

# Enhancing University Contributions to Tech Management and Entrepreneurship Education in Dynamic Industrial Clusters

Gee Jung Kwon<sup>1</sup>, Won-il Lee<sup>2</sup>

<sup>1</sup> Professor, Department of Accounting, Hanbat National University, South Korea,  
[geejung@hanbat.ac.kr](mailto:geejung@hanbat.ac.kr)

<sup>2</sup> Professor, Department of Business Administration, Hanbat National University, South Korea,  
[tech201@hanbat.ac.kr](mailto:tech201@hanbat.ac.kr)

Corresponding author: Won-il Lee

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**Abstract:** This study examined the role of universities in innovative industrial clusters with a focus on ambidextrous strategies for technology management and technology entrepreneurship education. The university pursues an entrepreneurial university and its role as an agent of innovation and entrepreneurship is very important. Case study, issue analysis and scenario planning were conducted based on the theory of technology management, entrepreneurship, and industry-academia cooperation-based education regarding the role of universities in innovative industrial clusters. The strategic direction of the entrepreneurial university was established through scenario planning methods. The first strategic direction to become an entrepreneurial university is for the university to have a technology management education system as well as knowledge creation and research and development system. The second is to have the capacity to upgrade the entrepreneurship education system to enable regional-based startups. The third is to not only advance the system to support the growth of local companies through technology transfer, but also to establish an education system based on industry-academia cooperation. This paper can be said to be significant in that it sets a strategic direction for developing into an entrepreneurial university at a time when the role of universities in innovative industrial clusters is being emphasized in the region.

**Keywords:** Innovative Industry Cluster, Technology Management, Entrepreneurship, Industry-Academia Cooperation, Role of Universities, Issue Analysis, Scenario Planning

## 1. Introduction

In the current rapidly changing hyper-competitive environment, it can be said that it is very difficult to create and maintain corporate competitiveness[1]. It can be said that only continuous innovation by local companies and new startups are the success formula that can maintain regional competitiveness. The role of universities can be said to be very important in this business environment. Universities in the region are meaningful as a new growth engine that not only functions as education and research, but also leads regional innovation and stimulates industry-academia cooperation. Regional innovation systems include regional innovation clusters, and universities, research institutes, and companies are connected to these innovation clusters[2][3]. For regional development, new capabilities of universities

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are required.

This study focused on examining the university's technology management, entrepreneurship, and industry-academia cooperation education among the roles of the university. Universities conduct a variety of research, including basic, applied, and development research, and it is necessary to establish a university-level technology management system for the commercialization of research results. The concept of technology management can be applied in a variety of areas, including not only private companies but also industrial, public, and government sectors. It is very important to establish such a technology management system and promote related professional education at the university level. In addition to establishing a technology management system at the university level, entrepreneurship at the university level also plays a very important role. With the emergence of the AI-based digital innovation economy, university startups have also come into the spotlight, and the importance of university-based startups as well as innovation in education is growing. As the importance of entrepreneurship in these universities is growing, the meaning of the entrepreneurial universities is being redefined. This concept of university entrepreneurship can be said to encompass not only entrepreneurship education but also the establishment of an entrepreneurship ecosystem around universities. Not only university technology management and entrepreneurship but also university-industrial cooperation are emerging as more important concepts. University-industry cooperation can be said to be a concept that encompasses the linkage between universities and companies, and the linkage between universities and research institutes[2][3]. It is also worth noting that not only the technology transfer of university research results to create results in companies, but also various cooperation such as human resources, education, and mentoring are all included in the area of industry-academia cooperation.

In existing literature, not much research has been done on the role of universities in regional innovative industrial clusters. Accordingly, this study examines the role of universities in regional innovative industrial clusters. Through this, this study examine the importance of technology management education and entrepreneurship education among the roles of universities. In addition, we look at various issues as to why universities should focus on these areas and consider the strategic direction of entrepreneurial universities. Based on this theoretical research, this study examines the role of universities in Daejeon's technological innovation ecosystem, focusing on technology management, entrepreneurship, and industry-academia cooperation-based education. This paper examines the role of universities in Daejeon's innovative industrial cluster through examples. Through this, this paper examines various issues and sets a strategic direction to become an entrepreneurial university through scenario planning.

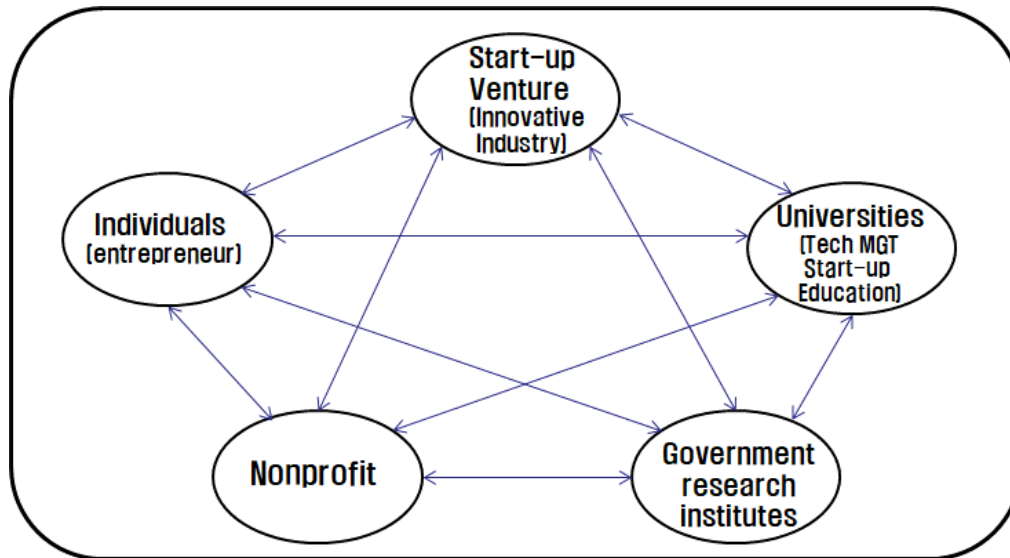
## 2. Literature Review

### 2.1 Innovative Industry Cluster

A regional cluster is a concept in which innovation entities from industry, academia, and research institutes form regional connections. Industry is added to this regional concept to pursue innovation in regional industries, which can be called an industrial cluster[2-4].

OECD (1999, 2001) presented the concept of industrial clusters, and many countries around the world are fostering industrial clusters to promote industries in these regions[3][4]. As a concept to advance these industries in a more innovative way, this paper presents the concept of an 'innovative industry cluster'. An innovative industry cluster means that in order to foster local industries more innovatively and ensure sustainable growth of the industry, networking must be established to connect industry, academia, and research institutes centered on local industries to continuously create innovation. This

concept of an innovative industrial cluster can be said to be a cluster development concept that emphasizes new industry-centered innovation that is differentiated from existing industrial clusters and innovation clusters. When an innovative industrial cluster is established in a region, continuous innovation can become possible in the region. In the region, strategic industries can be set in the IT, BIO, and Nano fields and such innovative industrial clusters can be built.



[Fig. 1] The Role of Universities related to Entrepreneurship and Innovation, The Sources of Innovation Suggested by Schilling, 2008 was Redrawn by Emphasizing the Role of Universities

The role of universities in these industrial innovation clusters can be said to be very important [5][6]. It can be said that universities have gone beyond the concept of simply producers of knowledge and have changed into a concept that not only produces knowledge in the region but also acts as a trigger for new innovation and networking[5][6]. Generally, in the past, the concept of a university was accepted as knowledge production, education, and a certain level of industry-academic cooperation. However, in the current rapidly changing hyper-competitive environment, the concept of a university is changing into an ‘entrepreneurial university’. In these times, it can be said that the university's function of managing technological innovation, leading local startups, and leading strong industry-academia cooperation have become very important[6]. Nowadays, the meaning of such an entrepreneurial university can be said to have become more important. In these entrepreneurial universities, technology start-ups can be implemented through technology transfer from the university's technology holding company. Additionally, college students can start technology startups with new engineering ideas, and they can also start new startups to solve social problems around universities. The role of universities in these industrial innovation clusters is becoming more important.

Entrepreneurship in universities was generally considered to encourage students to start businesses[7]. However, at a time when students' creativity and innovation are considered more important, university entrepreneurship education has been a priority. In addition, the significance of university entrepreneurship education has become even greater at a time when the economy is transitioning to an AI-based digital innovation economy. University startups can be largely divided into entrepreneurship education, startup execution, and building a local startup ecosystem[7]. Entrepreneurship education is about teaching entrepreneurship mindset and practical start-up skills. Startup execution can be said to be education related to discovering business opportunities, verifying and supplementing start-up items, and growing start-ups[7]. In addition, the expected role of university

startups has grown, even in the area of building a local startup ecosystem. It is necessary to support not only college students' start-ups, but also the general public's start-ups by utilizing the university's start-up capabilities. In addition, it is necessary to strengthen the capacity of university start-up support so that it can spread the start-up culture in connection with high schools and universities.

Technology management can be said to be the strategic acquisition, management, and commercialization of technological innovation[8][9]. Such technology management is generally considered to be handled by companies in connection with the company's strategy. However, this technology management can be applied and managed not only in industry, but also in public institutions, regional levels, and universities. In universities, the research management function is managed by the university's industry-academia cooperation group. However, if these functions are managed at the university-wide level, greater performance may be possible. Hence, in this study, technology management education in universities was examined.

A university's strong industrial-academic cooperation means utilizing the university's capabilities to actively conduct technology transfer, exchange, education, and human resource exchange with local companies and regional research institutes[5][6]. In general, industry-academia cooperation can be thought of only in terms of technology transfer or solving technological difficulties. However, it can be said that the university's strong industry-academia cooperation encompasses the overall cooperation for innovation in local industries. In this study, education based on industry-academia cooperation was also examined.

### **3. Research Methodology**

In this study, scenario planning methodology was used as a research methodology to set the strategic direction of an entrepreneurial university. In uncertain future situations, it is possible to respond to various future situations through scenarios. To set up these scenarios, an axis of uncertainty was established through issue analysis, and a preferred future scenario, business as usual scenario, and worst-case scenario were set. First, the role of universities in the innovative industrial cluster in general was looked into, then various issues at universities were examined. Afterwards, an analysis framework for setting scenarios was established based on these issues[10-12].

In this study, a case study was conducted on the role of universities in innovative industrial clusters, focusing on technology management, entrepreneurship, and industry-academic cooperation, and several strategic issues were derived based on this. Based on these issues, future scenarios are set to establish strategic directions to grow into an entrepreneurial university in the region. To set up a scenario, analyze strategic issues, set up an issue-based analysis framework, set a time axis, and prepare scenarios for each situation[13][14].

## **4. Setting Strategic Direction toward an Entrepreneurial University**

### **4.1 A Review of University Technology Startup and Technology Management Education**

Based on the case study of H University, various issues for scenario planning can be derived. The case study at H University is an in-depth phenomenological examination of a case. First, in order to discover strategic issues, we examine various issues such as university technology management education, entrepreneurship education, and industry-academia cooperation education. The target of analysis is H University in Daejeon, and for the research, analysis of regional data and analysis of the university's role in innovative industrial cluster were conducted.

As a case study to discover strategic direction-setting issues for entrepreneurial universities, this

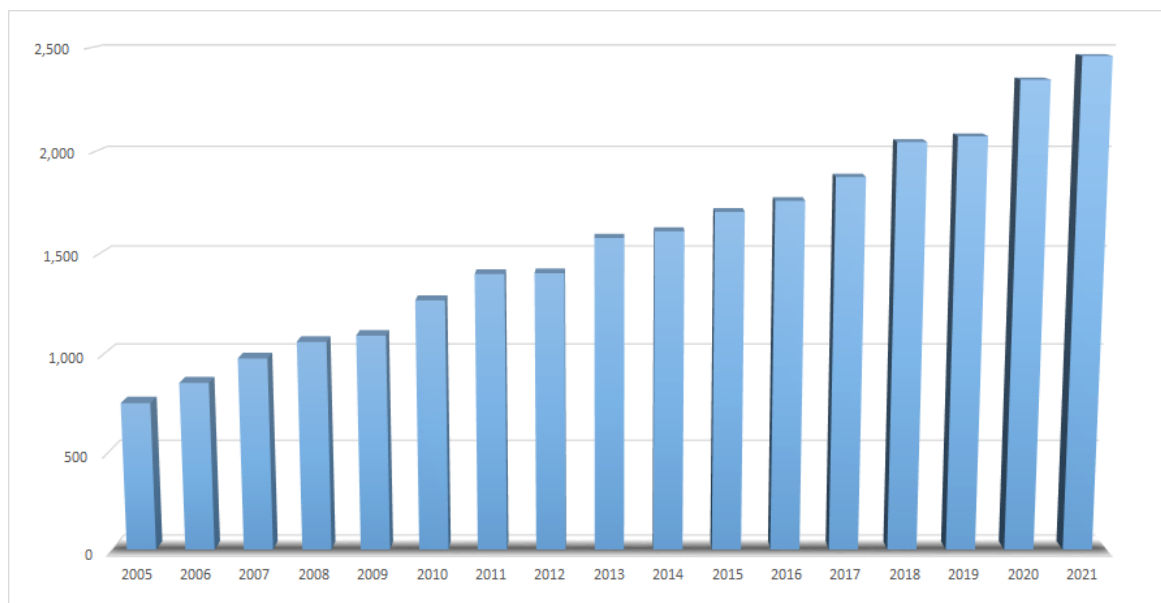
study examined H University's cases of technology entrepreneurship and technology management education. In order to set the strategic direction of an organization, it is desirable to analyze related issues and set an analysis frame based on the most important issues among them. Accordingly, this study discovered strategic issues through a review of H University's technology startup and technology management education cases.

#### 4.1.1 Daejeon Innovation Environment

First, to macro-analyze the role of universities in innovative industry clusters, the status of entrepreneurial universities in innovative industry clusters was analyzed. According to the 2021 Daejeon Metropolitan City Regional Industry Promotion Plan, the strategic industries in the Daejeon region are the next-generation wireless communication convergence industry, intelligent robot industry, and bio-medical industry, and these regional industries are continuously changing[15]. From 2023, the core strategic industries are being selected and evolving into (1) Nano and semiconductor industry, (2) Biohealth industry, (3) National defense industry, and (4) Space industry[16].

In Daejeon, there is the Daedeok Research and Development Special Zone (Daedeok Innopolis) as well as Daejeon's policy development plan. The role of H University's entrepreneurial university is also evolving to innovate the industry in these regions. As an innovation cluster, the number of companies in the Daedeok Special Research and Development Zone is continuously increasing. The entrepreneurship education function of universities as a source of entrepreneurship and the university's industry-academic cooperation capacity needs to be strengthened. As shown in the [Fig. 2], the number of companies in Daedeok Special Research and Development Zone has been steadily increasing since 2005, and has increased to 2,461 as of 2021[17].

This means that beyond the simple increase in the number of companies, start-ups have steadily increased, and the importance of the role of start-ups in universities has become even greater. In the case of successful innovative industry clusters, the importance of entrepreneurship in universities is very high. In Silicon Valley, the United States, many start-ups are taking place to the extent that the boundaries between universities and companies are blurred[18].



[Fig. 2] Increase in Number of Sompanies in Daedeok Special R&D Zone, Drawing based on Open Statistical Data from Daedeok Innopolis Website

The regional industries in these regions were examined and the increase in the number of companies due to the increase in start-ups in the region was analyzed. After this macroscopic analysis, the active promotion of technology entrepreneurship education, technology management education, and industry-academia cooperation-based education promoted by universities was also analyzed. It is difficult to analyze the situation of all universities in this innovative industrial cluster. Therefore, H University in Daejeon was selected, which has received excellent evaluations for industry-academia cooperation, and its current status was examined. Cases and issues of technology management education, entrepreneurship education, and industry-academia cooperation are as follows.

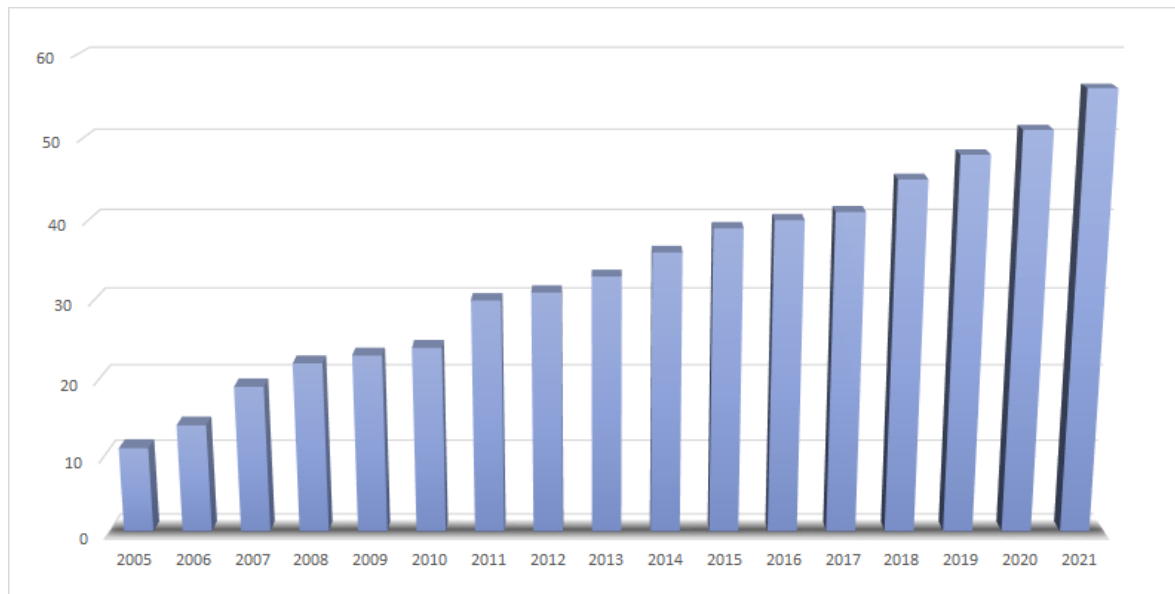
#### **4.1.2 University Issue Analysis Regarding Tech Management and Entrepreneurship**

First, H University provides specialized technology management education for the growth of technology start-ups. In addition to operating a techno-management department at the graduate school, the convergence business administration department offers several technology management subjects such as technology management, technology strategy, and technology commercialization. In particular, designating technology management as a required subject allows students to recognize the importance of strategic technology management. The Graduate School's Department of Technology Management offers a variety of specialized technology management courses, including technology management, technology strategy, research and development project management, technology commercialization, and science and technology policy management theory.

Second, in order to promote entrepreneurship by utilizing local resources as an entrepreneurial university, the university is promotes the establishment of a support system where not only students but also faculty can understand the importance of entrepreneurship and actually carry out entrepreneurship. At H University, there is a successful case of Advanced Nano Products Co., Ltd (ANP) as a representative example of a faculty startup. Advanced Nano Products Co., Ltd (ANP) started as a start-up company at a Startup incubation center in 2000 and is currently a KOSDAQ-listed company and has grown into a mid-sized company with sales of KRW 79.9 billion as of 2022. Advanced Nano Products Co., Ltd (ANP) is growing rapidly through active research and development and industry-academia cooperation activities. It produces secondary battery materials, semiconductor materials, and solar materials, and is expected to grow further along with the growth of the electric vehicle market[19][20].

There are many KOSDAQ-listed companies such as Advanced Nano Products Co., Ltd (ANP) in Daedeok Special Research and Development Zone. It can be said that these KOSDAQ-listed companies are continuously increasing. The number of KOSDAQ listed companies increased from 11 in 2005 to 56 in 2021, as shown in [Fig. 3] below. Universities have various support programs for the growth of start-ups, as well as start-up incubation centers. In this way, universities have had a great influence on the birth and growth of start-ups.

Third, the practical entrepreneurship lecture program is being redesigned in order to strengthen students' competencies necessary for entrepreneurship activities. Entrepreneurship education is provided at both undergraduate and graduate levels. H University not only operates the Department of Entrepreneurial Management at the undergraduate level, but also systematically operates the Department of Entrepreneurship at the graduate school level. The graduate school's Department of Entrepreneurship is leading local entrepreneurship education with a focus on practical entrepreneurship and is an excellent curriculum in which many startups are taking place.

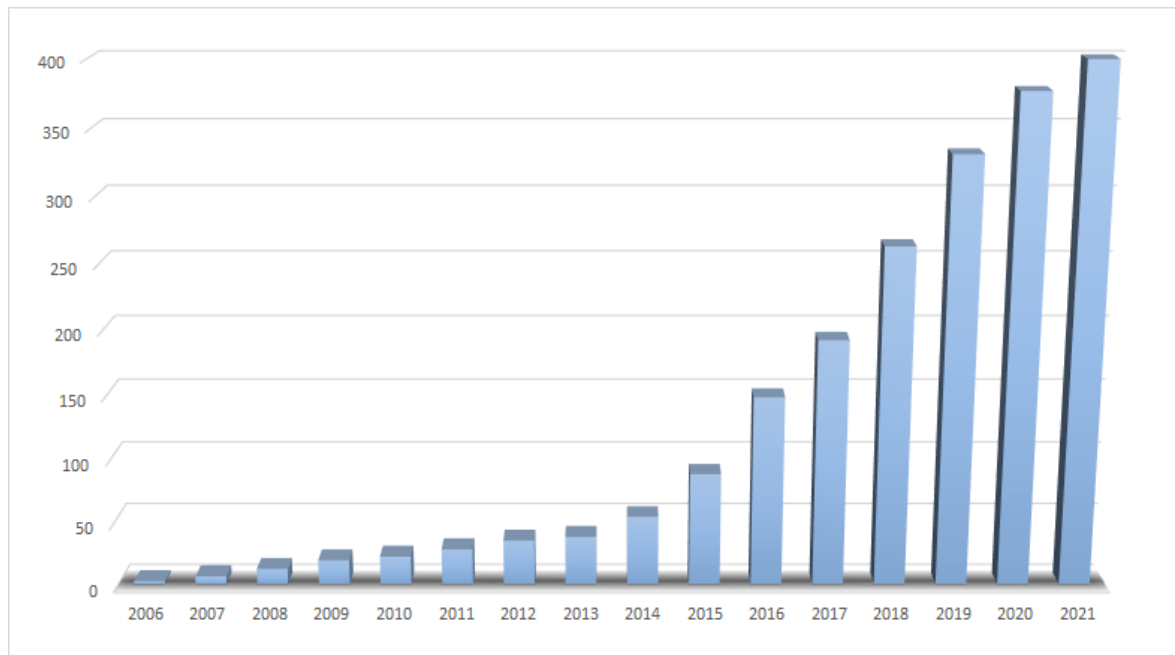


[Fig. 3] Increase in number of KOSDAQ-listed companies in Daedeok, Drawing based on Open Statistical Data from Daedeok Innopolis Website

Fourth, H University is utilizing the university's startup capabilities to promote startup education and culture by linking startup education and support to nearby high schools. H University's Startup Support Group is promoting various start-up projects such as pre-start-up packages and initial start-up package projects supported by the central government, and is also working to spread start-up culture in the region.

Fifth, H University operates industry-academic majors linked to local industries, corporate-tailored contract departments, and convergence majors. Support is provided so that students can naturally find employment while completing these courses and participating in related internships and practicums. There are approximately 2,400 venture companies in Daedeok R&D Special Zone, including 1,400 venture-certified companies in Daejeon, and there are about 56 KOSDAQ-listed companies in Daedeok R&D Special Zone, including Advanced Nano Products Co., Ltd (ANP), Truwin Co., Ltd., and Bioneer Co., Ltd. It is important to make efforts to establish close connections with local companies so that students can adapt and find employment in these companies step by step. As shown in [Fig. 2] and [Fig. 3], the number of venture companies and KOSDAQ listed companies is continuously increasing. Industry-academic cooperation and related education are needed in close connection with these companies and universities.

There are many government-funded research institutes in Daedeok, and many research-based spin-off companies are founded based on public technology. These research-based spin-off companies have a 10% stake in public institutions and aim to commercialize technology through the transfer of public technology[17]. These research-based spin-off companies are also increasing every year, as shown in [Fig. 4] below. These companies can be created based on technology from government-funded research institutes, or they can also be created based on technology from university technology holding companies. University support has become more important as many research-based spin-off companies are founded through technology transfer by university technology holding companies.



[Fig. 4] Growth of Research-based Spin-off Companies in Daedeok, Drawing based on Open Statistical Data from Daedeok Innopolis Website

#### 4.2 Identifying Various Strategic Issues

Based on this case study of H University, various issues for scenario planning were derived. The case study at University H is an in-depth phenomenological examination of a case. After this in-depth consideration, various issues were identified. The issues to become an entrepreneurial university derived through case analysis are as follows.

1. Promotion of professional technology management/technology commercialization education for scale-up of technology startups
2. Promotion of professor entrepreneurship and discovery of excellent cases
3. Promotion of practical entrepreneurship education linked to the region
4. Construction of a local startup ecosystem
5. Integrated practical education linked to industry and academia

In addition, there may be various issues in order to become an excellent entrepreneurial university in the region. However, in this study, five issues were derived through case analysis. Although it would have been desirable to derive issues by analyzing cases promoted at various universities in the Daejeon area, there were limitations in time and analysis. For this reason, issues were derived targeting a representative university in Daejeon that aims to be an entrepreneurial university. In this study, issues requiring actual review were derived through case analysis. Based on these issues, a scenario planning was conducted and strategic directions were set to become an entrepreneurial university in the region.

In this study, a case study was conducted on the role of universities in innovative industrial clusters, focusing on technology management, entrepreneurship, and industry-academic cooperation. Based on this, several strategic issues were derived. Although it would be desirable to identify more diverse issues for becoming an entrepreneurial university through case studies of various universities, only five issues were identified in this study.

The issues reviewed for becoming an entrepreneurial university derived through case analysis are as follows; 1. Promotion of professional technology management/technology commercialization



education for scale-up of technology startups, 2. Promotion of professor entrepreneurship and discovery of excellent cases, 3. Promotion of practical entrepreneurship education linked to the region, 4. Construction of a local startup ecosystem, 5. Integrated practical education linked to industry and academia

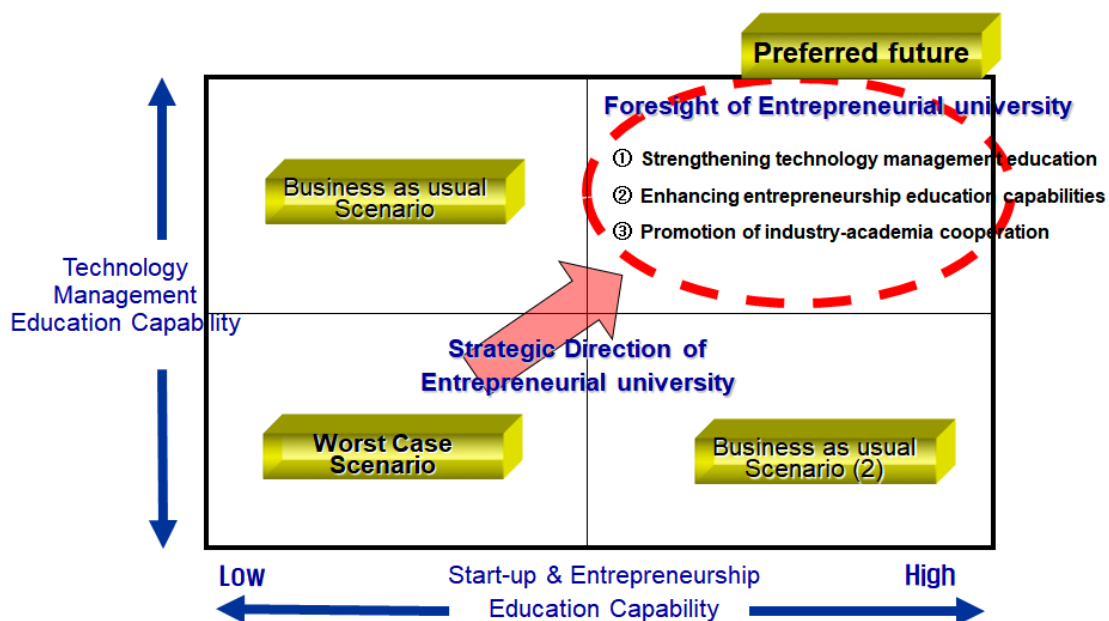
### 4.3 Setting Strategic Direction toward an Entrepreneurial University

Many methodologies such as the Delphi method and future wheel are being used as foresight methods, but scenario planning methods are widely used as a response to an uncertain future[10-12]. Foresight can be used at the national level, regional level, and corporate level[10]. This paper examined the future of entrepreneurial universities in the region. According to a review of university technology startup and technology management education, future scenarios are set to establish strategic directions to grow into an entrepreneurial university in the region. To set up a scenario, analyze strategic issues, set up an issue-based analysis framework, set a time axis, and prepare scenarios for each situation [13][14]. The analysis time axis is currently 2023, so it is set to 2030 as a mid- to long-term setting. Strategic issue analysis has already been established as a case analysis.

In order to establish an issue-based analysis framework, this study set ‘Start-up & Entrepreneurship Education’ and ‘Technology Management Education’, which were reviewed as important parts in theory and case analysis, as important analysis axes. Scenarios can be broadly divided into four types according to ‘Start-up & Entrepreneurship Education’ and ‘Technology Management Education’, and detailed scenarios can be further divided according to the degree of uncertainty. In this paper, scenario planning is broadly divided into four categories.

Based on these analysis axes, four scenarios were set for scenario planning as shown in the following [Fig. 5].

The first scenario was the ‘preferred future scenario’, which is a scenario model in which both technology management and technology entrepreneurship education are strengthened to grow into an entrepreneurial university.



[Fig. 5] Setting the Future Image of an Entrepreneurial University Closely Connected to the Region: Scenario Planning

The scenario writing for the desirable future in 2030 is as follows.

Preferred Future (Desirable future) scenario in 2030

*“In 2030, the number of companies in the region will continue to increase, and many people will gather and transform into a vibrant region. Technology, talent, and a new vibrant culture are being formed in the region. K University is in the midst of these regional changes. K University is famous as an entrepreneurial university. Many people think that if they go to K University, they can receive systematic, practical entrepreneurship education on technology startups and actually start a business. Not only is it possible to simply start a business, but it is also possible to receive technology management education for professional scale-up. Many people say that through this kind of technology management/technology commercialization education, it is possible to create a growing business rather than a one-time business. Accordingly, K University was evaluated as a university closely connected to the region and became a central university for entrepreneurship and technology management education.”*

‘Business as usual scenario’ is a scenario model that focuses only on technology management education or technology entrepreneurship education. The worst case scenario is a scenario in which the technology entrepreneurship education or technology management education system is not developed.

*Business as usual scenario (1) in 2030: Developments in the field of technology management education*

*“K University in Daejeon has a close cooperation system with government-funded research institutes. In general, cooperation with universities and research institutes is considered difficult, but K University has an excellent technology management education system and technology management capabilities, so there are many opportunities for cooperation, so a lot of cooperation is taking place. Also, not only start-ups but also promising mid-sized companies are sending many employees to K University to receive technology management education. In addition, the company is receiving support from universities to establish a technology management system. K University is growing in Daejeon's innovation cluster with a well-equipped technology commercialization and technology management education and operation system.”*

*Business as usual scenario (2) in 2030 : Developments in the field of entrepreneurship education*

*“In 2030, Daejeon's K University has developed excellent capabilities in the field of technology startups. Many companies in Daedeok Techno Valley started at K University's Startup Incubation Center. Not only business incubation but also entrepreneurship education for the general public is evaluated as excellent, and it is evaluated as having made a significant contribution to building a local startup ecosystem. However, the technology commercialization program that commercializes the technology of the government-funded research institute in Daejeon is evaluated as lacking. In order for a successful technology start-up to occur, a connection between technology transfer and technology start-up is necessary, and it is important to establish a technology management system from the beginning of a start-up, but this connection between technology start-up, technology transfer, and technology commercialization is lacking.”*

In this study, future scenarios were set through scenario planning regarding the strategic direction of the university to grow into an entrepreneurial university. In order to achieve this future vision, the strategic direction was considered as follows.

The strategic direction to become the first entrepreneurial university is for the university to have a technology management education system for not only knowledge creation and research and

development, but also commercialization at the university level. Through this, the university contributes to the local technology commercialization ecosystem by nurturing technology management experts. In order to build a technology commercialization ecosystem in the region, it is necessary to not only increase the number of companies that are the main entities of value creation in the region, but also to have various support organizations such as technology commercialization specialized agencies, patent law firms, and marketing consulting firms that can support technology commercialization. In order to build such a technology commercialization ecosystem, universities must become places that train experts in technology management and technology commercialization.

The second is to have the capacity to upgrade the entrepreneurship education system to enable regional-based startups. Currently, as digital transformation based on artificial intelligence is accelerating, a new transformation is taking place in entrepreneurship. In line with these changing times, universities should not only support students to acquire professional capabilities related to entrepreneurship, but also support them to cultivate creativity and an innovative mind. There is a need to change the entrepreneurship education system to focus not only on theoretical entrepreneurship lectures but also on practical entrepreneurship lectures such as business opportunity discovery, business idea development and verification, business plan writing, business model verification, and practical entrepreneurship workshops. In addition, it is necessary to provide support not only to students but also to the general public so that they can utilize university resources to develop practical start-up capabilities and succeed in commercialization through pivoting start-up items.

The third is to develop a system where universities can establish an industry-academia cooperation system with local companies and support the growth of local companies through technology transfer. It is very important for a university to not only have a technology management and technology entrepreneurship education system, but also to have an organic industry-academia cooperation system with local companies in order for the university to grow closely with the region. It is important to advance the technology transfer system so that companies can commercialize and utilize university technology. A cooperative system must be established between universities and companies for technology transfer, human resource exchange, resolving technical difficulties, and consulting.

## 5. Conclusion

In this study, in order to become an entrepreneurial university as a university's role in an innovative industrial cluster, issue analysis and future direction focusing on technology start-up, technology management, and industry-academia cooperation were considered through scenario planning. Through this study, a strategic direction was set to become an entrepreneurial university in an innovative industry cluster according to the university's strategic issue analysis and scenario planning methodology. It is divided into a desirable future scenario of an entrepreneurial university in which both technology management education and technology entrepreneurship education have developed, a scenario in which only technology management education has developed, a scenario in which only technology entrepreneurship education has developed, and a worst-case scenario in which both technology management education and technology entrepreneurship education are underdeveloped. Among these four scenarios, the strategic direction to move toward a desirable future scenario is as follows. The first direction to become an entrepreneurial university is for the university to have a technology management education system as well as knowledge creation and research and development system. The second direction is to upgrade the entrepreneurship education system and convert it to a practical type to enable regional-based startups. The third direction is to establish an industry-academia cooperation system with local companies and create a system that can support the growth of local companies through technology transfer.

In this study, the role of universities in innovative industrial clusters was examined. It contributes to the region by strengthening technology management education and entrepreneurship education. It can be said to be meaningful in that it examines the strategic direction of universities in the region for this purpose. Daejeon is home to Daejeon's strategic industries and the Daedeok Research and Development Special Zone (Daedeok Innopolis). Local innovation systems and central innovation systems are coevolving. The role of universities will become more important in these innovative industrial clusters. In this study, the roles of universities were looked into, focusing on technology management education, technology entrepreneurship education, and industry-academic cooperation. Additionally, this paper examines how universities can contribute to the region through these roles.

The implications of this study are as follows. Based on the roles of industrial innovation clusters and universities, this study was able to examine the role of universities in a multidimensional manner in the current rapidly changing competitive environment. In addition, this study considered actual cases and consider the possibility of linked education between technology management and entrepreneurship education. In the future, this analysis should be made more sophisticated and at the same time supplemented to establish a desirable future image of an entrepreneurial university.

## 6. Acknowledgement

Professor Gee Jung Kwon is the first author, and Professor Won-il Lee is the corresponding author. Professor Lee employs foresight methodology for strategic direction of an entrepreneurial university in an innovative industrial cluster. He completed the 'Foresight for Organizers and Practitioners' course at the PREST, University of Manchester in 2006. He engaged in 'Future National Promising Technology 21' and various technology roadmap projects. He serves concurrently as the head of the policy research institute affiliated with the Daedeok Innopolis Venture Association(DIVA), Daejeon, Korea.

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