. They thought that various factors such as culture, institution, manpower, etc., of cities where companies are located are needed for innovation. They also explained innovation can only be created through interactions among companies, so that the external environmental factors surrounding the company are just as important as internal factors of its capabilities and activities in order for a

company to succeed in innovation. These external factors can be established by interaction among firms, but support from cities or governments are also needed.

As we have seen so far, it is necessary to cooperate and interact with entities external to the companies in order to ensure proper leadership for an innovation by reducing risk and creating more opportunities, and it is important that the role of the government is "as a convener and an enabler". Government can influence company activities and markets in a variety of ways and drive innovation. This can be explained in the concept of governpreneurship described by Hisrich and Al-Dabbagh [32]. According to Hisrich and Al-Dabbagh, governpreneurship is an extension of entrepreneurship to the government or public domain. Traditionally, entrepreneurship has been applied to private sectors, but has gradually expanded to the public sector like non-profits, social ventures, national organizations, and even governments. Hisrich and Al-Dabbagh argue that "governpreneurship is becoming increasingly important in an era of economic downturn and reduced sources of revenue".

3. Research Design

We studied cases where the Korean government helped companies promote business model innovation and new business model creation. The Korean government operates a support program, the Flagship Projects Support Program (FPSP), to solve the difficulties of entry into the market as a latecomer of SMEs in the technology sector related to the Fourth Industrial Revolution. The market is already occupied by large companies, which makes it difficult for SMEs to enter the market even if they have the technology. For the sustainable growth of the economy, various innovations must succeed, and value creation must continue. If latecomers do not get the opportunity for innovation success in a market where large companies dominate, market diversity, creativity, and flexibility will be inferior and value creation will stagnate. Therefore, the government encourages SMEs to develop an opportunity for innovation success by establishing cooperative relations with each other and creating new business models and new business ecosystems that are different from the existing business models of the market. We collected detailed information about the project progress, including participating companies, partnerships, funding, collaborative activities, etc., and output and outcome data about two cases of this support program, Smart Car/Internet of Things (IoT) and Virtual Reality (VR) industries from the Korea Institute of Science and Technology Evaluation and Planning which is an agency for managing FPSP program.

This study is aimed at evaluating whether the government has succeeded in creating new business models and new value creation by supporting SME companies. With the evaluation of the government's success in supporting innovation, the effectiveness of the support program can also be discussed.

> *Research Goal: To evaluate whether the Korean government has succeeded in creating new business models and new value creation by supporting SME companies. To discuss the effectiveness of the support program.*

We performed a comprehensive and qualitative evaluation to examine the effectiveness of the government support from the outcome of the program with the Logic Model Framework [33]. Figure 3 shows the analysis framework. The logic model method is a widely applied analytic framework for evaluating public program performance. The logic model generally consists of inputs, activities, outputs, and outcomes of the program which can then be analyzed.

> *Research Method: A comprehensive and qualitative program evaluation with the Logic Model Framework, consisting of an investigation of business ecosystems before and after Flagship Project support, assessment of outcomes, and evaluation for effectiveness of Flagship Project.*

An investigation of before and after Flagship Project support includes analysis of existing business ecosystems, barrier analysis to new business creation, and new business ecosystems supported by the Flagship Project. Assessment of outcomes consists of two questions: have the barriers been overcome?

Has a new business model been created? After this, the effectiveness of the Flagship Project Support Program will be evaluated comprehensively and qualitatively.

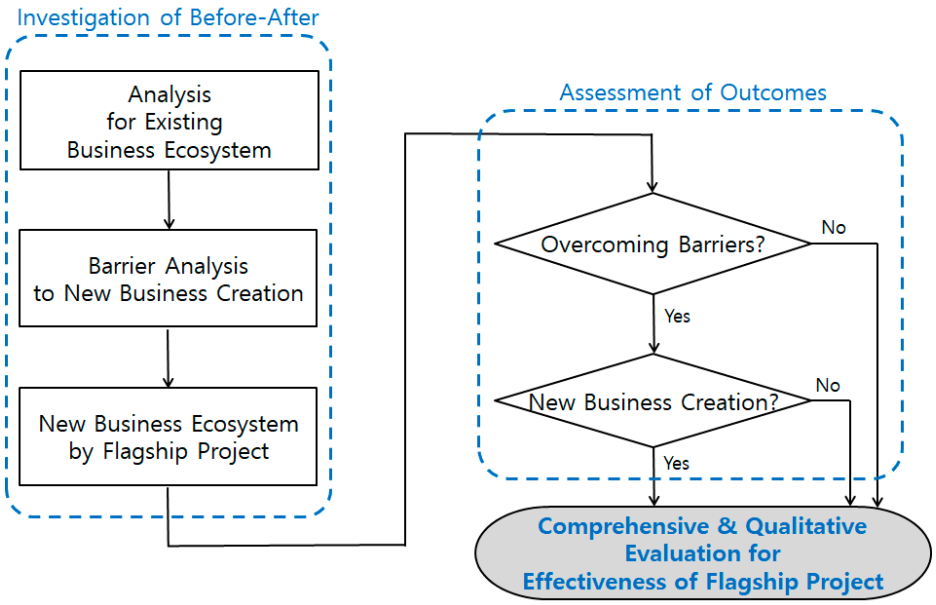

Figure 3. Analysis framework based on the logic model method.

4. Korean Government Program: Flagship Project Support Program

The Flagship Projects Support Program, instituted by the Korean Ministry of Science, ICT, and Future Planning (the ministry changed its name to the Ministry of Science and ICT during the current administration), is a program supporting new business model creation and platform development in technological fields. The program is conducted to seek a future growth engine for industries like smart devices, next generation mobile communication, robotics, IoT, etc.

The FPSP is not a program that supports technology development. Instead, the purpose of this program is to support companies that have already developed elemental technology but have not formed a business model. Many companies have difficulty commercializing their products and services, despite having adequate technology. In particular, it is very difficult for latecomers, who cannot afford the risk inherent in adapting a new business model, to enter the business ecosystem established by big players. Latecomers may have difficulty building partnerships with other companies, research institutions, and universities because of the lack of brand value. Latecomers cannot invest enough time and cost to build their own business model. However, innovation cannot occur without these new players. Thus, the FPSP was developed to provide latecomers with this platform and help them overcome barriers in time and cost.

The FPSP was launched in 2015, and among the companies that submitted applications, companies with a high technology level and high possibility of commercialization were selected after an expert review process. The FPSP supported a total of 24 projects from 2015 to 2017, and the projects were related to fields in the Fourth Industrial Revolution such as smart devices, IoT, robotics, etc. When the FPSP was first launched, the program selected and supported three projects including the Smart Car/IoT and VR industries, where latecomers are hardly able to enter the business ecosystem that large corporations have already built in Korea. Those three projects were the first complete projects of the FPSP. In order to analyze the initial performance of the FPSP, Smart Car/IoT and VR projects were selected among three projects with similarities in attempting new business model creation based on open platforms. The two projects helped latecomers build an open platform to collect and process data and content. These open platforms not only allowed companies to build partnerships with related companies but also encouraged consumers to participate.

The first flagship project developed an open platform for Smart Car/IoT business as a consortium developed and led by the telecommunication company KT, and joined by the small–medium-sized manufacturer Jastec as a collaborator. The government provided about US $1 million to the consortium over seven months (September 2015–March 2016) and the consortium matched these funds to approximately US $1.3 million.

The second flagship project was an open platform for the VR industry. Today, this consortium includes a content and solutions company, ThinkBridge, as a main leader, a VR technology-holding company AlcaCruz as a technology provider, and LG Electronics as a VR headset provider. The government grant was approximately US $0.8 million over six months (December 2015–May 2016) and the consortium raised approximately US $58 million dollars (the government grant was very small compared to the consortium's overall funds, which implies government support was needed in a different way than cost).

5. Results

We analyzed the performance of the FPSP through the following analysis framework. First, we examined the existing ecosystem of the industrial sector. Second, we reviewed the obstacles to services and new business creation. Third, we analyzed the FPSP projects to determine whether the new industrial ecosystem had overcome obstacles and created new business models. Finally, we confirmed whether new services or business were created in order to evaluate whether the FPSP had been effective.

5.1. The Smart Car/Internet of Things (IoT) Open Platform

5.1.1. Existing Barriers

The IoT field was being developed mainly in the smart home and home appliance industries while the projects were conducted. Its application to automobiles remains in the early stages, and the market is still insufficiently formulated. The Smart Car/IoT industry is led by major car companies and in many cases, they have a one-on-one or one-on-N partnership with IT/telecommunication companies, or they make their own applications internally. Existing smart car applications are mostly specialized for specific cars, so the applications are difficult to develop without the cooperation of automobile companies.

In Korea, one of the top telecommunication companies, SK Telecom, developed an application for Hyundai/Kia car users. However, no agreement with Hyundai/Kia Motors and SK Telecom was reached and eventually they abandoned the application launch due to the objection of Hyundai/Kia Motors.

Globally, there are technology alliances among large companies to preempt smart car OS platforms, such as Open Automotive Alliance [34] with Audi, GE, Google, etc.; 5G Automotive Association [35] with AT&T, Audi, etc.; and GENIVI Alliance [36] with BMW, Intel, etc., which are only some examples of alliances in the future smart and connected car industry.

Therefore, it is difficult for latecomers to enter the existing network. These new companies face hurdles when it comes to building an R&D environment, securing Smart Car/IoT data, and building or demonstrating a test bed. Figure 4 shows the original Smart Car/IoT business ecosystem in Korea.

5.1.2. Project Progress and Output

KT, a Korean telecom operator, carried out this project with the goal of building an LTE-based Smart Car/IoT network and dataset open platform by supplying IoT sensor modules that can be mounted on the on-board diagnostics (OBDs) of all automobiles regardless of vehicle brand. To accomplish this goal, KT formed a consortium with Jastec, a company that manufactures IoT OBD sensor modules. Jastec manufactured and supplied Smart Car/IoT sensor modules to KT. Its Smart Car/IoT sensor module can be installed in all automobiles to which the K-OBD (Korea-OBD standard) is applied.

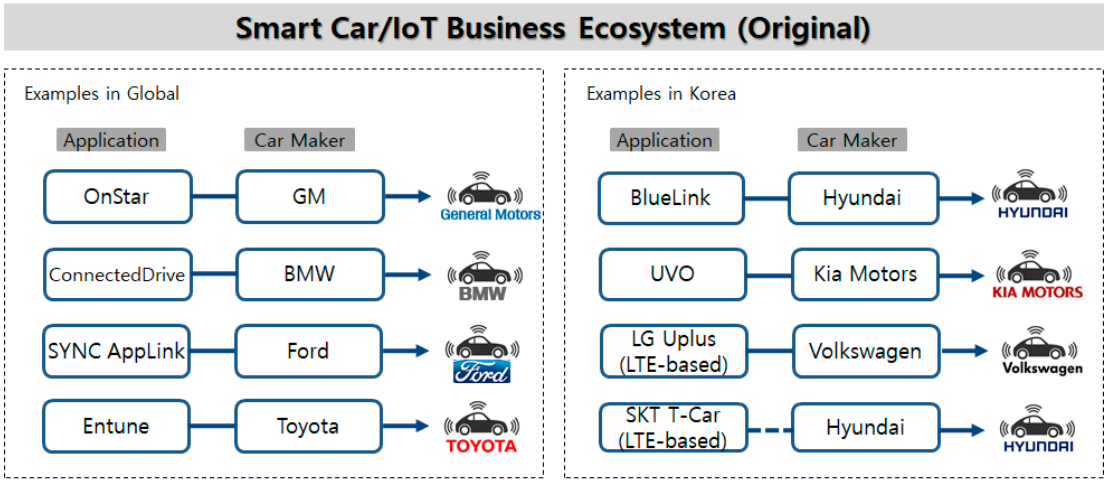

Figure 4. Original Smart Car/IoT business ecosystem.

KT recruited 10,000 volunteers who were willing to experience OBD sensor modules and LTE-based Smart Car/IoT network service. KT launched Korea's first Smart Car/IoT terminal and communication fare (OBD fare) for Smart Car user recruitment. KT built the first Smart Car service test-bed in the world in order to gather data in real-time by connecting users to the network. Volunteers were able to use the OBD sensor module and LTE service for one year free of charge.

The data collected from the Smart Car/IoT test-bed were released through the Open API, allowing every user to analyze the data and generate new business ideas. Then, KT held a user idea contest to obtain new business ideas related to Smart Car/IoT. Approximately 90 users participated, and 36 new business ideas were presented.

5.1.3. Project Outcome

KT is one of the large traditional telecommunication companies in Korea, and Smart Car/IoT is a new business area. The larger the company, the more complex the decision-making process, and thus, making a change to the business model is not an easy decision. Even if one unit in the company wants to try new things, it is difficult to persuade all people involved in the decision-making process, including the CEO, due to the burden of time and cost and the risk of failure. KT was selected as a FPSP project, so it shared the risk with the government and was able to experiment with business model innovation relatively easily.

Together, KT, a latecomer to Smart Car/IoT technology, and Jastec, a small company, were able to recruit 10,000 Smart Car/IoT data production objects without establishing a partnership with a major automobile company. Platforms based on partnership with major automobile companies are usually limited to datasets dependent on a specific brand. But because KT and Jastec did not have a relationship with any single company, they could build an open platform.

Although KT is one of the major telecommunication companies in Korea, it has not promoted Smart Car-related business, so it is not recognized in this industry. KT was largely helped by the government and the FPSP project to promote its product to consumers resulting in the first Smart Car/IoT service test bed in the world and a study with 10,000 volunteers. In addition, the open platform gathers data from users, processes it, and releases the data back to users. The idea contest resulted in a total of 35 new business ideas.

KT plans to launch a usage-based insurance in partner with a fire insurance company (MERITZ Fire and Marine Insurance Co., Ltd.) using a result of its analysis of vehicle operation patterns. This item is one of 35 new business ideas. Other new business ideas include container monitoring, hazard vehicle monitoring, and fresh food logistics, contributing to the expansion of industrial boundaries beyond the traditional automotive sector.

5.1.4. Business Model Creation

The open platform through the FPSP project provides smart car users with service opportunities to identify vehicle diagnostics and driving habits. The open platform also provides opportunities for partner companies to create new services, such as insurance using smart car data, since it provides an environment in which big data can be collected and analyzed without relying on automobile companies. These new service opportunities have a meaning of customer value proposition.

Based on these new service opportunities, the FPSP project creates new business models: drivers can buy OBD sensor modules and subscribe to an LTE network service to use smart car services, and partners can encourage their customers to use smart car services, which in turn, will enable the company to provide new service. Figure 5 illustrates new Smart Car/IoT business ecosystem due to the Flagship Project Support Program (FPSP) project.

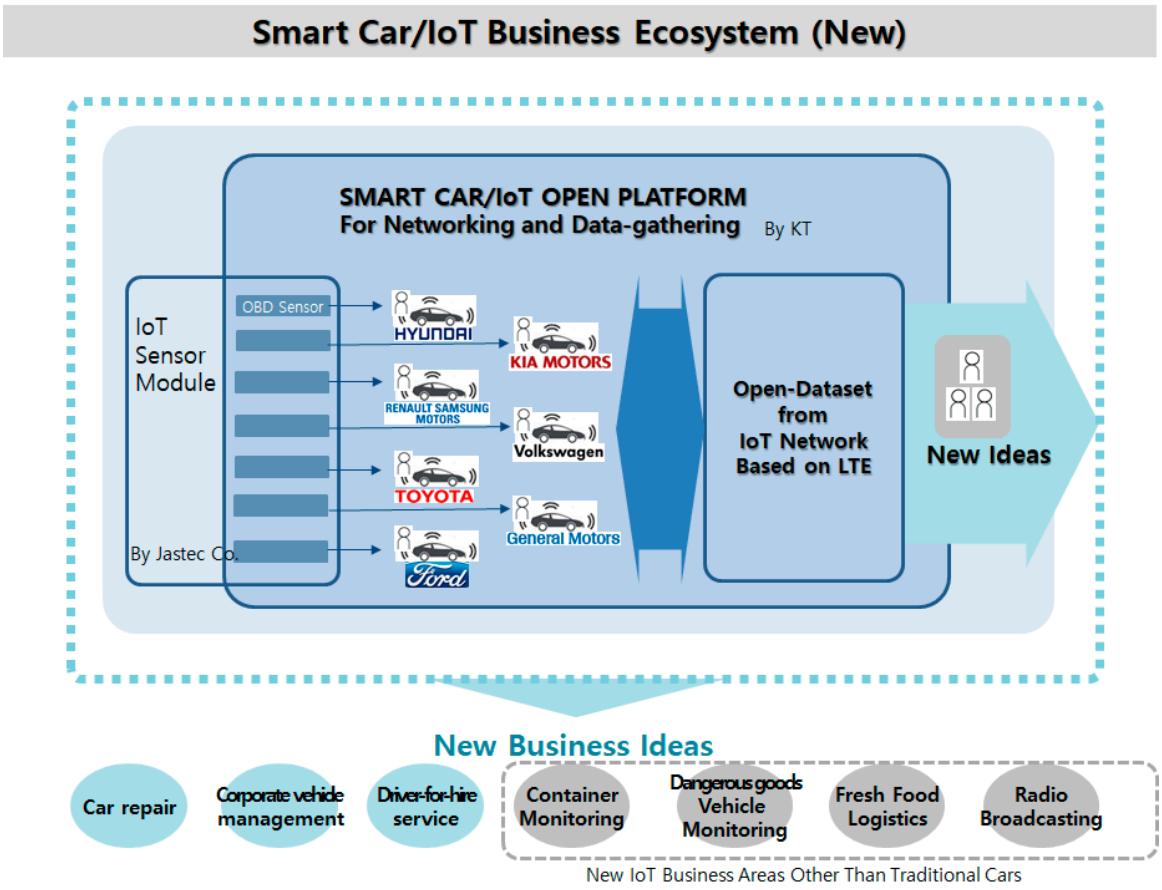

Figure 5. New Smart Car/IoT business ecosystem due to the Flagship Project Support Program (FPSP) project.

5.2. The Virtual Reality (VR) Open Platform

5.2.1. Existing Barriers

The existing development of VR headsets and their content are composed of closed cooperative relations centered on large companies. Most of these companies, including Samsung, SONY, HTC, and Facebook, operate a closed distribution platform that creates and distributes their own formats. Meanwhile, most of the cost is spent on the post-processing of raw video content to VR content. As a result, there is still relatively few VR content available (This is reminiscent of the 3D TV industry. One of reasons this industry has failed in the past is the lack of 3D TV content. There is not enough production equipment for producing 3D TV and the quality is low. If the VR industry fails to innovate, it will reach

a similar end). These two facts make it difficult for latecomers to enter the VR business ecosystem. On top of this, it is also difficult to secure VR content, share, and build a distribution platform.

Smartphone users already produce various kinds of video content themselves. Virtual reality content cannot keep up with the various needs of users, so there is a needs gap. Currently, VR content is limited to specific fields, such as gaming, depending on manufacturer convenience. There is a lack of VR content that appeals to general users. This needs gap is one of the obstacles to market formation, and the VR market is still struggling to enter the growth phase. Figure 6 shows the original virtual reality (VR) business ecosystem in Korea.

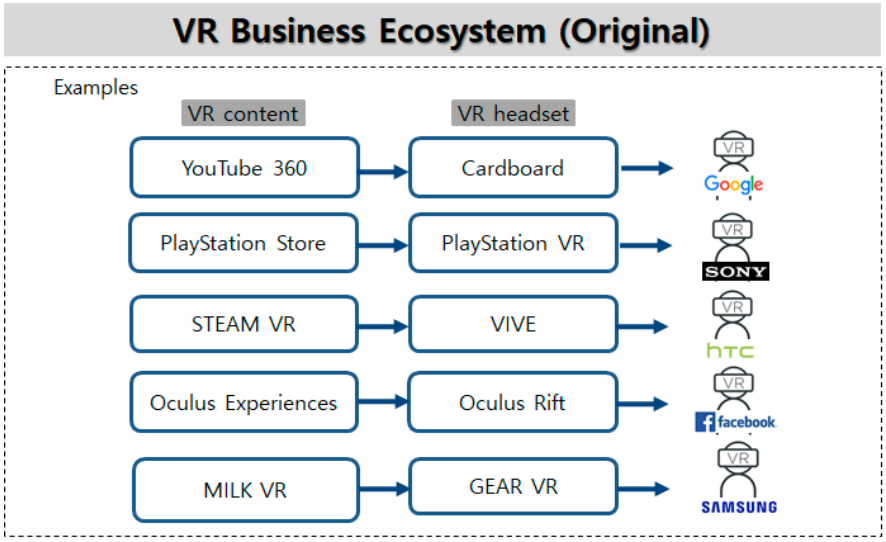

Figure 6. Original virtual reality (VR) business ecosystem.

5.2.2. Project Progress and Output

ThinkBridge, the leader of the FPSP consortium, is responsible for developing an open VR UX/UI development platform that includes user needs analyses and open-platform VR UX process planning. AlcaCruz, which has secured automation technology for the post-processing of raw video to VR content, developed a cloud-based VR platform for sharing, watching, and distributing content. The cloud-based post-processing algorithm makes it easy for anyone to upload, encode, watch, and share video content. In addition, LG Electronics produces a VR headset (LG 360 VR) and a 360 camera. LG Electronics is a relative latecomer among VR device makers and does not yet have rich content for LG 360 VR users. LG Electronics has secured VR content through the FPSP project.

ThinkBridge has established partnerships with professional content providers to obtain VR content and bring it onto the open platform. In addition, a user-created content (UCC) contest was held to secure 600 VR videos, and awareness spread regarding the VR open platform.

The VR open platform jointly developed by ThinkBridge and AlcaCruz was demonstrated on the HTC ViVe and LG 360 VR. In other words, the open platform can be used with VR headsets of all brands. Virtual reality headset manufacturers as well as general users and professional content producers can participate in the open platform.

5.2.3. Project Outcome

ThinkBridge and AlcaCruz are small- and medium-sized companies. The VR market is composed of large corporations, and latecomers were having difficulty entering the market. With the support of the FPSP project, cooperation among companies has become relatively easy.

A partnership with LG Electronics, which is also a large company but which joined the VR industry relatively late, was established. The relationship between large companies and SMEs in Korea is generally related to the supply of SMEs to large companies. In this project, ThinkBridge acted as the

main leader and LG Electronics as a collaborator, i.e., VR headset provider. This is a new business relationship in Korea.

Virtual reality post-processing is costly and has not yet been standardized, so each company has a closed platform consisting of only a few related companies operating in a different way. The post-processing algorithm of the ThinkBridge and AlcaCruz open platform lowers costs and increases the possibility of standardization. Anyone can easily convert video to VR and enjoy and distribute their content on the VR open platform, making it easy to enjoy VR, changing people's perceptions about VR. As a result, the VR open platform has contributed to an increase of users and expanded the market.

Thanks to the FPSP project, little-known SME companies can encourage users to participate in the open platform as consumers and producers. Through the UCC contest, they obtained other kinds of video and were able to create new business ideas, including broadcasting, travel, education, etc. In addition, they have produced much Korean content, including Korean drama, documentaries of Korea's historical palaces, tourist attractions, etc., and business opportunities related to the Korean Wave.

5.2.4. Business Model Creation

Through the open platform, VR content converted from general video can be shared and realistic content can be appreciated, which satisfies the needs of VR device consumers, VR content consumers, and developers, all of who use the open platform service. This is new value proposition for customers.

Based on the open platform and new VR business ecosystem, the FPSP project creates new business models: the open platform has resulted in increased revenue from sales of VR devices and advertising revenue. Several new business model ideas also came out based on the open platform. Figure 7 illustrates new VR business ecosystem due to the FPSP project.

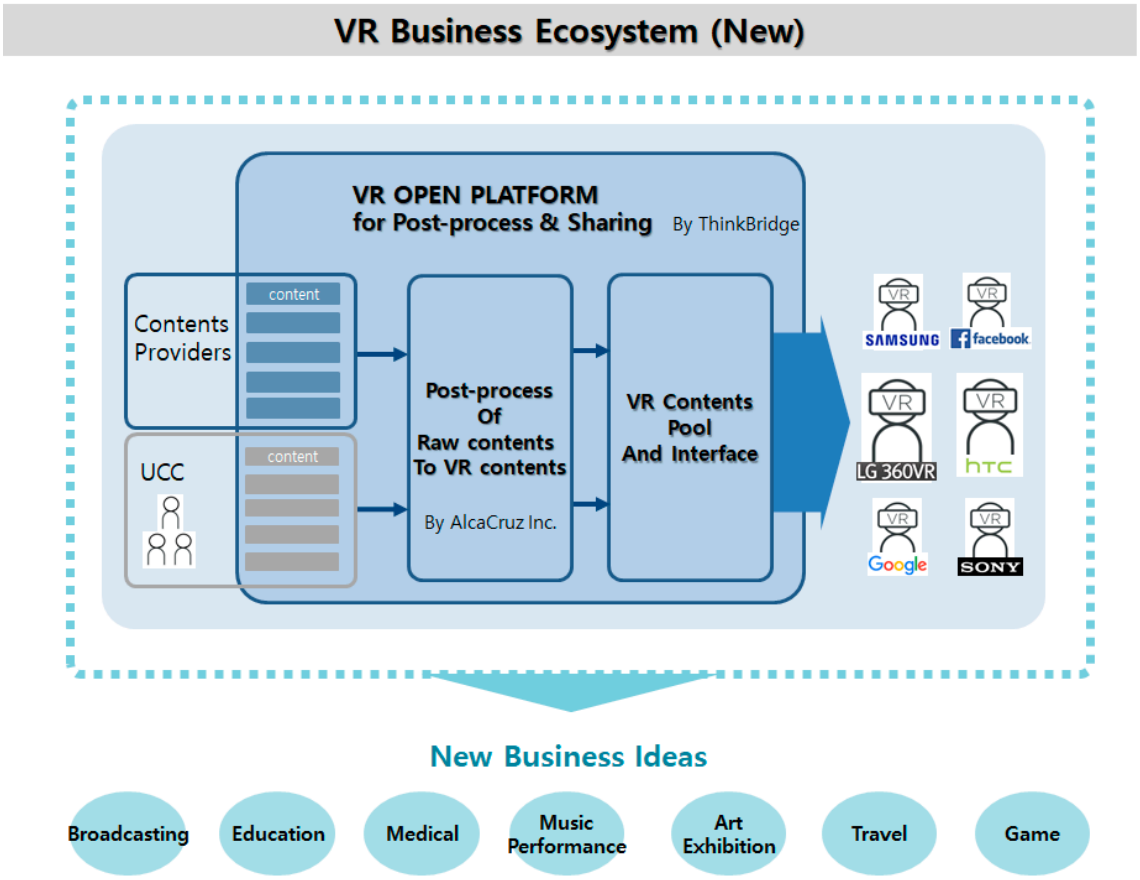

Figure 7. New VR business ecosystem due to the FPSP project.

6. Discussion

In the previous chapters, we examined the results of two projects supported by FPSP. The Smart Car/IoT and VR industries are already being marketed by large companies in Korea and worldwide. Figures 4 and 6 show that large companies are building their own closed relationships to build their own domains and preempt markets in the Smart Car/IoT and VR industries. Smart Car/IoT and VR are emerging industries that are just beginning, and large companies will pursue business with closed cooperation based on strong capital power in order to preoccupy the dominance of the market. In Korea, large companies dominate the market more than any other country. The high-tech sectors that require large capital inputs, such as IT and biotechnology, are particularly large in terms of the impact of large companies that can manage their investment risks, and it is very difficult for SMEs to enter.

The FPSP is a meaningful example of how governments can help technology-savvy SMEs when they already have large companies in high technology industries. Figure 4 shows that major car makers in Korea, such as Hyundai and Kia, and big companies in telecommunication, such as LG and SK Telecom, have already found their partner companies and are building partnerships. In the case of Smart Car/IoT, cooperation between car makers and IT companies is essential. Although KT is Korea's leading telecommunication company, it is one step behind establishing partnership with major car makers and uses a different approach to enter the Smart Car/IoT industry. It does not rely on any particular car maker, but rather tried a generic open platform construction. It was supported by the government's FPSP to cooperate with technology-savvy SMEs, involves general consumers as members of the open platform, and mitigates the risk burden. KT has chosen a strategy different from the business strategy chosen by other major companies. This project had Jastec, the developer of the IoT sensor module, participate in the Smart Car/IoT open platform. The new business ecosystem in Figure 5 does not replace the business ecosystem in Figure 4. However, the openness created in the new business ecosystem can overcome the limitations of the existing closed business ecosystem. The new business ecosystem based on the open platform can unlock more innovation opportunities in the marketplace and increase the likelihood of innovation. We can confirm that many new business ideas have been proposed through this open platform.

The VR project is similar to the Smart Car/IoT project. Construction of a VR open platform based on the FPSP forms a different business ecosystem from the closed cooperative relationships between large companies in Figure 6. Like the Smart Car/IoT, it is different from the present leading companies' way, in that it does not depend on a particular brand of VR equipment built. The VR open platform also encourages consumers to participate as prosumers. This is more positive example than the Smart/Car IoT business ecosystem.

There are two features that are common to both open platforms. First, they developed a platform that does not depend on a specific large company. This means that it does not rely on a particular brand of a car or VR equipment. This is a differentiating way for current major companies to use closed strategies to secure loyal customers. The SMEs that have difficulty building partnerships with large companies can create new opportunities by developing an open platform that breaks brand dependency. When developing an open platform, government funding will help reduce investment risk. Government support can serve as a catalyst to encourage companies to participate even if it is not a big fund. This means that it can be a way to solve the "leadership gap" described by Chesbrough. The reason why companies cannot succeed in their own business model innovation is that it is difficult to find appropriate leadership to lead the innovation and to manage the risk. Government support is a kind of risk-sharing guarantee for companies. Government support projects give the psychological comfort that a company will not be hurt even if it fails. If the government shares the risk, the companies are willing to participate in the projects and could try the business model innovation easily. Second, the project drives to engage consumers as business ecosystem partners. By engaging consumers as volunteers or as prosumers, they can gain a variety of advantages, including open platform diversity and creativity, enough data, and channels of communication with consumers. When encouraging consumer participation, government support can enhance consumer

confidence and encourage consumer involvement. This can be seen as an example of "governments as a platform" based on "an effective balance between control and generativity", as O'Reilly [27] explained. The government can act as a catalyst to build a new business ecosystem based on promoting the participation of various companies and consumers by increasing the trust of the project even if it supports a small fund.

Not only Korea but also other countries have also tried various policies in order to succeed in the era of the Fourth Industrial Revolution. For example, the UK has established investment prioritization to become the best in the world, including big data, nurturing of science talents and scientific infrastructure etc. [37]. The US announced its innovation strategy to invest in basic research, to promote STEM (Science, Technology, Engineering and Mathematics) education, to build cutting edge physical infrastructure, etc. [38]. The Korean government focuses more on direct economic effects through innovation. Other countries like the UK and the US are formulating strategies more for building the environment and infrastructure for innovation, while Korea is focusing more on R&D and business activities.

Korea's case of building a new business ecosystem can be applied to other countries. Even if the government does not support enough funds, it can lead to an increase in the trust of the project, thereby including participation of various companies and sharing the risk that the company cannot afford itself, leading to the possibility of innovation. In addition, creativity and generativity can be enhanced through an open platform where various participants interact with one another. If the government declares its willingness to support innovation and opens up open platforms where companies can cooperate and find opportunities for innovation, this can enhance the innovation potential and possibility of latecomers and SMEs.

7. Conclusions

In the era of the Fourth Industrial Revolution, many corporations, institutions, and major countries are making efforts to change their business practices. The Fourth Industrial Revolution is a megatrend where emerging innovative technologies are becoming more prominent in all industrial fields, and countries are rushing to gain a leading position and not to be left behind. The World Economic Forum set the Fourth Industrial Revolution as the global agenda of its 2016 annual meeting. Meanwhile, governments are concerned about their role in the era of the Fourth Industrial Revolution; the United States, Germany, Japan, and China are all pursuing various policies for a new era. The Korean government is also preparing and promoting policies in accordance with this trend; the Flagship Project Support Program, instituted by the Korean Ministry of Science, ICT, and Future Planning is one such support policy. This case study of the FPSP's performances suggests the role of the government in the era of the Fourth Industrial.

In the past, the Korean government has focused on supporting research and development. However, a business model has become more important as well as recent technological development, and the FPSP was designed to support business model creation after technology development. The purpose of this program is to support companies that have already developed the elemental technology and which struggle with commercialization. The FPSP helps companies create new business models. Latecomers have difficulties entering business ecosystems that big players have established and for which they cannot afford the risk of creating a new business model on their own. It is the government's role to support these companies, since the more players who participate in the business ecosystem, the more opportunities for innovation.

The performances of two FPSP projects were analyzed in this study: the open platforms for Smart Car/IoT and VR content. The two projects were intended as supports for latecomers who were unable to enter the business ecosystems that large corporations have already built in Korea. The government helped overcome existing barriers and build open platforms for collecting and processing data and content through the consortium's cooperative networks. They succeeded in building open platforms without the help of big players in the industries. In addition, they overcame existing

cooperative relationships and brand dependency. The Smart Car/IoT platform allows drivers to participate regardless of their car brand, and succeeded in building a large-scale Smart Car/IoT dataset. Likewise, the VR content platform allows anyone to upload videos and enjoy VR content on any device regardless of the headset manufacturer. Volunteers have a high degree of dynamics on the open platform, and play a role not only as data consumers, but also as data producers and provider of ideas. The voluntary participation of users and the exchange of ideas has led to the creation of new business ideas.

To summarize, two projects supported by the FPSP succeeded in overcoming existing barriers and building open platforms to create new business models. The FPSP is an example where the government can encourage companies, especially latecomers, to build open platforms and create new business models. The FPSP is a successful case of business model innovation through government support.

7.1. Limitations and Further Studies

Since this study is only a case study of two industries, Smart Car/IoT and VR, it is difficult to apply this result directly to other fields of industry. Other industries, such as healthcare, robotics, etc., are different from ICT fields, so the characteristics of each field should be understood. In order for the government to prepare for the era of the Fourth Industrial Revolution, case studies of various fields should be added, and this will be our next study.

This study only focused on open platform cases without investigation of closed platforms. If we can investigate a closed platform and compare it to an open platform, it will be able to better understand the characteristics of the open platform, which is a limitation of this study.

A performance evaluation of the FPSP was conducted to verify whether the projects helped to overcome the barriers to existing business ecosystems, but we did not identify drivers and enablers that worked to overcome barriers and create new business models. This could be derived from in-depth interviews with companies participating in the project, but it was not conducted in this study, which is another limitation of this study. If they can accurately identify drivers and enablers through in-depth interviews with FPSP participants in the future, this will provide significant policy implications.

7.2. Policy Implications

New industries and new business models are essential to prepare for the era of the Fourth Industrial Revolution. This expands opportunities for innovation, which will be the basis for sustainable growth in the future. This study presents a Korean example to guide future government policy. The government can play an important role in the era of the Fourth Industrial Revolution in assisting business model innovation by supporting the construction of open platforms where companies can cooperate and find opportunities for innovation. This can enhance the innovation potential and possibility of latecomers and SMEs. We expect this study to have implications for the role of the governments in preparing for the Fourth Industrial Revolution.

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