Knowledge Sharing Program

2016/17 Knowledge Sharing Program with Mexico:

SMEs Development Strategies towards Revitalizing Sustainable Regional Economy in Mexico



Ministry of Strategy and Finance

KDI Korea Development Institute

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Preface

Knowledge is a pivotal driver of growth and the fruit of all endeavors dedicated to socio-economic development. Accordingly, knowledge sharing has become an essential tool in strengthening nations' capacity to design and execute policies and programs. On the global front, the UN is making efforts through its Sustainable Development Goals (SDGs) to underscore the role of both knowledge and knowledge sharing in tackling sustainable development issues and in establishing and enhancing global partnerships.

Indeed, knowledge laid the foundations for Korea's remarkable transformation from a poor agro-based economy into an industrialized nation with an open and democratic society. And the process, though arduous, has enabled Korea to accumulate invaluable and practical lessons not found in conventional textbooks. Now, as a global economic leader, Korea is working with the international development community and partner countries to identify key development challenges and solutions by sharing its tangible know-how and experience.

The Knowledge Sharing Program (KSP) was initiated in 2004 by the Ministry of Strategy and Finance (MOSF) and is implemented by Korea Development Institute (KDI). The program plays a vital role in further expanding knowledge sharing as well as in strengthening government partnerships with low to high income economies. As of this year, 940 research studies have been conducted with 59 partner countries. And in 2016, KSP policy consultations and capacity building workshops were organized with 28 partner countries including new partner countries such as Jordan and the Sub-Saharan Africa Partnership for Skills in Applied Sciences, Engineering and Technology (PASET).

The 2016/17 KSP with Mexico was undertaken by MOSF and the Mexican Agency for International Development Cooperation (AMEXCID) of the United Mexican States to support the formulation of the "SMEs Development Strategies towards Revitalizing Sustainable Regional Economy in Mexico". To that end, KSP and Mexico engaged in a range of collaborative efforts including exchanging development experiences, conducting joint studies, and designing a policy action plan in line with the country's development targets.

It is with great optimism for the future of Mexico that the results of the 2016/17 KSP are presented. I firmly believe that KSP will serve as a stepping stone to further elevate the mutual learning and economic cooperation between both our countries, and hope it will positively impact Mexico's attainment of its goals for sustainable development.

I wish to convey my sincere gratitude to Senior Advisor Mr. Young Ju Kim, Principal Investigator Prof. Seung-Kwan Jang as well as project consultants Dr. Hanhyung Pyo and Dr. Chongin Lim for their extensive contributions. I am also grateful to Executive Director Dr. Kwangeon Sul, Project Manager Mr. Taihee Lee, Project Officer Ms. Youran Hwang and all members of the Center for International Development (CID) for their hard work and dedication to this program. Lastly, I extend my warmest thanks to the Mexican collaborates, AMEXCID, Secretariat of Education of State of Mexico, Chihuahua Council for Economic Development (CODECH), Secretariat of Economic Development of State of Colima and related agencies, project coordinators, and participants for their steadfast effort and support.

Joon-Kyung Kim
President
Korea Development Institute

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2016/17 KSP with Mexico

Youran Hwang (Project Officer, Korea Development Institute)

Mexico, the 14th largest trading partner of Korea in 2016 has promoted an omnidirectional and in-depth reform including education, telecommunications, finance, tax, and energy since 2014 after the inauguration of President Enrique Peña Nieto.

Since establishing diplomatic relations with Korea in 1961, Mexico has strengthened the cooperation and maintained the strategic partnership in various fields, such as economy, culture, science and technology. In particular, the United States reinforced the protectionism such as withdrawal of TPP and renegotiation of NAFTA. Still, Korea and Mexico, both sharing a common sense of liberalism and openness of trade, continue an active international exchange. For example, on February 13 and 14, 2017, there were preliminary discussions in Mexico City to resume negotiation for the Korea-Mexico FTA, which were discontinued since 2008. Moreover, on August 17 in Baden-Baden, Germany, both countries signed a Memorandum of Understanding (MOU) to establish an economic cooperation committee and the ministerial-level of economic council was built.

Under this background, the Knowledge Sharing Program (KSP) with Mexico was first initiated by the G20 Finance Minister Meeting in 2012 and the theme were "Policy Consultation on Promotion of Mechanical Part Industry and Technical Manpower Development and Promotion of Industry-Academy Cooperation in Hidalgo of Mexico". It was successfully completed in 2012 and the cooperation continued between Mexico and Korea in 2013, under the heading "Consultation

for Economic Development of Mexico's Four States". In 2014, Mexico became a Strategic Development Partner Country (SDPS), which paved the way for a more comprehensive and profound research over the following two years. Research was conducted under the titles of "Enhancing Innovation Capacities for Sustainable Development of the Mexican Economy" in 2014 and "Implementing Innovation Ecosystem for Sustainable Growth of the Mexican Economy" in 2015.

In 2016/17, the KSP with Mexico based on the five demand surveys submitted by Mexican Agency for International Development Cooperation (AMEXCID). Based on these demand surveys and a prior consultation, conducted with the Senior Policy Dialogue and Final Reporting Workshop in 2015/16 KSP, Ministry of Strategy and Finance (MOSF) decided to focus on three topics. And Korea Development Institute (KDI) launched the 2016/17 KSP with Mexico, under the theme of "SMEs Development Strategies towards Revitalizing Sustainable Regional Economy in Mexico". The specific topics selected under this theme are provided in <Table 1>.

〈Table 1〉 2016/17 KSP Consultation Team and Topics

No.	Topics	Requesting Ministries	Name of Researchers (Organization)
SMEs Development Strategies towards Revitalizing Sustainable Regional Economy in Mexico			
Senior Advisor: Young Ju Kim, Former Minister of Commerce, Industry and Energy, Republic of Korea **Project Manager**: Taihee Lee, Specialist, Center for International Development (CID), KDI **Principal Investigator**: Seung Kwan Jang, Professor, Korea Polytechnic University **Program Officer**: Youran Hwang, Research Associate, CID, KDI Lorena Garcia, Head of the Department for Asia-Pacific of AMEXCID			
1	Evaluation and Expansion of the CAI Center for Promoting HRD and Improving the Competitiveness of SMEs in the State of Mexico	Secretariat of Education of State of Mexico	**Seung Kwan Jang** (Korea Polytechnic University)
2	Public Policy for Extending SMEs Financing Support Programs in the State of Chihuahua	Chihuahua Council for Economic Development	**Hanhyung Pyo** (Korea Small Business Institute)
3	Strategies of Development and Operation for Colima Techno Park	Secretariat of Economic Development of State of Colima	**Chongin Lim** (Korea Industrial Complex Corporation)

As the first step of the 2016/17 KSP, the "High-Level Demand Survey and Pilot Study" was carried out form September 19 to 26, 2016, in Mexico, to identify their specific needs and to examine policy concerns. The Korean delegation, headed by Young Ju Kim, Former Minister of Commerce, Industry and Energy and senior advisor for the 2016 KSP with Mexico, met the representatives of the counterpart-States of Mexico, Chihuahua and Colima- to clarify their demand based on the submitted demand surveys. In addition, the delegation met with relevant institutions such as the Secretariat of Education of the State of Mexico, the Chihuahua Council for Economic Development, the Secretariat of Economic Development of State of Colima, universities of each states, and related governments and institutions to discuss the direction of the research and the role to share.

The next step was a "Local Reporting Workshop and Additional Pilot Study". From November 27 to December 4, 2016, the Korean delegation visited Mexico again to confirm the progress of the research and to collect more information for analysis. During the Local Reporting Workshop, Korean researchers presented related Korean experiences concerning the research and discussed on how to apply this to the Mexican reality. After the seminar, the delegation visited each state and met with various relevant institutions, including the universities of State of Mexico, the Technology Hub of Chihuahua and the Manzanillo International Port Administration of Colima. During this visit, the Korean experts checked the progress plan for further research and set the directions for a final policy recommendation. In addition, KDI and AMEXCID discussed the Activity Agreement (AA) based on the Memorandum of Understanding (MOU) signed in 2015.

In March 19 to 25, 2017, the "Interim Reporting Seminar and Policy Practitioner's Workshop" was held in Korea. The Mexican delegation, headed by Carlos Dominguez, the Minister of a Secretary of Economic Development of the State of Colima, made their first visit to Korea to share the interim results of the research and to visit Korean institutions related to the topic. The Interim Reporting Seminar was opened by both, Young ju Kim and Carlos Dominguez. During this seminar, Korean researchers presented the interim results of their policy consultation and received feedback from the Mexican experts. Moreover, the Mexican experts announced the preparation status for the opening ceremony of the CAI (Industry Academy Cooperation) Center and the inauguration ceremony for the Colima Techno Park. For the Policy Practitioner's Workshop, the Mexican delegation visited relevant institutions in Korea, such as the Korea Industrial Complex Corporation (KICOX), Korea Federation of Credit Guarantee Foundations (KOREG), and Busan Port Authority (BPA). All schedules, lectures, and institutional visits were designed in consultation with Mexico. In particular, during their visit, the KDI and Korea Trade-Investment Promotion Agency (KOTRA) successfully held a "Mexico Investment Seminar" under the theme of "Mexico Investment Strategy in the face of a Shifting

Global Trade Environment" to provide a unique opportunity to Korean companies that wish to do business with Mexico.

As a final step of the 2016/17 KSP with Mexico, the Korean delegation visited Mexico City to share the final research outcomes and policy recommendations with high-level policymakers, policy practitioners, and other stakeholders of each state government in the "Senior Policy Dialogue & Final reporting Seminar". The Senior Policy Dialogue was held separately for in-depth conversation with Carlos Dominguez (State of Colima), Elizabeth Vilchis Pérez (State of Mexico), Omar Saucedo (State of Chihuahua) and other stakeholders. During these meetings, the Korean delegation shared their final recommendation and heard the future plans of each state. The final reporting seminar opened with welcoming remarks from Martha Navarro, Director General of the Technical and Scientific Cooperation of AMEXCID, followed by opening remarks from Young Ju Kim. After that, Korean researchers had presentations and discussions held with local experts. The seminar was successful completed with more than 100 participants from relevant institutions, universities, and research institutes. This phase allowed the stakeholders to identify key state government achievements that may be realized in the future, and outstanding results are expected thanks to high interest and participation from the state governments.

The purpose of the 2016/17 KSP with Mexico was to complete the phases of the program of the State of Mexico and Colima, which have continued since 2014/15 KSP, and to seek ways to support the finance problem for SMEs of Chihuahua. During this program period, different steps, such as the Investment Seminar and additional joint research in Korea, were planned and progressed by the Korean and Mexican Government. Because of these efforts, the program successfully accomplished all the planned goals. Although the 2016/17 KSP with Mexico has ended, it is expected to generate additional performances and outcomes in the future, considering the willingness of the government officials and the counterpart, AMEXCID. And these achievements will be the foundation of an economic cooperation between Korea and Mexico.

Executive Summary

Seung-Kwan Jang (Korea Polytechnic University)

1. Evaluation and Expansion of the CAI Center for Promoting HRD and Improving the Competitiveness of SMEs in the State of Mexico

In the past three years, State of Mexico has pursued a Knowledge Sharing Program (KSP) project aimed at strengthening the competitiveness of small and medium-sized enterprises based on the success of Industry-Academia Cooperation (IAC) in improving corporate competitiveness in Korea.

During the three years of research, State of Mexico jointly promoted experts from four universities to actively participate in the KSP project. These Mexican experts stayed in Korea for more than a week each year and were able to directly test the development of Korea, which was a useful tool in their evaluation of the KSP study.

The primary aim of the KSP study in the first year was to establish a basic plan for the establishment and operation of CAI centers in four state universities in Mexico. The model of this CAI center was based on the IAC model of Korea Polytechnic University (KPU), which is a representative institution of industry-academia cooperative education in Korea.

In the following year, I studied the operation plan of the CAI center. One of the accomplishments of this KSP study was the successful opening of the CAI Center in June 2016. Key members of both countries were in attendance at Polytechnic

University of the Valley of Mexico (UPVM), one of the four universities participating in the KSP project. In addition to the opening ceremony achievement, there have also been cases where new technology was exchanged and products were transferred with KPU's partner companies. In addition, the CAI Center, operated by four Mexican universities, has witnessed several visible achievements of the IAC.

The Education of the state is required to disseminate the results of these CAI centers to other universities. Therefore, the main aim of the third year of the KSP project is to establish a plan to spread the CAI center to other universities in Mexico, as it is currently operated among the initial four universities.

Section 1 introduces the overall content of the KSP project conducted up to the second year and the intention to proceed into the third year.

In section 2, the main content of the KSP study is the operation of CAI centers at Coacalco Technology Institute (TESCo) and UPVM colleges that are already operating CAI centers. The study also includes an analysis of the current status of IAC implementation at Ecatepec Technology Institute (TESE) and Cuautitlán Izcalli Technology Institute (TESCI) universities.

The Korean experience, the core of this study, was introduced in Sections 3 and 4. The research on the LINC project, a Korean experience, is a useful reference model for Mexico to plan for the expansion of CAI centers in other universities, and this research is introduced in Section 4.

Section 5 also examined the evaluation methodology of the IAC program of the KPU in order to establish effective CAI center management.

Based on this experience in Korea, this study proposed the evaluation method of CAI center's IAC program and expansion plan in Sections 6 and 7. In particular, the studies in Sections 6 and 7 are based on the situation analysis of the Mexican side introduced in Sections 2 and 3 and the experience of Korea in Sections 4 and 5.

This study has been conducted for three years with the goal of improving the competitiveness of SMEs based on IAC in Mexico. Four universities participating in the KSP project during the second year are establishing and operating the CAI center in accordance with the content of the KSP research. In addition, the Mexico federal and state governments have established policies to support these CAI centers, and they are preparing budgets to effectively support them. UPVM University also invited government officials from both countries to the opening of the CAI Center in June 2016 and successfully opened the CAI Center.

In 2017, the Mexico State government officially announced plans to open CAI centers in five remaining universities in early 2018. Four universities have been operating CAI centers effectively. Based on this CAI center, many programs have been established to provide effective on-the-job training and support for students. In terms of spreading bilateral exchanges, these have already begun through CAI centers, such as when Mexican companies purchase and analyze Korean companies and products for technology transfer and assembly production.

In the third year of the project, the Mexican government prepared a basic plan to expand the CAI center; they intend to spread the center to other universities in the province, which can be regarded as one of the success stories of the KSP study.

The State government has been able to solve problems with low IAC linkages between companies and universities through CAI centers, which can act as a successful model for university education reform in Mexico.

This CAI Center provides students with on-the-job training for companies to participate in, and the company hires students who have completed on-site training. Enterprises can easily introduce new technologies and develop new products through the program of industry-academia cooperation in the CAI Center. As a result, enterprises can increase technological competitiveness through the CAI Center.

In addition, exchanges of technology, manpower and culture between Korea and Mexico will be expanded through the CAI Center. The completion of the CAI center's expansion plan in Mexico is expected to lead to rapid growth of the industry as well as to innovative development of education within the country.

2. Public Policy for Extending SMEs Financing Support Programs in the State of Chihuahua

The 2016/17 KSP with the State of Chihuahua, Mexico, titled "Public Policy for Extending SMEs' Financing Support Programs in the State of Chihuahua" aims at sharing experience and information on SMEs' financing support program in Korea. Not only in Mexico, but also in other nations, the role of SMEs has been emphasized by stimulating the ripple effect of FDI since it contributed to job creation and economic development. In this context, the State of Chihuahua is interested in Korean SME policy, especially as it relates to financing, since it has made an effort to search the various approaches to develop endogenous growth of SMEs in Chihuahua.

To reach our purpose, this study briefly reviews the current economic status of Mexico and the State of Chihuahua to discover relevant initiatives that are compatible with Korean ones. After reviewing these details, it is evident that

public venture capital and the credit guarantee system have been scrutinized as interchangeable to Chihuahua. Therefore, this study suggests the following approaches on the SMEs support solution for Chihuahua. First, Credit Guarantee Scheme (CGS), which support SMEs, seem appropriate since the SMEs in Chihuahua are either excluded in official economy activities or limited from central government financing. Second, this study proposes establishing the public venture capital system for high-tech firms in Chihuahua that survive with the benefits of FDI. Third, this study approves the initiative to provide full-fledged employees that have made long-term contributions to multinational corporations with entrepreneurship programs as a means of boosting start-up foundations.

The adoption of CGS should be the first step for the State of Chihuahua to initiate public policies because CGS clearly attenuates risk on investments and yields effectiveness by absolving public actors from the duty of providing financial aid on a regular basis. Indeed, the government is responsible for putting initially assigned funding in the preparation stage. After that, in the underlying mechanism, the credit guarantee scheme is no longer dependent on financial aid from public hands. FOF could be the better choice to promote a certain industry, to which the government prefers, but a lack of sophisticated preparation could result in disaster.

3. The Strategy of Development and Operation for the Colima Techno-park

Colima has been participating in the KSP project since 2014 with deep interest in Korea's industrial development experience, especially the techno park policy, for the past three years. Therefore, this study should be consistent with the KSP project, which was conducted twice in 2014 and 2015. A strategy was proposed for the development and operation of Colima Techno-park (TP), which focused on the establishment of the innovative ecosystem and cooperation between the industry and academia. We also presented strategies for foreign direct investment attraction, human resource development, marketing, and international cooperation between Korean-Mexican research institutes for Colima TP.

This study consists of four sections, which are 1) Status and Future Task of Colima State, 2) Korean Experience, 3) Building Strategy of Innovation Ecosystem, and 4) Activation Strategy of Colima TP.

Section 1 presented an industry structure analysis of Colima State, a spatial distribution analysis of Colima's economy, an analysis of human resource and science/technology resources, the current status of Colima TP, and the task of Colima State to activate the Colima TP. Section 2 explored an industry development policy, innovation cluster policy, industry-academia cooperation policy, and TP development policy for

the past 50 years as a Korean experience review. Based on this experience in Korea, we suggested implications for the policy to be presented to Colima. Section 3 consists of building strategies for industry-academia cooperation and innovative eco-systems for Colima TP. This included how to organize the industry-academia cooperation system and operate it sustainably. Also, we presented tools for operating the family company system, technology transfer, and commercialization program, which have been successfully implemented in Korea. Section 4 explored the activation strategies of Colima TP. These included the strategy of investment attraction from domestic & foreign companies, human resource development, image building & promotion, and international cooperation between Korean-Mexican research institutes for Colima TP.

This study is concerned with the "Designing, Implementing and Linking Public Policies to Stimulate Scientific and Technological Development of Colima State: Policy Suggestions for CLQ TP Master Plan" in the first year, the "Linking Stratedy of Academia, Business Government for Innovation Ecosystem in Colima Science and Technology Park" in the second year, and the "The strategy of development and operation for the Colima Techno-park" in the third year. We have established a consistent policy proposal system that suggests the following process: policy master plan activation strategy. Based on this, Colima State will be able to raise the level of high-tech industries like bio-agriculture, IT, logistics IT, and renewable energy in an industrial structure concentrated on port logistics.

First of all, this study presents the activation strategy of Colima TP, which is a bridgehead for port logistics, wholesale and retail, agriculture and mining to enhance the industrial structure of these main areas. Thus, it is possible to build an innovative ecosystem that includes industry-academia cooperation, R&D, technology transfer and commercialization while enhancing the industrial structure in bio-agriculture, IT, logistics IT and renewable energy.

In addition, attracting investments from domestic & foreign companies for the Colima TP will assist in human resources development for TP operation, image building, promotion, and international cooperation between Korea and Mexico.

2016/17 Knowledge Sharing Program with Mexico:
SMEs Development Strategies towards Revitalizing
Sustainable Regional Economy in Mexico

Chapter 1

Evaluation and Expansion of the CAI Center for Promoting HRD and Improving the Competitiveness of SMEs in the State of Mexico

1. Introduction
2. Current Status for the CAI Center in State of Mexico
3. LINC of Ministry of Education in Korea for Promoting IAC
4. KPU's Evaluation Methods of the IAC Programs
5. Evaluation of the CAI Center's IAC Programs
6. Planning for Expanding the Pilot CAI Center

Evaluation and Expansion of the CAI Center for Promoting HRD and Improving the Competitiveness of SMEs in the State of Mexico

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Alejandro Luna Aviles (Coacalco Technology Institute)
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Marco Antonio Lopez Cuachayo (Cuautitlán Izcalli Technology Institute)
Francisco Jacob Avila Camacho (Ecatepec Technology Institute)

Summary

The purpose of the Knowledge Sharing Program (KSP) study that began in 2013 was to build a plan to improve the competitiveness of small-to-medium enterprises (SMEs) in Mexico State. In the first year, this KSP study created a basic plan for this purpose.

The direction of this study was to build a foundation to support university–industry cooperation between industry and academia based on Korea Polytechnic University (KPU)'s Industry Academy Cooperation (IAC) model, the most successful IAC model in Korea.

Over the course of this study, four universities in Mexico State established CAI centers, which were the Spanish equivalent of the IAC. These consisted of an Engineering House (E/H), a Technology Business Incubator (TBI), and an Equipment Support Center (ESC). The plans for establishing the CAI Center in four universities included space calculations for establishing the E/H, TBI and ESC.

The main purpose of the KSP study in the second year was to prepare the operational plan for the CAI centers.

During the second phase of the KSP study, the Polytechnic University of the Valley of Mexico (UPVM) performed the opening ceremony for the CAI Center. In particular,

these four universities have achieved industry–academia cooperation by establishing and operating this CAI Center.

This KSP project resulted in a great deal of interest and influence on governments, universities, and companies in Mexico State. The Government of Mexico State has sought to build a plan to expand this pilot CAI Center to other universities. This is the basic direction of the KSP project this year.

The purpose of this study is to present the evaluation methods of the IAC program for the effective operation of the pilot CAI Center and to prepare an expansion plan for the pilot CAI Center in Mexico State.

To ensure that the study would be effective, the KSP project team created a T/F team that included experts recommended by the government of the State of Mexico and visited both countries to find the information needed for the KSP study.

The T/F team members were experts from TESCo at the UPVM and worked together on the KSP study until last year. This year, experts from Ecatepec Technology Institute (TESE) and Cuautitlán Izcalli Technology Institute (TESCI) participated.

The main contents of the KSP study conducted this year are as follows.

Chapter 1 introduces the KSP project and its progress over the past two years, as well as this year's objectives.

Chapter 2 analyzes the operation status of the pilot CAI Center as well as the status of TESE and TESCI, the new members of the T/F team. This study included analysis of the industry situation around each university in order to direct the characterization of the IAC program at their CAI centers.

The Korean experience that is at the core of this study is the subject of Chapters 3 and 4. The Leaders in Industry-University Cooperation (LINC) project, a Korean experience, provides a good model for the creation of a proliferation plan for the pilot CAI Center, which is the core of this KSP study. This project was created by the Ministry of Education to spread the IAC model of the KPU to other universities in Korea. The results of this study are given in Chapter 3, the main contents of which are the background, purpose, business contents, and achievements of the LINC project each year.

The purpose of the study in Chapter 5 was to analyze the KPU's evaluation method in order to formulate a method to evaluate the IAC program at the CAI Center.

The evaluation of the IAC program of the CAI Center and the expanding plan of the pilot CAI Center are addressed in Chapters 6 and 7, respectively.

The research in Chapters 6 and 7 was based on the analysis of the situation from a Mexican perspective introduced in Chapters 2 and 3 and from a Korean perspective in Chapters 4 and 5. In particular, the experts of Mexico, who were members of T/F for the KSP study, stayed in Korea for 7 days and conducted joint research.

1. Introduction

The KSP study in Mexico State started in 2014. Its purpose was to enhance the competitiveness of Mexico State's SMEs through IAC.

In the first year, the KSP study established the IAC center in the State of Mexico based on KPU's IAC Model.

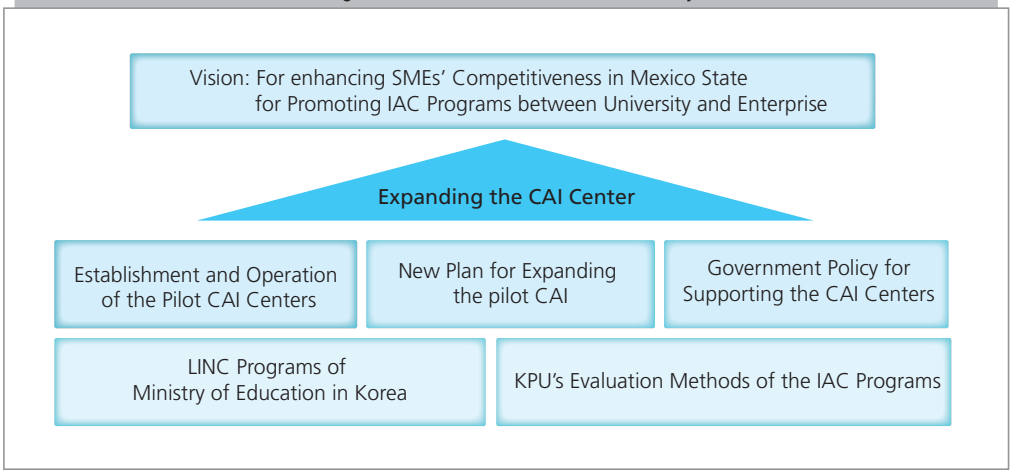
In the second year, the study established and operated the CAI center in four universities in the State of Mexico.

Because of this study, four universities (TESCo, UPVM, TESJo, UTTec) in Mexico State have established and operated CAI Centers, and UPVM University launched the opening ceremony for its CAI Center in 2016.

In addition, four universities have received support, including budgets, for the operation of the IAC program from the federal Government of Mexico and the local government of Mexico State after the operation of the pilot CAI Center. As a result, these four universities have had positive results in cooperation with companies through their CAI centers.

The direction of the State of Mexico's KSP study this year is shown in [Figure 1-1].

[Figure 1-1] Direction of the KSP Study



Based on these achievements, the Government of Mexico State plans to spread the pilot CAI Center to other universities. The primary purpose of this year's KSP program is to study how to effectively conduct this expansion.

The Korean Ministry of Education created and implemented the LINC project to expand the IAC Model of KPU to other universities in Korea. This undertaking provides an ideal example to use when planning how to spread CAI Centers across Mexico state.

Therefore, this study intends examine how the Korean LINC program operated and performed over a span of five years and to build plans for the expansion of the pilot CAI Center in other universities in Mexico State.

In addition, to prepare the pilot CAI Center to operate effectively, the procedures and methods for evaluating the various types of IAC programs in the CAI Center should be generated. The government of Mexico State wanted this study to include an adaptation of KPU's IAC program evaluation in this study.

This year, the KSP Study in Mexico State was composed of experts from four universities (TESCo, UPVM, TESE, TESCI) in Mexico State. The T/F team coordinated through mutual visits or the website as needed.

The contents of this study are described in detail in the next chapter.

〈Tips〉 Industry Academy Cooperation in Korea

Korea's IAC project was established as a major component of the new university after the enactment of the 'Industry–university Cooperation Promotion Act' as part of the university's cultural focus on education and research.

After the LINC project, the technology transfer from university to SMEs has been more active than it is even in the metropolitan areas, and has played an integral role in the development of local SMEs.

KPU's E/H, TBI, ESC, and partner company systems are recognized as being successful IAC models for other universities in Korea, and provide a good example of disseminating the ICA model to universities in the State of Mexico.

IAC performance has increased through the LINC project, but the performance of some projects has differed from the requirements of the enterprise.

The implementation of the IAC program in Mexico State through this KSP study will require a plan to overcome these problems in Korea.
In other words, before the implementation of IAC programs in the CAI Center of the State of Mexico, the demand survey of companies should be conducted first, and the areas and methods of the IAC should be modified according to the results of the survey.

In addition, the implementation of the IAC project should be accompanied by a set of regulations and systems for the promotion of the IAC project.

2. Current Status for the CAI Center in State of Mexico

2.1. Background and Target of the CAI Center for IAC

This chapter will describe the status of the four CAI Centers established in Mexico State. Their names are:

1) Ecatepec Technology Institute (TESE)
2) Cuautitlán Izcalli Technology Institute (TESCI)
3) Coacalco Technology Institute (TESCo)
4) Polytechnic University of the Valley of Mexico (UPVM)

The first two universities, TESE and TESCI, are in the process of installing their own CAI Center. Development will be conducted over the course of a year, from June 2016 to August 2017. The two other universities, TESCo and UPVM, have been in place since 2014 as per the adaptation and assimilation of the model and will share their experiences with TESE and TESCI.

TESCo and UPVM will provide all fundamentals, including the operation and organization manual, to TESE and TESCI to ensure the correct expansion of the CAI Center.

In the following sections, the resulted will be presented with the aim of reporting on four main topics:

1) The current status of the pilot CAI Center (TESCo and UPVM)
2) The operation of the pilot CAI Center (TESCo and UPVM)
3) The government plan and policy for supporting and expanding the CAI Centers
4) An analysis of the environment of the expanding CAI Centers (TESE and TESCI)

The CAI Center´s main objective is:

To improve the competitiveness and productivity of companies, mainly SMEs, established in the State of Mexico, through basic and applied research projects, technology transfer, and the training of highly specialized human resources in the technological areas of advanced manufacturing, control and automation, design of mechatronic systems, and information and communications technologies.

The CAI Center´s main goals are to:

1) Support companies to identify specific needs and translate these criteria into technical information in order to establish a scientific basis for solution development.
2) Create an innovation ecosystem that promotes the inclusion of skilled labor in the productive sector and the development of linked projects as the fundamental basis of scientific and technological development.
3) Promote the participation of companies in calls for federal and state funds that support the process of innovation and technological development.
4) Create technology that will be transferred in the future.
5) Support initiatives for the creation of technology-based SMEs through the SPIN OFF and STAR UP models.
6) Promote technology transfer between Korean and Mexican enterprises and provide technical and marketing support.

The integrated vision for the CAI Centers:

The CAI Centers are visualized as specialized centers for development, assimilation, technology transfer, and highly specialized technical capacitation that will give support to enterprises, mainly SMEs.

2.2. Current Status of the Pilot CAI Center

This section will detail the status of the pilot CAI Centers at TESCo and UPVM.

1) TESCo's technological areas
   - Advanced manufacturing
   - Control and automation

2) UPVM's technological areas
   - Advanced manufacturing
   - Design of mechatronic systems

Both universities function as a single CAI Center, meaning that all resources that TESCo has can be used by UPVM, and vice versa. This allows them to acquire specific equipment to strengthen the three technological areas of advanced manufacturing, control and automation, and the design of mechatronic systems.

For example, for advanced manufacturing, TESCo will acquire a five-line vertical machining center (VMC), and UPVM will acquire a three-line VMC with special adaptations for graphite machining, a ram electrical discharge machining (EDM), and a wire EDM. Personnel will have full access to these so that they can develop industrial services and research. Both universities share the same CAI Center operation and organization manual.

The technological areas have the following specifications:

1) **Advanced manufacturing:** mainly oriented towards tooling and injection molding related to manufacturing and design, the mechanical development of special industrial equipment, and the conceptual development of control and automation systems.

2) **Control and automation:** mainly oriented towards programming human machine interfaces (HMI), developing integrated control net systems, creating new control strategies, and developing specifications for the automation of production lines and select sensors for a variety of applications, as well as actuators, like electric motors, pneumatic pistons, hydraulic systems, and more. Also, this area is responsible for programming logic controllers and the assembly of control and power cabinets.

3) **Mechatronic system design:** mainly oriented towards the development of special commercial equipment for applications like biomechanics, rehabilitation, agroindustry devices, and more. In addition, the programming of embedded systems and specific platforms is conducted, primarily in Java or for Android.

The main economic development in the region is oriented towards the automotive, aerospace, and plastics industries, as well as agroindustry. The State of Mexico contributes 9.41% of the Gross Domestic Product (GDP) of Mexico.[1)]

2.2.1. Establishment of Pilot CAI Center (Building and Facilities)

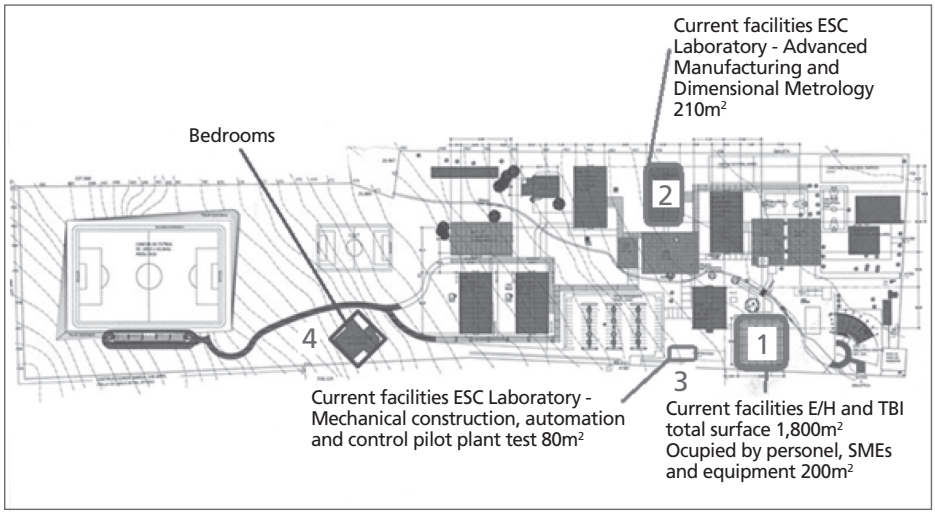
The CAI Center has strengthened the relationship between academy and industry, promoting new ways to link and develop technology for the SMEs of the State of Mexico and including students in projects related to innovation and technology development to improve their competitiveness.

The building and facilities of the CAI Centers at TESCo and UPVM are shown in the next section.

2.2.1.1. TESCo

[Figure 1-2] shows the current location of the facilities inside the university. As can be observed, one building is entirely dedicated to CAI Center; however, not all equipment is inside of this building.

[Figure 1-2] The Current Facilities of TESCo



Note: 1. CAI Center, 2. B Building, 3. MCAC Building, 4. Bedrooms.
Source: TESCo.

1) Foro Consultivo Científico y Tecnológico, A.C., «Diagnósticos Estatales de Ciencia, Tecnología e Innovación 2014 Estado de México,» FCCYT, México, D.F., 2014.

In the first building identify as CAI Center – TESCo are installed the Engineering House (E/H) and Technological Business Incubator (TBI). In this facility are installed eight people (two for E/H, three for TBI, and three for ESC). Also, one SME is installed.

[Figure 1-3] shows the current exteriors of the building, the main gate, and the area dedicated to E/H and TBI.

[Figure 1-3] CAI Center - TESCo



A. The current exterior of the TESCo CAI Center



B. The main gate



C. The E/H and TBI Offices

[Figure 1-4] shows the B Building in which two laboratories are installed, the Advanced Manufacturing Laboratory (AML) and the Dimensional Metrology Laboratory (DML). The DML is certified in the ISO 17025 and currently developing several services for industry. Their certification number is D-139, given by the Mexican Entity for Accreditation (EMA).

[Figure 1-4] The TESCo CAI Center Facilities – B Building



A. B building



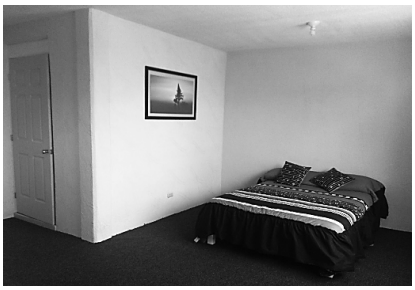
B. DML



C. AML

[Figure 1-5] shows the bedrooms, which are specifically designed to host researchers, technicians and enterprise personnel. The Mechanical Construction, Automation and Control (MCAC) laboratory is specifically for the assembly and integration of industrial equipment. It also enables the validation of control systems and the automation of the pilot process plant.

[Figure 1-5] Other Facilities at the TESCo CAI Center



A. Bedrooms

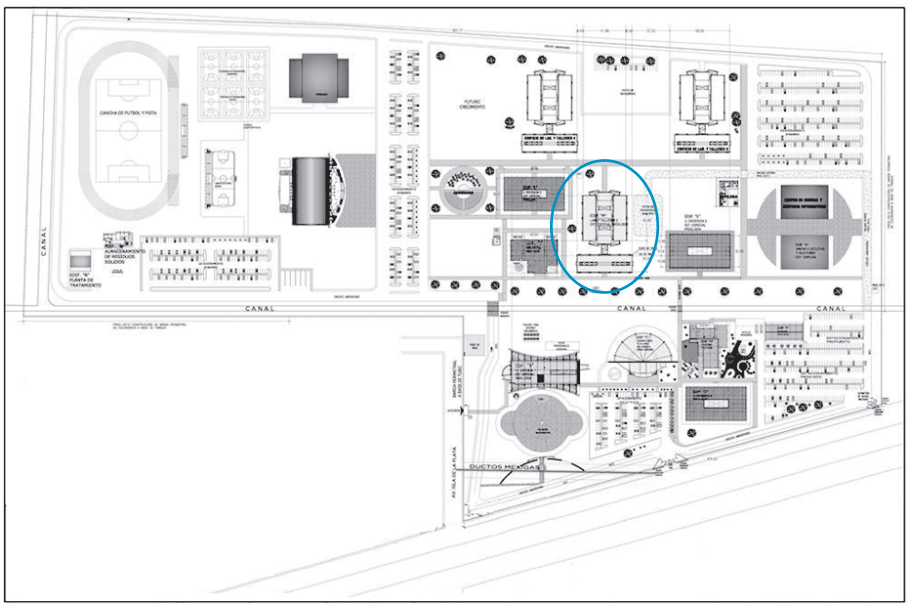


B. MCAC

2.2.1.2. UPVM

The location of the CAI Center in the UPVM is shown in [Figure 1-6]. This figure shows the architectural plan of the UPVM, with the red circle indicating the location of the CAI Center building. [Figure 1-7] shows the CAI Center building.

[Figure 1-6] Architectural Plan of UPVM



Source: UPVM.

[Figure 1-7] CAI Center UPVM Building



The CAI Center building is not yet 100% finished. However, the construction of ramps and entrances to the building, and electricity, internet, gas and water installations are finished. Some laboratories, such as the E/H and TBI, are already in use.

[Figure 1-8] The CAI Center UPVM Building Facilities



A. Front of CAI Center building.



B. Exteriors



C. Services

Equipment for the Nanotechnology, Biotechnology, Physics, Chemistry, Thermo-fluids, Computing and 3D Design labs are currently being installed. Some of these laboratories, such as Thermo-fluids, Nanotechnology, Biotechnology, Chemistry and Physics, are currently functioning.

In the following section, each area's distribution will be shown.

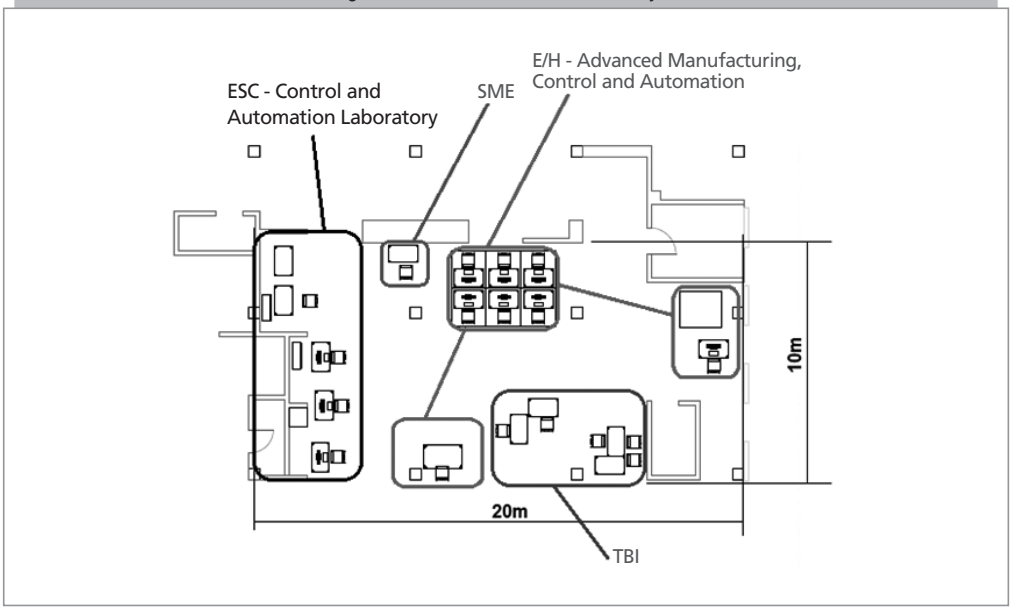
2.2.2. Layout for E/H, TBI and ESC

In this section, the layouts for the TESCo and UPVM CAI Centers are shown, with a particular focus on space usage and distribution.

2.2.2.1. TESCo

[Figure 1-9] show the layout of the TESCo CAI Center. This space currently only occupies 200m^2. This is because expansion of this Center has been planned since its inception, with a particular focus on expanding the services offered and the quantity of linked SMEs.

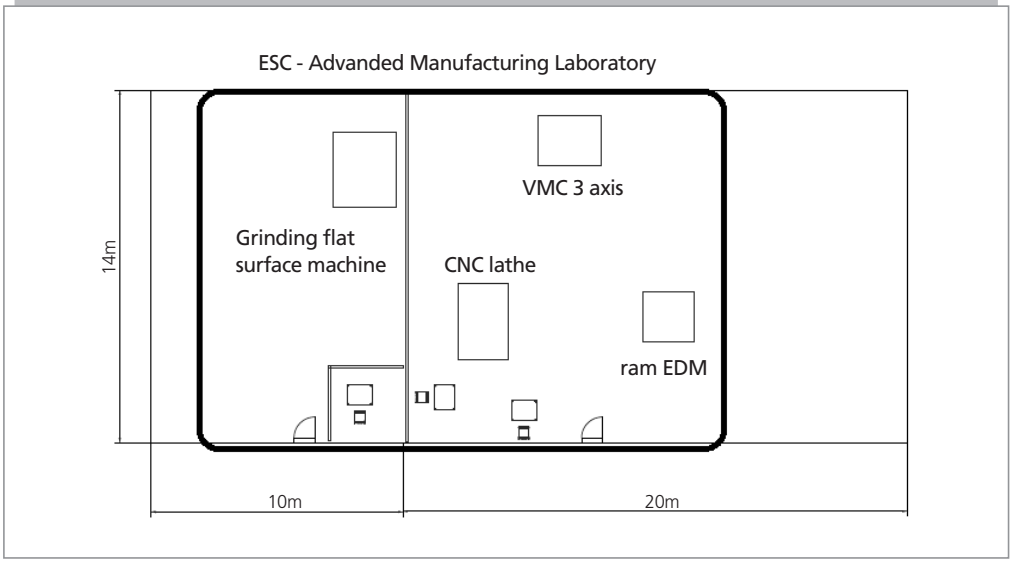
[Figure 1-9] TESCo CAI Center Layout



Source: TESCo

[Figure 1-10] shows the layout of the ESC AML. This laboratory is installed in an area of 420m^2. Specifically, this section is dedicated to creating special components for prototypes.

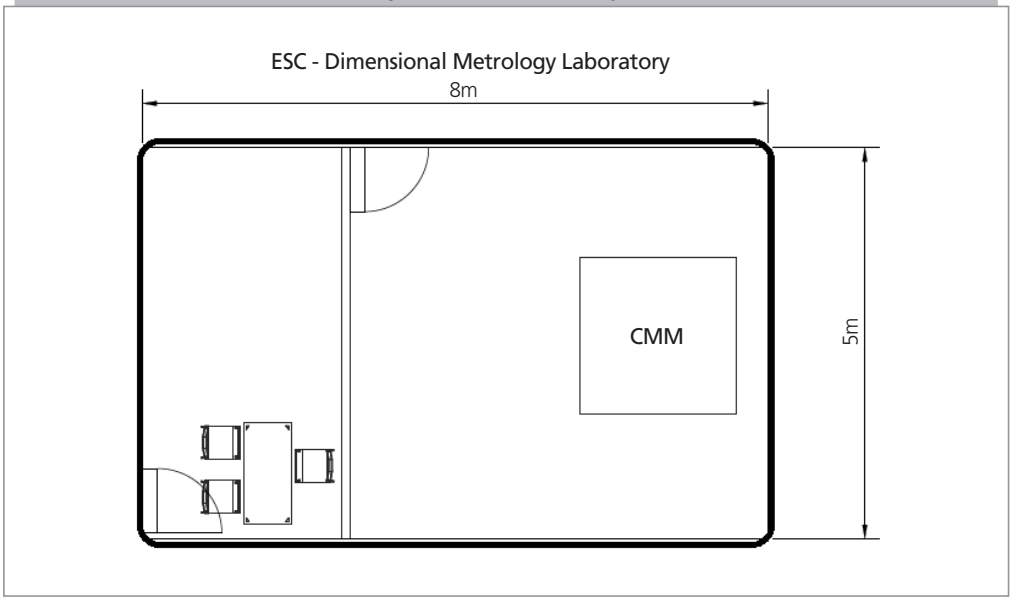
[Figure 1-10] The AML Layout



Source: TESCo.

[Figure 1-11] shows the layout of the ESC DML. This laboratory is installed in an area of 40m^2 and provides industry services.

[Figure 1-11] The DML Layout



Source: TESCo.

2.2.2.2. UPVM

The CAI Center building is distributed between two buildings, A and B.

In building A, there are five spaces for Engineering Houses (E/H) and four spaces for Technological Business Incubators (TBI).

In building B, there are two spaces for the Production Area, two spaces for Engineering Houses (E/H), and the Engineering Support Center (ESC), which includes 11 laboratories.

ESC Laboratories:

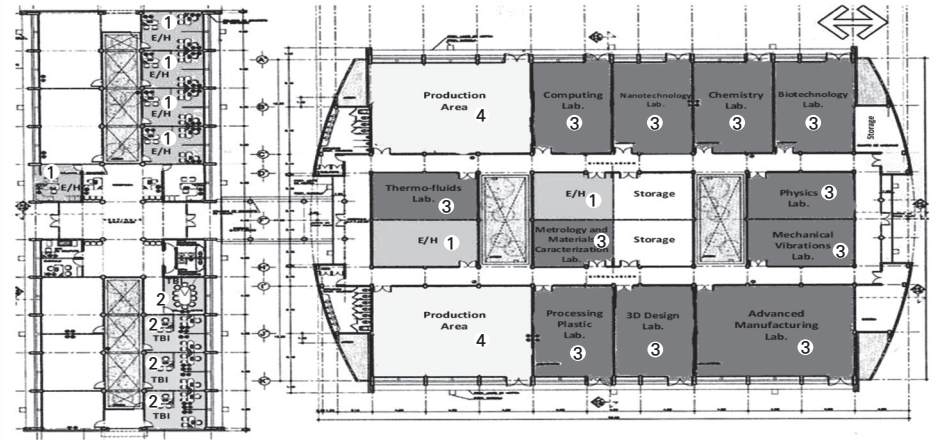
- Computing
- Nanotechnology
- Chemistry
- Biotechnology
- Physics
- Thermo-fluids
- Metrology and Materials Characterization
- Mechanical Vibrations
- Processing plastic
- 3D Design
- Advanced Manufacturing

[Figure 1-12] shows the layout of the CAI Center building. The main areas are denoted using the number shown in <Table 1-1>.

〈Table 1-1〉 Number for the CAI Center areas

CAI Center area	Number
Engineering House (E/H)	①
Technological Business Incubator (TBI)	②
Engineering Support Center (ESC)	③
Production Area	④

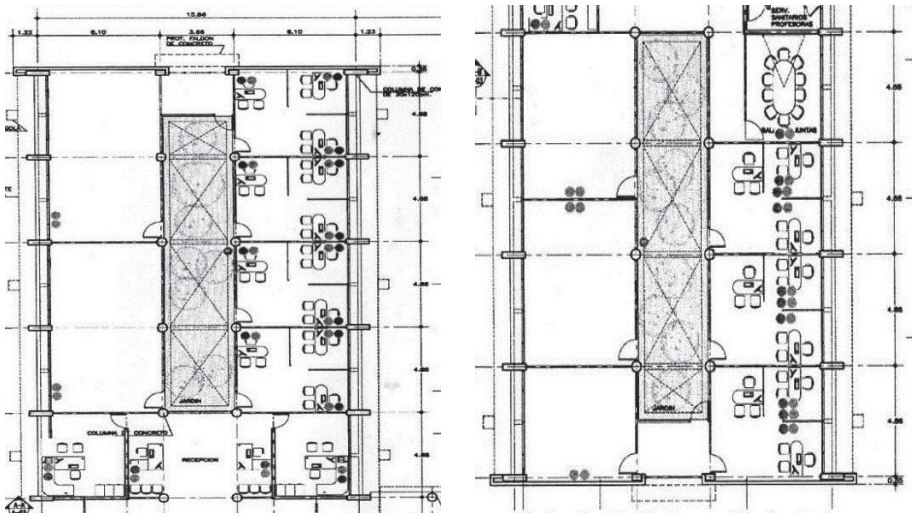
[Figure 1-12] The Layout of the CAI Building



Source: UPVM.

Building A of the CAI Center building has spaces dedicated to E/H and TBI, which are filled with office furniture and computer equipment. [Figure 1-13] shows Building A divided into two parts. The five spaces dedicated to the E/H and the layout of each space are shown on the left, and the four spaces dedicated to TBI and the layout of each space are shown on the right.

[Figure 1-13] Layout of the CAI Center



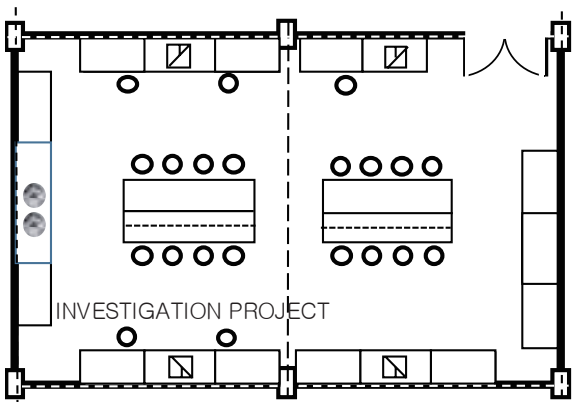
A. Layout of E/H

B. Layout of TBI

Source: UPVM.

The ESC is composed of 11 laboratories, each with its own layout. [Figure 1-14] shows the layout of the thermos-fluids laboratory.

[Figure 1-14] Layout of Thermo-fluids Laboratory



Source: UPVM.

The next section will detail the equipment installed in each area.

2.2.3. Equipment for E/H, TBI and ESC

In this section, the equipment installed in each area of the CAI Center will be defined. Details such as capabilities, personnel, and tooling also will be mentioned.

2.2.3.1. TESCo

One Coordinate-Measuring Machine (CMM) is installed inside the DML. Five technicians work in this laboratory, two of whom are in charge of developing measurements, and three whose job is to develop administrative and maintenance procedures.

This laboratory has twenty-five feelers, a roughness tester, and specialized software for developing measurements and office equipment. [Figure 1-15] shows the physical equipment.

[Figure 1-15] The DML Equipment



[Figure 1-16] shows the equipment installed in the AML, which is as follows:

1) **One three Line Vertical Machine Center (VMC):** Vertical Machining Center; 20" x 16" x 20" (508 x 406 x 508 mm), 40 taper, 30 hp (22.4 kW) vector drive, 8,100 rpm, inline direct-drive, 20-station carousel tool changer, 1,000 ipm (25.4 m/min) rapids, power-failure detection module, 1GB program memory, 15" color LCD monitor, USB port, memory lock key switch, rigid tapping, and 55-gallon (208 liter) flood coolant system.
2) **One CNC lathe machine CNC Lathe:** 15" x 21" (381 x 533 mm) max capacity, 2.0" (51 mm) bar, 31.75" (806 mm) swing, 20 hp (14.9 kW) vector drive, 4,000 rpm, A2-6 spindle, 8.3" (210 mm) chuck, 12-station bolt-on turret, 15" color LCD monitor, memory lock key switch, USB port, and rigid tapping.
3) **One ram Electro Discharge Machine (EDM):** Capacity Of Work Tank 44" x 24" x 16", Work Table Dimension 28" x 18", Longitudinal/Cross Travel (X/Y Line) 16" x 12", SpindlE/Headstock Travel 8" / 10", Available Loading Weight Of Electrode 220 lbs, Loading Capacity Of Work Table 2,200 lbs, Max Output Current 60A, Input Rating 7 KVA, Max Processing Speed 6 G/MIN, Electrode Wear Ratio 0.25%, Max Programming Capacity 500 Blocks, Min D.R.O. Resolution 0.0002", Max D.R.O. Distance 99.9999", Fluid Tank Capacity / Pump 380L / 1/2HP, Voltage 220 V AC / 3PH, and Net Weight 3,960 LBS.
4) **One grinding flat surfaces machine:** Table Size (in./W x L) 12 x 24, Grinding Capacity (in./W x L) 12 x 24, Maximum Table Workload without Magnetic Chuck Capacity (lbs.) 690, Maximum Table Workload with Magnetic 924, Grinding Wheel Size 14 x 2 x 5, Diameter x Width X Hole (in.) - Standard Chuck Size (in./W x L) 11-3/4 x 23-5/8.

Eight people work in the AML; one ESC technician, and one Higher Education Institute (HEI) student are assigned to each machine and are responsible for the maintenance and execution of projects. There are also several hand tools like screwdrivers, cutters, hammers, clamp pressure, clampers, and cones, among others.

[Figure 1-16] The AML Equipment



A. One three Line Vertical Machine Center (VMC)



B. One ram Electro Discharge Machine (EDM)



C. One CNC lathe machine



D. One grinding flat surfaces machine

[Figure 1-17] shows the equipment installed in the TESCo CAI Center. Eight people work in these facilities, four of whom are responsible for the ESC Control and Automation Laboratory (CAL), three of whom are responsible for TBI, and one of whom is responsible for E/H.

[Figure 1-17] The Current Equipment in the TESCo CAI Center



A. ESC-CAL



B. TBI



C. E/H prototyping machine



D. E/H facilities

The equipment currently installed in the ESC-CAL is as follows:

- Software Factory Talk View®
- Software RS Logics 5000®
- Several kinds of controllers
- Sensors, drives and servo-drives
- Analogical and digital modules with HART communication protocol
- A Human Machine Interface (HMI)

A ZPRINTER 350 is also available in the E/H. This device enables students to create models from a white powder held together with a binding agent. These models can be up to 10 L x 8 W x 8 H in inches. The time to print is approximately 2 hours per inch in height, but when finished, models require a few hours to dry.

Additionally, the E/H has the following software: MATLAB®, ANSYS®, CATIA®, and MOLDFLOW®, which are used for scientific research.

The technological fields in TESCo are Advanced Manufacturing and Control and Automation. All infrastructure described is oriented to support the following specific demands:

1) Improvement and optimization of production lines and processes through integrated control networks

This area will focus on the use of control and automation technologies, as well as technical feasibility analysis for robot integration. Other activities will include, but are not limited to:

- Process simulations
- Development of specialized control and automation sequences
- Sequence programming in specialized robots
- Validation of communication protocols
- Integration of monitoring and control rooms
- Specialized design of end effectors for robots.

2) Design of molds, dies and auxiliary systems

Considering that there are several local companies associated with the automotive sector, it is of high importance to provide the design and manufacture of prototype tooling for the creation of automotive components. It is in this area that high precision machine tools play an important role in guaranteeing the precision and repetition demanded. In addition, different manufacturing techniques can be tested to reduce manufacturing times and methods for integrating the sequences into the control systems in conjunction with the use of specialized robots.

3) Development of laboratory equipment and special processes

Many companies have production process requirements, and it is for this reason that the design, manufacture, control and automation of specialized systems is essential to ensure that the consumer goods obtained are of the similar or higher quality, while simultaneously lowering production time and cost.

2.2.3.2. UPVM

The equipment in the E/H and TBI is basically computer equipment and office furniture. However, the E/H and TBI computers have specific software installed to perform certain functions. The E/H uses specific software such as SolidWorks®, AbaqusCAE®, ANSYS® as per its status as a research area.

The ESC has 11 laboratories, each for specific purposes. <Table 1-2> shows the equipment in the laboratories.

〈Table 1-2〉 Equipment in the ESC Laboratories

CAI Center area	Color
Computing	- Computer equipment
Nanotechnology	- Infrared Spectrometer - Raman Spectrometer - Particle analyzer (Micrometrix®) - Microscope - Ovens
Chemistry	- Centrifuge (Heal force®) - Oven (Arsa®) - Laminar flow hood (Veco®) - Tables (4)
Biotechnology	- Fridge (Ojeda®) - Microscope - Hood (BIOBASE®) - Tables (6)
Physics	- Teaching equipment - Tables (4)
Thermo-fluids	- Heat exchanger - Tables (2)
Metrology and Materials Characterization	- To be equipped
Mechanical Vibrations	- To be equipped
Processing Plastic	- To be equipped
3D Design	- Zspace® system - ProtoMat® - CubeX Duo® - Computer equipment (30) - Specialized Software (SolidWorks® education license)
Advanced Manufacturing	- To be equipped

Source: UPVM.

Metrology and Materials Characterization, Mechanical Vibrations, Plastic Processing, and Advanced Manufacturing laboratories will be equipped in the following months.

The nanotechnology laboratory has equipment which allows material characterization to be performed. Material characterization is important because it helps define the mechanical characteristics of each material. A brief description of the equipment used is given in the following section.

1) **Infrared Spectrometer:** this device troubleshoots manufacturing problems, identifies product contaminants, confirms the quality of materials, and allows

for the study of advanced material properties.

2) **Raman Spectrometer:** this system is based around a high-performance microscope and is ideal for routine sample analysis, sample identification, and advanced analysis, such as chemical imaging. It has a near infrared 785 nm laser as an excitation source; the spectral range is from 95 to 3,200 cm^{-1}. Their peak resolution is < 10 cm^{-1}, average dispersion across spectral range and laser spot size of 10-micron spot size, when using 100x objective.
3) **Particle analyzer (Micrometrix®):** it is an instrument for characterizing Nano and microparticles in dispersions and solutions. It determines particle size, zeta potential and molecular mass. The range of temperature is from 0 to 90°C; the light source is a Laser/40mW, 658 nm; laser warm-up time is 6 min. the operation temperature is between 10 to 35°C.

In the 3D Design laboratory, it is possible design 3D parts, mechanisms, and machines, and it is also possible to perform numerical analyses on these designs Prototypes can be printed using the 3D printers. This laboratory is directly related to the technological areas of the CAI Center UPVM.

1) **Zspace® system:** this provides an immersive environment for users in many industries driven by the desire to create and visualize objects with immersive realism. The Zspace system includes a Zspace display: 24 inches HD LCD (180p7120HZ) with built-in tracking sensors, a stylus with 3-buttons and integrated LED, and polarized passive eyewear.
2) **ProtoMat®:** a printed circuit board prototyping machine. The ProtoMat includes software-controlled 2.5D milling and cutting or drilling of aluminum, brass, copper, and plastic, allowing for metal core PBC development. The maximum material size is 229 mm x 305 mm x 35/22 mm (9¨ x 12¨ x 1.4/1.9¨). This machine has a resolution of 0.5 µm (0.02mil), a repeatability of ±0.001 mm (±0.04 Mil), and a power supply 90-240V, 50-60Hz, 450W.
3) **CubeX Duo®:** a 3D printer. The largest build area available is 240 mm x 265 mm x 240 mm, and prints using PLA and ABS plastic with a resolution of 0.100 mm (0.004¨ / 100 microns).

The technological areas of the CAI Center UPVM are the advanced manufacturing and design of mechatronic systems; however, the CAI Center building houses some laboratories that are not directly related to these areas. Some of these laboratories are dedicated to basic science, like chemistry, physics, and mechanical vibrations. These laboratories are used by the students for basic courses, but may also be used to perform basic research by the cooperation projects.

The CAI Center UPVM also has nanotechnology, biotechnology, and thermo-fluid laboratories which enable some research. For example, the nanotechnology

laboratory can perform characterization of materials, which can be used in manufacturing projects because it has a particle analyzer for making particle measurements using digital imaging.

[Figure 1-18] Laboratories of the ESC.



A. Biotechnology laboratory



B. Thermo-fluids laboratory



C. Nanotechnology laboratory



D. 3D Design laboratory

The design of prosthetics is part of mechatronics system design. In the biotechnology laboratory, it is possible develop biocompatibility tests to examine a specific material used in prosthetics and to synthesize and characterize the biomaterials used in biomechanics projects.

In the next section, the system of company participation will be described.

2.2.4. Companies Participation System

Company participation in the CAI Centers progresses along the following steps:

1) First reunions between the HEI and SMEs mainly occur through industrial organizations or direct meetings. If both organizations are interested in developing a link, the next step is to sign a general agreement or memorandum of understanding (MOU).

2) The signing of the MOU is conducted in a legal department. This document specifies the services offered by the HEI. The main services of HEI and the SME obligations are described below.

- Main services of HEI:
  - Undergraduate courses
  - Special courses
  - Graduate courses
  - Project development with or without government funding
  - Professional residences

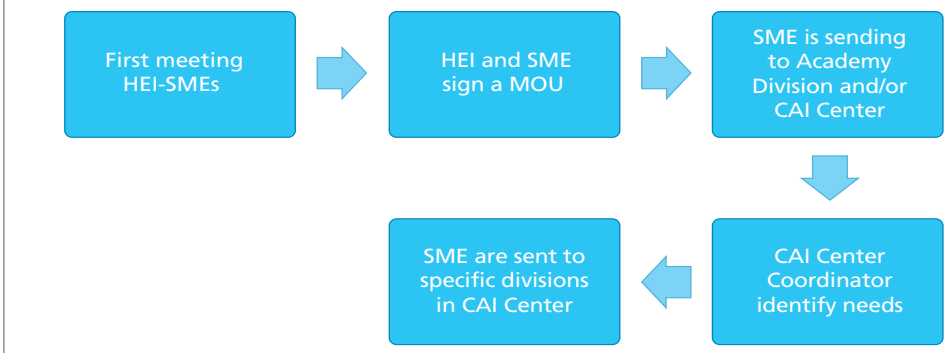
- Main obligations of SMEs
  - Receive industrial visits
  - Participate in special course definition and undergraduate course content
  - Sign documents related to project development

3) The SME is sent to the HEI linking department. In this area, the main needs of the SME are defined and must be satisfied by HEI. The SME can be oriented towards the Academic Department and/or the CAI Center (Technology Development Department).
4) When the SME is sent to CAI Center, the CAI Center Coordinator directly engages with the SME to identify specific technological needs. Other needs, like product marketing, services, administration, financial support, and specific certification, will also be examined.
5) As necessary, the CAI Center Coordinator will send the SME to the Administrative Division (AD), Division of Relations Academy-Industry (DRAI), and/or the Technical Services Division (TSD). In each division, the identified needs are attended to.

[Figure 1-19] illustrates this process. For each project, a specific MOU must be signed. The physical spaces for SMEs are allotted by taking the following conditions into account:

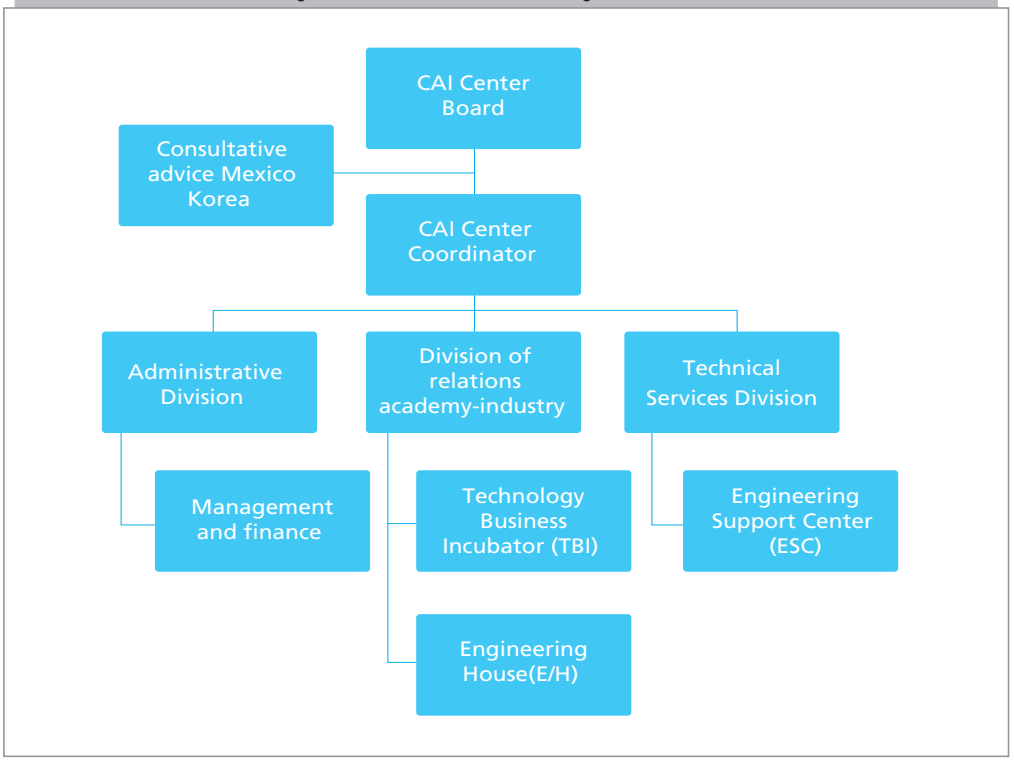
- The SME is a spin-off model
- The SME is a start-up model
- The SME is developing a project and requested the physical space

[Figure 1-19] The SME Participation System



Not all of the services in the CAI Center are related to technology development because most of the enterprises involved are SMEs, which are more inclined to need financial services and management support. For this reason, other areas in the CAI Center are specifically designed to attend to these needs. [Figure 1-20] shows the organization chart.

[Figure 1-20] The CAI Center Organization Chart



The main activities of some key positions are shown in [Figure 1-21].

[Figure 1-21] Personnel Key Activities

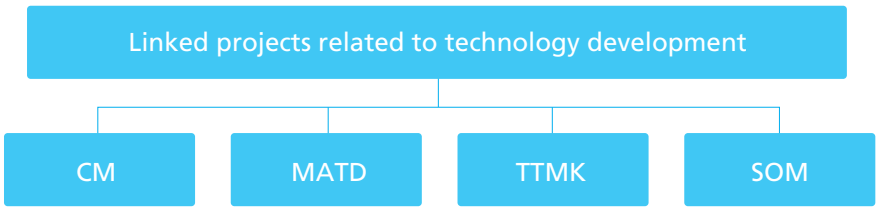
CAI Center Coordinator	- Administration and promotion of the TESCo CAI Center model - Definition, use and management of federal and estate funding resources - Main contact with customers and suppliers - Identify SMEs needs
Division Leader	- Distribution of human resources for project development - Technical validation of project development - Planning workshop and laboratories activities - Certification of areas and/or laboratories
Administrative project manager	- Responsible for administration of projects mainly oriented to external services, technical buying and MOU signing - Facilitate administrative processes - Coordination of human resources assigned to projects
Researcher of E/H, ESC and TBI member	- Development of technical proposal for projects and special services - Propose research projects with orientation to MATD - Execution of projects and services - Intellectual appropriation of technology

The CAI Centers have four linking programs for SME participation in technology development. These are:

- Classic model (CM)
- Market Analysis for Technology Development (MATD)
- Technology Transfer Mexico Korea (TTMK)
- Spin Off model (SOM)

These are shown in [Figure 1-22].

[Figure 1-22] Technology Models of the CAI Center



In the following section, each program is described, and its relationship with E/H, TBI, and ESC is defined.

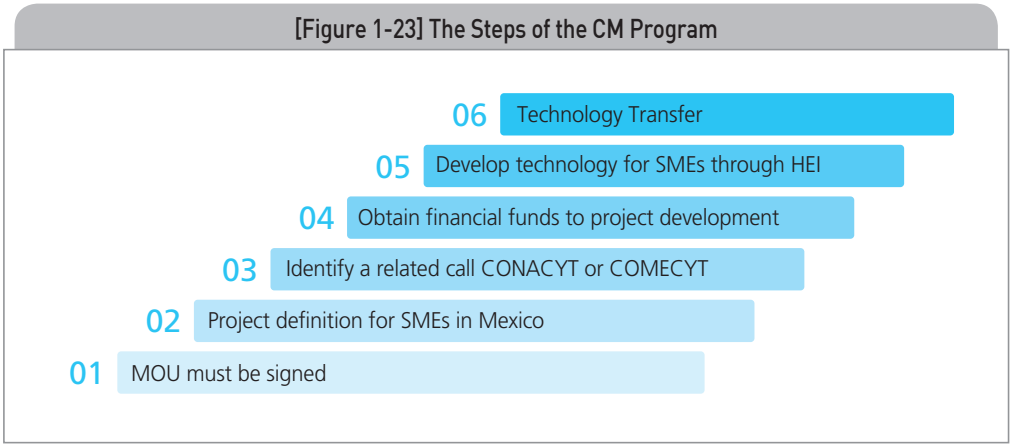
2.3. Operation of the Pilot CAI Center

2.3.1. Industry Academy Cooperation (IAC) Programs for E/H, TBI and ESC

In this section, the programs related to E/H, TBI and ESC are presented. The CM, TTMK and SOM are specific programs for technology transfer, technology development, and applied scientific research. The MATD program is common for every division in the CAI Center and is related to basic scientific research. This program will be presented at the end of the section.

The CM program is specifically developed to support technological development and applied research with financial funds provided by the Mexican government. These funds support 70% of the linked projects. The steps are shown below in [Figure 1-23].

[Figure 1-23] The Steps of the CM Program



This program is referred to as the Classic Model. Because it was launched in Mexico in 2009 and several projects have been executed since then using this program. Now, with the CAI Center, more researchers and students can be included in project development, and the collaborative net allows more attention to be given to technological areas. The description of the steps is given below:

1) The specific MOU must be signed.
2) The specific project is defined by the needs of the enterprise with help from E/H, TBI and ESC experts, resulting in a sketch of the proposed solution. This

sketched document is used to develop a proposal to determine who will participate in a specific government call. These calls are launched by the National Council of Science and Technology[2] (CONACYT) or by the State Council of Science and Technology[3] (COMECYT). The reference for the developed proposal is denoted by the standard NMX-GT-002-IMNC-2008. This document can be found on the web page of Mexican Institute for Normalization and Standardization[4] (IMNC). It is normal for these proposals to have a length between 25 and 50 pages.

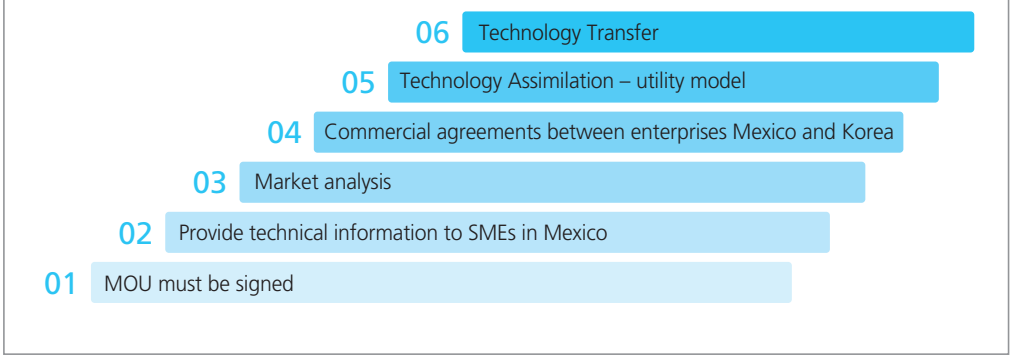
3) Once the proposal has been developed, and the amount of financial aid has been defined, the TBI team is responsible for monitoring a call related to a proposal. Different calls are open and closed in a year, which gives enterprises the chance to define a technological development strategy and do a projection of cash flow.
4) All proposals are evaluated by recognized researchers, most of whom are affiliated to National System of Researchers[5] (SNI by the acronym in Spanish), this organization depends on CONACYT. The researchers have the final decision on whether to give financial support to the proposal.
5) Once the funds are given to an enterprise, and the specific project is launched, an administrative project manager is assigned. Their main functions were described in the previous section.
6) In this kind of project, all technological development is mainly focused on E/H and ESC. All reports related to projects and technical information are transferred to SMEs. Also, specific training programs are executed to assure a complete understanding of technology.

The TTMK is a specific program designed to understand Korean technology and adapt it to Mexican SMEs. In this program, it is possible obtain financial funds from the Mexican government, but this income will only cover 40-50% of the entire project.

The main benefits of this program are related to the acquisition of previously validated and developed technology in order to build a pilot plant for assembly. The technology and industrial property that can be obtained for Mexican SMEs includes, but is not limited to patents, utility models, industrial designs, protection of software, and authors' rights. [Figure 1-24] shows the steps of this progress.

2) http://conacyt.gob.mx/
3) http://comecyt.edomex.gob.mx/
4) http://www.imnc.org.mx/
5) http://www.conacyt.gob.mx/index.php/el-conacyt/sistema-nacional-de-investigadores

[Figure 1-24] TTMK Steps Model



1) At the beginning, a specific MOU must be signed. This takes place between the CAI Center and a Korean enterprise. In the following steps, the CAI Center is responsible for signing additional MOUs with interested Mexican enterprises. Among other specifications, the MOU must protect the industrial property of the Korean enterprise and allow the CAI Center to divulgate the technology in specialized forums in Mexico.
2) The Korean enterprise must send enough technical information to be disseminated between Mexican enterprises. This information allows the TBI to conduct research to analyze the specific economic regions related to the proposed technology.
3) Once a Mexican SME is interested in the technology, the TBI helps define its commercial capabilities and develops market analysis to establish a base price. This is a complex process, and several international methodologies must be used.
4) The Korean enterprise and the Mexican SME must meet and discuss the price of the technology.
5) If an agreement is reached, a MOU between the Korean enterprise, Mexican SME, and CAI Center must be signed. At this point, the technology assimilation process begins. The CAI Center E/H and ESC researchers are responsible for this while the TBI is responsible for developing a proposal for participation in a government call for financial support for the pilot plant assembly and validation test.
6) All reports related to the project and technical information is transferred to the SME. Specific training programs are executed in order to ensure the complete understanding of the technology.

The SOM model is specifically designed to attend to the needs of students, teachers and entrepreneurs who are interested in developing a business idea related to technology. The benefits are listed below.

1) Students, teachers and entrepreneurs:

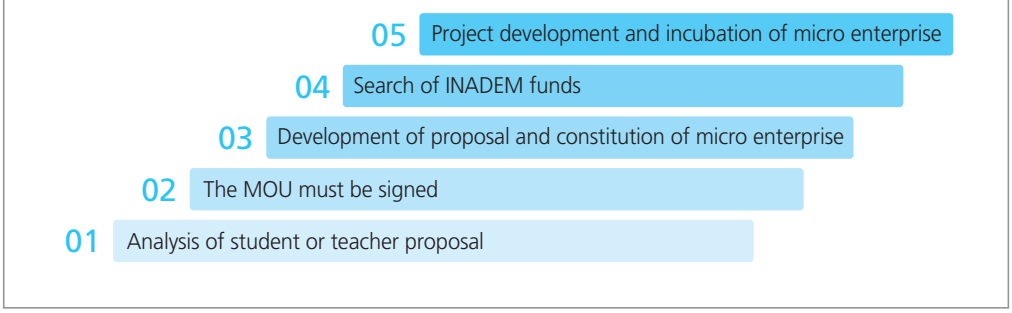
- Low cost to develop a project related to technology
- Expert advisory of E/H, TBI, and ESC researchers
- Advisory for the establishment and management of an enterprise from the AD
- Development of prototypes in the CAI Center facilities
- Government financial funds for project development

2) CAI Center:

- Economic participation in intellectual property
- Incubation of a technological base enterprise

[Figure 1-25] illustrates these steps.

[Figure 1-25] The SOM Step Model



1) The first step is to analytically identify the capability of an idea to produce economic benefits and specific technology.
2) A specific MOU must be signed. This document defines the basis for industrial property negotiation.
3) The TBI is responsible for developing the proposal such that it can participate in a government call and receive financial support. As a parallel process, the entrepreneur must constitute their micro enterprise. The advisory and support will be given by the AD.
4) In this case, the funds will come from the National Institute of Entrepreneur-

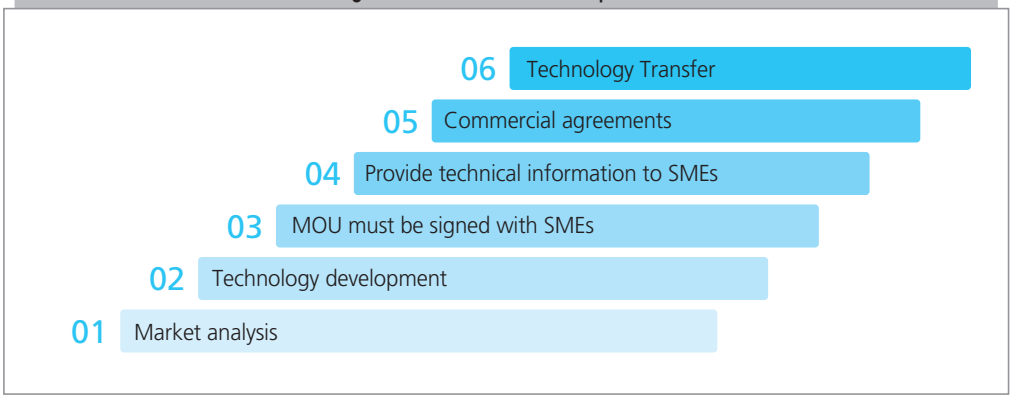
ship[6] (INADEM by its acronym in Spanish). Like a previous model, the proposal is evaluated by researchers.

5) The new micro enterprise is incubated inside of a CAI Center and will be trained and supported by three years.

The MATD model is specifically designed to develop technology through basic scientific research and the economic analysis of specific micro-macro regions or states. The main results of this model are meant to create industrial property for the CAI Center and develop scientific knowledge. This kind of technological development will be focused on startup models.

The principal customers for this model will be enterprises who are interested in the technology offered. [Figure 1-26] below shows these steps.

[Figure 1-26] The MATD Steps Model



1) The first step is to conduct market analysis in order to identify the technological needs of a specific region or state. Needs must be classified once they have been defined. This classification is developed by considering the capabilities to create new technology, time involved, economic capability to produce income, capability to produce patents, utility models, industrial designs, and more. This is primarily done by the TBI.
2) In the second step, basic scientific projects will be developed using the analysis as a reference. As in previous models, calls launched by CONACYT serve as the financial support for this development. It is important to mention that results are expected to be obtained in 3-5 years and are mainly focused on the acquisition of patents, utility models, high-impact publication in journals, books and manuals.
3) A specific MOU must be signed; this document protects the industrial property

6) https://www.inadem.gob.mx/

of the CAI Center to divulge the technology in specialized forums in Mexico.

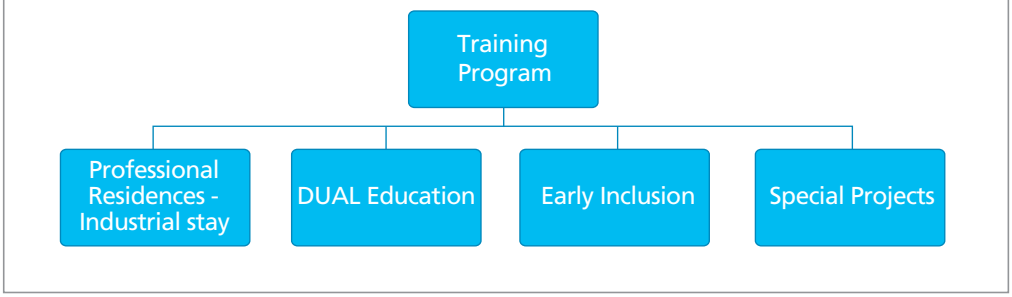
4) The CAI Center will provide interested SMEs with enough technical information for analysis.
5) If an agreement is reached, a MOU between a SME and the CAI Center must be signed. It is important to remember that the TBI is responsible for assigning a price to the technology developed.
6) All reports related to project and technical information are transferred to the SME and specific training programs are executed to ensure a complete understanding of technology.

In the next section, practical education programs are presented.

2.3.2. Practical Education through E/H, TBI and ESC

In this section, practical education programs are discussed in conjunction with the ways that E/H, TBI and ESC participate in practical education. [Figure 1-27] illustrates the training programs related to the CAI Center. A brief explanation of each one is presented below.

[Figure 1-27] Training Models



2.3.2.1. Professional Residences – Industrial Stay

Each HEI has a program that is related to the participation of students in enterprises. The differences between these are:

1) **Industrial Stays:** These give students time to practice their academic knowledge of the industry they are interested in. Industrial stays are performed in two stages: after the first year of study, and after the second. These stays have a duration of 120 hours and are performed over 4 months.[7)]

7) http://upvm.edomex.gob.mx/alumnos/estancias-estadia

2) **Professional residencies:** Professional residencies are similar to industrial stays. However, professional residencies are performed at the end of one's academic study. These have a duration of 600 hours and are performed over 6 months.[8)]

2.3.2.2. Dual Education

The dual education model establishes vocational training both at school and in an enterprise. The learning process in the enterprise alternates and complements the theoretical training from the University. The student devotes four days a week to the enterprise and one day at school.

2.3.2.3. Early Inclusion

In this model, enterprises request students with specific knowledge about a topic, and students develop their skills through a specific project with one such enterprise.

2.3.2.4. Special Projects

Experience related to technology development is considered to be of special importance for students who want to be involved in this field. Therefore, students who want to practice and learn should be able to conduct such a project. This model is more common at the postgraduate level.

Thanks to this CAI Center model, it is easier include students to specific projects, and depending of their interest they may do an industrial stay, professional residency, dual education, early inclusion, or a special project.

Considering their profile and interest, students may assist in the E/H, TBI, or ESC. [Figure 1-28] gives a macro view of how students are included.

The main function of researchers is to define a project involving technology development and to assign specific functions to students. This work can be used as a means for graduation or to increase the knowledge of interested students.

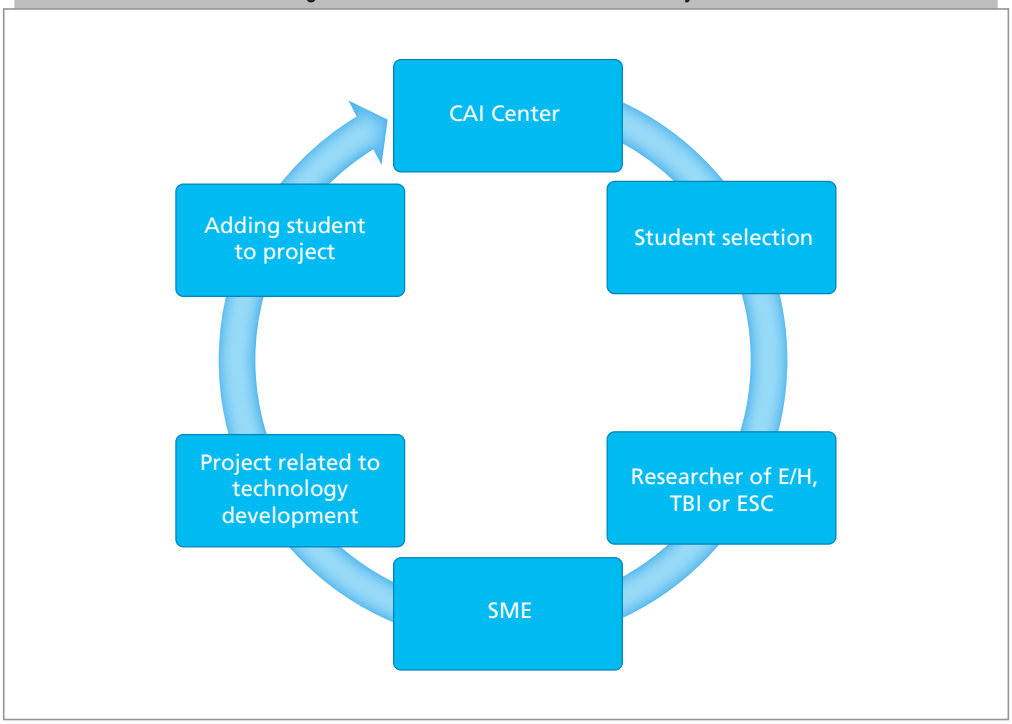
The main benefits of this process areas follow:

- To promote initiative in students
- To guarantee that a student is developing a project as per their specific knowledge area
- To provide interaction between theoretical and practical knowledge

8) http://www.tesco.edu.mx/gem/HTM/ALUMNOS/residencia-profesional.html

- The possibility of attaining graduation or release credits (Professional residences – Industrial stay)

[Figure 1-28] Inclusion of Students to Projects



In next section, the CAI Center current achievements are shown.

2.3.3. Achievements of the CAI Center

In <Table 1-3>, the key performance indicators are shown. This table shows the two main guidelines for all activities related to the CAI Center: technology development and practical education.

All CAI Centers function as one. In this way, the diversity of projects that can be conducted is increased. The infrastructure and equipment can be used by any researcher who is in the CAI Center, and the machinery and equipment fees are solely used for maintenance and expendables.

〈Table 1-3〉 Key Performance Indicators (KPI) of the CAI Center

No.	Key Performance Indicators for CAI Centers
1	Number of projects submitted or developed thanks to financial support given by federal and state funds related to technological development
2	Number of technological services provided by the CAI Center
3	Number of undergraduates who graduated thanks to projects developed in the CAI Center
4	Number of documents related to scientific and technological production
5	Number of SMEs using the facilities in CAI Center
6	Number of technology transfer from CAI Center to SMEs
7	Number of SMEs created with the TBI
8	Number of joint projects between Korea and Mexico

Main results for each Pilot CAI Center (TESCo and UPVM) are show below:

2.3.3.1. TESCo

〈Table 1-4〉 The Prospective and Current Results of the TESCo CAI Center

No.	Achievement at November 2016	Expected results at August 2017
1	- Two projects submitted to calls	- Ten projects submitted to calls - Five projects supported
2	- Two quotations solicited	- Four projects in process
3	- Three students finished their professional residences - Two students graduated with a BSc in Mechatronics - Three students of Control and Automation Specialty in process of thesis development	- Four students in projects - Two graduated students
4	- MATD model in process	- Two patents solicited
5	- Two SMEs in facilities	- Four SMEs in facilities
6	- CM, TTMK and SOM model in process	- Two technology transfers
7	- SOM model in process	- SOM model in process
8	- TTMK model in process	- One technology transfer from Korea to Mexico

2.3.3.2. UPVM

1) **Case 1:** A case of success is the enterprise "America Solar SA de CV" which attained financial support from state funds for a value of $14,300.00 US. This enterprise has currently signed an agreement with the CAI for collaboration in the E/H for the design of an electronic circuit and a heat dissipater for an LED light. This Enterprise will implement a pilot plant to produce the light in the production area of the CAI.
2) **Case 2:** Another achievement of the same project is that four students—three researchers and one staff member—will perform their industrial stays at this enterprise.

2.4. Government Plan and Policy for Supporting and Expanding the CAI Center

2.4.1. National Plan of Development for Mexico 2013-2018

In Mexico, every time a new government is in charge, a new National Plan of Development[9] (PND) document must be developed. Its main function is to provide a guideline for policy and government programs.

In the case of the current government (2013-2018), there are five macro objectives. These are:

1) Mexico in peace
2) Inclusive Mexico
3) Mexico with quality education
4) Prosperous Mexico
5) Mexico with global responsibility

The objective most closely related to CAI Centers is "Mexico with quality education," which has two subsections, the diagnosis phase and the action plan.

Inside of the action plan, there is a special objective related to science and technology – "Make scientific, technological and innovation development pillars for sustainable economic and social progress." – identified with the objective 3.5.

The strategies for this objective are as follows:

- 3.5.1. Contribute to national investment in scientific research and technological

9) Plan Nacional de Desarrollo 2013 – 2018, Gobierno de México 2013 - 2018, recuperado de abril de 2015, http://pnd.gob.mx/

development with the aim of composing 1% of the Gross Domestic Product (GDP).

- 3.5.2. Contribute to the formation and strengthening of high-quality human resources.
- 3.5.3. Promote the development of the talents of scientists, engineers, and inventors to strengthen sustainable and inclusive regional development capabilities.
- 3.5.4. Contribute to use and transfer of knowledge, promoting a link between higher education institutions and research centers with public, social and private sectors.
- 3.5.5. Contribute to the strengthening of scientific and technological infrastructure.

These strategies are used to develop specific documents for other government agencies.

Three specific government agencies are related to the CAI Centers: CONACYT, the National Technologic of Mexico (TecNM), and the General Coordination of Technological and Polytechnic Universities.

CONACYT is involved with all science and technology activities in Mexico, TecNM is the regulatory body of the Technologic of Higher Education, and the General Coordination of Technological and Polytechnic Universities is the regulatory body of Technological and Polytechnic Universities.

2.4.2. Special Program of Science Technology and Innovation 2014-2018 CONACYT

This document has four chapters identified in the following way:

- Chapter 1. Diagnosis
- Chapter 2. Relation with PND 2013-2018
- Chapter 3. Objectives, strategies and action lines
- Chapter 4. Indicators

Chapter 3, it can be noted that objective 1 is the same as the 3.5.1 strategy previously named. This section includes defined strategies, most related to the CAI Centers, as described below.

- Strategy 1.1. Increase inversion in science technology and innovation in a sustainable way.

- 1.1.1. Create new stimuli and strengthen the promotion of financial funds for enterprises related to scientific research and experimental development.
- 1.1.2. Create new stimuli and strengthen the increase of spending for science, technology and innovation of the various states, with special consideration for their differences.
- 1.1.3. Create new stimuli and increase the government's spending on science, technology and innovation.
- 1.1.4. Increase the spending in science, technology and innovation related to IHE and Research Centers (RC).

- Strategy 1.2. Link public, social and private sectors in their investment in science, technology and innovation.

  - 1.2.1. Financial support should be given to scientific research, technology development and innovation using resources from public, social and private sectors.

The other objectives are partially related to CAI Center; these are named below.

- Objective 2. Contribute to the training and strengthening of high-quality human resources.
- Objective 3. Promote the development of specific technological areas related to local science, technology and innovation capabilities in order to strengthen sustainable and inclusive regional development.
- Objective 4. Promote the creation of technology, technology transfer and the use of technology developed by HEI to enterprises.
- Objective 5. Strengthening scientific and technological infrastructure in Mexico.

In the next section, this report will present the objectives and strategies of TecNM.

2.4.3. Institutional Program of Development and Innovation 2013-2018 TecNIM

This document has four chapters identified in the following way:
- Chapter 1. Diagnosis
- Chapter 2. Relation with PND 2013-2018
- Chapter 3. Objectives, strategies and action lines
- Chapter 4. Indicators

Chapter 3 includes objective four, the promotion of science, technology, and innovation. The defined strategies most closely related to the CAI Centers are:

- Strategy 4.1. Promote the development of scientific and technological capabilities in the productive vocation of the regions.
- Strategy 4.2. Promote the training of highly specialized human resources in research and technological development.
- Strategy 4.3. Promote the increase of the products of scientific research, technological development and innovation.
- Strategy 4.4. Strengthen the infrastructure oriented to scientific, technological and innovation activity.

In addition, objective five, the strengthening of links with the public, social and private sectors, is composed of the following strategies which are related to the CAI Centers:

- Strategy 5.1. Strengthen institutional linkage schemes.
- Strategy 5.2. Encourage management and the commercialization of intellectual property.
- Strategy 5.3. Promote the transfer of knowledge and technological development to enterprises.
- Strategy 5.4. Develop entrepreneurial talent and entrepreneurship with a technological basis.
- Strategy 5.5. Establish institutional mechanisms to facilitate the incorporation of students and graduates into the labor market.

2.4.4. Industrial Development Program 2013-2018 General Coordination of the Technological and Polytechnic Universities (Polytechnic Universities Subsystem)

The Institutional Development Program 2013-2018 of the General Coordination of the Technological and Polytechnic Universities (UTyP) establish the bases necessary for the Federal Government coordinates planning activities, between the entities of the national public administration and the federative entities. This program is applied to the Polytechnics Universities in Mexico.

This document is formed by four chapters, the names of which are as follows:

- Chapter 1. Alignment to the National Development Plan
- Chapter 2. Diagnosis
- Chapter 3. Aims, strategies and action lines
- Chapter 4. Indicators

Chapter 1 describes the contents of the National Development Plan 2013-2018 and the Sector Education Program 2013-2018 in order to identify the Federal

Government Policies related to the aims and mission of the Polytechnic Universities Subsystem.

Chapter II establishes the status of the Polytechnic Universities and makes comparisons with past years.

Chapter III details the aims, strategies and action lines of the Institutional Development Program 2013-2018 of the Polytechnic Universities System. Similar to the Sector Education Program, this chapter includes the conceptualization of 15 working lines and the achievements, goals, and indicators expected in the following years.

Chapter IV explains the 83 indicators used by the Polytechnic Universities Subsystem for the 15 work lines.

This next section elucidates some of the work lines, aims and strategies related to the CAI Center from Chapter III of the Institutional Development Program 2013–2018 of the UTyP.

2.4.4.1. Expansion and Improvement of the Infrastructure and Equipment of Higer Education

- **Aim**: To obtain new facilities and equipment of workshops and laboratories that utilize new technologies to ensure the quality and relevance of education provided in the Polytechnic Universities.
- **Strategies:**
  - Promote the realization of agreements with the productive sector so that students can use the facilities of enterprises.
  - Design funding schemes that involve the participation of different levels of government.

2.4.4.2. Strengthening the Relevance of Higher Education to Respond the Country's Requirements

- **Aim**: Provide high-quality technological education services through updated curricula and programs relevant to the labor sector.
- **Strategies:**
  - Maintain the relevance of educational programs in accordance with the needs of the public, private and social sectors.
  - Strengthen the flexibility of the educational model used by the Polytechnic Universities Subsystem.

2.4.4.3. New Cooperation Models for the Internationalization of Higher Education

- **Aim**: Establish links and bilateral cooperation with foreign institutions to gain experiences and best practices in the field of internalization. Promote student and teacher mobility and the creation of collaborative academic networks.
- **Strategies:**
  - Encourage the creation of collaborative networks in various areas of knowledge with institutions which are experts in the field.
  - Create permanent student and teacher mobility programs.

2.4.4.4. Postgraduate in Polytechnic Universities

- **Aim**: Meet the demand of graduates from Polytechnic Universities that are looking to consolidate their academic education through postgraduate studies, and to increase the rate of research and innovation training among business professionals.
- **Strategies:**
  - Develop a diagnosis of regional needs in the context of long-term institutional planning.
  - Develop quality programs at the postgraduate level, taking into account the performance criteria and availability of resources, and based on the requirements of the national program of postgraduate quality (CONACYT).
  - Promote innovate postgraduate programs whose projects respond to the needs of the productive sector.

2.4.4.5. Promotion of Scientific and Technological Research and Promotion of the Generation and Dissemination of Knowledge

- **Aim**: Establish the substantive function of research, encouraging the application of innovative lines linked with the educational programs of the university and giving priority to technology transfer oriented towards solving problems with regional and national impact.
- **Strategies:**
  - Increase the level of qualification of full-time researchers and manage the organizational structures that respond to the needs and levels of development of Polytechnic Universities.
  - Strengthen the links with the productive and social sector of the region, as well as research centers.
  - Strengthen the quality and quantity of the academic production of researchers and academic bodies.

2.4.4.6. Democratize the Productivity, Linkage, Employability, Entrepreneurship and National System of Labor Competencies

- **Aim**: Deepening the link with productive sectors and encouraging the permanent revision of the educational offered in such a way that the relevance of academic programs ensures the employability of graduates.
- **Strategies:**
  - Generalize the creation of institutional linking bodies and improve the mechanisms of interaction with enterprises.
  - Create spaces for the participation of entrepreneurs in the fundamental decisions of universities
  - Consolidate and expand the incubator network of the subsystem by refining its methodology and diversifying its services.

2.4.4. Policy, Law and Strategic Vision for CAI Center

As mentioned in the previous points, all government entities use the PND to develop policies, plans, work access, laws and strategies. CONACYT, TecNM and the General Coordination of Technological and Polytechnic Universities are the closest related government bodies to CAI Centers because they provide policies about science, technology, innovation and education to HEI.

The CAI Centers are related to all objectives and strategies mentioned before. From a macro perspective, the CAI Centers provide strengthening to strategies 3.5.1, 3.5.2, 3.5.3, 3.5.4, and 3.5.5 mentioned in the PND.

Each HEI must develop the Institutional Program of Innovation and Development (PIID) considering the objectives and strategies named by TecNM. In this document, numeric values for indicators and conditions which are specific to each HEI are defined.

CAI Centers will receive financial support from specific calls like Mix-funds CONACYT and COMECYT, and will participate in other calls such as basic scientific research, national laboratories, and national problems.

To improve continuity to CAI Centers, the following policies have been proposed.

1) Improve the capability to use specific financial income related to projects of technological development, basic scientific research and applied scientific research.
2) Have a specific financial fund to support projects of technological development, basic scientific research, and apply this to projects that are developed in CAI

Centers.
3) HEI will give administrative and financial support for all activities related to CAI Centers.

The strategy for the development of CAI Centers is focused in two areas: technological project development, and the formation of programs.

The strategy of the first area is oriented toward the development of SMEs and entrepreneurship using government funds that give support to projects related to technology through CONACYT, COMECYT, INADEM, among others. The promotion of Korean technology that has been validated in order to solve specific needs is also integral to this strategy.

In the second area, the main strategy is to develop the specialized capacitation necessary to satisfy the needs of enterprises and promote entrepreneurship in young students.

The following steps detail the principal actions to be taken:

1) Applied research into the development of product and process concepts aimed at improvement or optimization
2) Continuous and accessible innovation for all companies
3) Support for the introduction of new products, the development of technological business plans, marketing, and technology transfer
4) Development of new technology to be offered to SMEs or serve as the basis for technological entrepreneurs
5) Capacitation of specialized engineers in fields that require SMEs
6) Laboratory services and experimental validation

Through this action, CAI Centers will be institutes for improved competitiveness and productivity in Mexico.

In the following section, the status of the expanded CAI Centers is shown.

2.5. Analysis of the Environment of the Expanding CAI Centers

2.5.1. Industrial and Economic Surrounding for each Expanded CAI Center

In this section, the economic surrounding of each CAI Center proposed for expansion will be shown.

2.5.1.1. Democratize the Productivity, Linkage, Employability, Entrepreneurship and National System of Labor Competencies

2.5.1.1. TESE

According to data gathered in 2010 by the National Institute of Statistics and Geography (INEGI), the municipality of Ecatepec de Morelos has a total population of 1,656,107 citizens, or in other words, 10,385.72 citizens per square kilometer. This municipality has the largest number of citizens in the State of Mexico.

INEGI mentioned that in the month of April 2013, 49.4 million people had a computer, and of these, 46.0 million used the Internet. This means that only 3% of the people of Ecatepec have a computer.

All study levels require the usage of a computer and Information and Communication Technologies (ICT), as can be seen in <Tables 1-5> and <Tables 1-6>.

〈Table 1-5〉 Enrollment of Students in ICT

Bachelor degree	2008/2009	2009/2010	2010/2011	2011/2012
Total	215,092	225,611	219,566	222,408
Informatic bachelor's degree	66,464	64,110	50,886	43,174
Informatic Engineering	3,381	3,650	7,295	11,178
Computer System Engineering	78,957	84,219	83,196	84,359
Computer Science Engineering	19,522	19,875	19,045	19,007
Computer Science bachelor's degree	4,291	4057	4074	4,098
Administration System Engineering	N/A	N/A	N/A	N/A
Application Mathematics and computer bachelor's degree	1,342	1,365	1,367	1,444
Control and computing Engineering	410	490	349	306
Automatization and Control Engineering	1,508	1,594	1,801	2,012
Information systems Engineering	4,813	8,269	14,237	17,808
Telematic Engineering	2,450	2,781	3,079	3,252
Discrete processes automatics Engineering: Industrial robotics	1,406	1,542	1,723	1,920
Electronics on Computing Engineering	2,956	3,270	3,328	4,008
Other Informatic bachelor's degrees	13,017	17,055	17,312	18,978

Note: Enrollment of students in Information Technologies and communications by career, 2000/2001 - 2011/2012.
Source: INEGI with ANUIES data.

〈Table 1-6〉 Post-degree Students in ICT

Post degree	2008/2009	2009/2010	2010/2011	2011/2012
Total	4,970	5,315	5,134	6,535
Automatization Computing Engineering	N/A	N/A	N/A	N/A
Telecommunications Administration	41	34	11	3
Information Systems Administration	69	46	45	104
Information Technologies Administration	259	328	313	355
Informatic Administration	3	15	8	64
Automation (Intelligent Systems)	29	72	91	84
Systems Automatization	N/A	N/A	N/A	N/A
Engineering Automatization	44	57	72	77
Control and Automatization	79	35	22	59
Computer Science	523	630	678	831
Computer Science and Industrial Materials	19	19	21	39
Science and Computer Engineering	93	76	81	75
Science: Instrumentation and Automatic Control	N/A	N/A	45	N/A
E-Commerce	3	16	27	59
Automatic Control	N/A	N/A	N/A	N/A
Computing	200	251	189	191
Applied computing	15	54	64	36
Computing and Information Systems	N/A	N/A	N/A	N/A
Computers in Education	N/A	N/A	N/A	N/A
Electronic and Computing	11	N/A	N/A	27
Electronic and Telecommunications	41	51	40	50
Informatic	65	66	71	86
Administrative Informatic	4	ND	ND	7
Applied Informatic	71	67	53	51
Medic Informatic	N/A	N/A	N/A	N/A
Informatic and Technology	24	21	10	13
Educational informatics	N/A	N/A	N/A	N/A
Electronic Systems and Computing Engineering	51	92	61	67

Note: Masters enrollment students in Technology Information and communications programs 2008/2013.
Source: INEGI with ANUIES data.

The INEGI shows that the State of Mexico has the largest number of enterprises, industries, and establishments with specific ICT needs, as is shown in <Table 1-7>.

〈Table 1-7〉 Industries using ICT

Federal Entity	Total	Use computer systems in their administrative process		Use the Internet in their consumer's relationship management		Use Computer equipment's in technic process design		Develop computer information programs or systems to improve their process	
		Yes	No	Yes	No	Yes	No	Yes	No
Federal District	342,475	56,238	286,237	41,509	300,966	29,869	312,606	19,805	322,670
Hidalgo	62,612	5,277	57,335	3,123	59,489	2,598	60,014	1,936	60,676
Mexico	364,921	25,226	339,695	16,757	348,164	13,533	351,338	9,607	355,314
Morelos	63,636	5,388	58,293	3,669	60,017	2,727	60,959	1,911	61,775
Puebla	165,237	14,109	151,128	8,733	156,504	7,097	158,140	5,084	160,153
Queretaro	42,524	7,971	34,553	5,299	37,225	3,856	38,668	2,718	39,806
Tlaxcala	38,315	2,292	36,023	1,362	36,953	1,209	37,106	834	37,481

Note: Industries that use technologies of the information in their processes and relationships with those customers, by federal Entity, 2008.
Source: INEGI Data.

Previous information provides sufficient evidence to establish which regions in the State of Mexico require specialists in ICT area who will oversee, organize, and protect information; specific applications will also be developed that will analyze large amount of information for use as a guide to improve competitiveness.

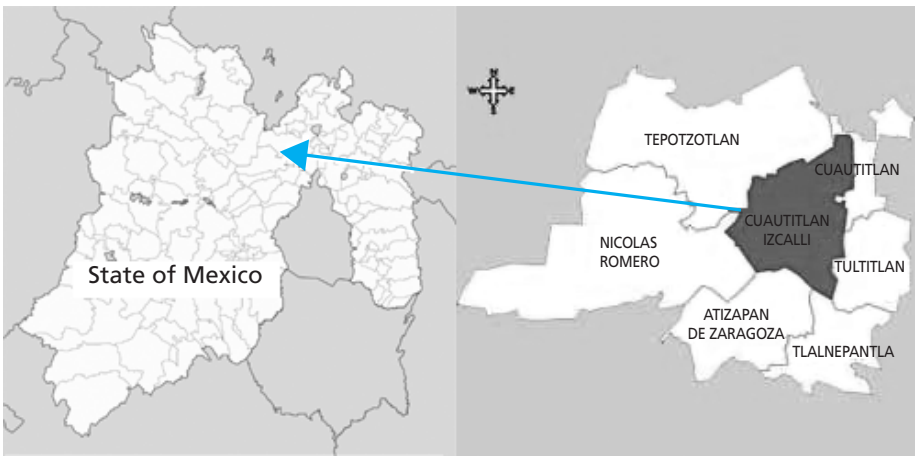
The key ICT areas in which SMEs in the region required professional services are:

- Software Development
- Mobile Applications Development
- Internet of Things (IoT)
- Information Security
- Ethical hacking
- Networks and Systems Security
- Data Science
- Big Data
- Data Mining

2.5.1.1.2. TESCI

Cuautitlán Izcalli is located in the northwest area of the Metropolitan Zone. Its territorial extension is 109.924km²; in the north, it is surrounded by the towns of Tepotzotlan, Cuautitlan and Teoloyucan; in the east, by Cuautitlan and Tultitlan; in the south, by Tlalnepantla de Baz and Atizapan; and in the west, by Nicolas Romero and Tepotzotlan. [Figure 1-29] shows the geographical location of the State of Mexico.

[Figure 1-29] Cuautitlan Izcalli Township



In Cuautitlan Izcalli, there are six industrial parks with 1337 enterprises, the names of which are given below:

1) Industrial Park of Cuamatla
2) Industrial Condominium Cuamatla
3) Industrial Park La Luz
4) Industrial Park La Joya
5) Industrial Park Cuautitlan
6) Industrial Park Xhala

To guarantee the quality of TESCI student education, several accreditations have been given by the following bodies: the Accreditation Council for Teaching in Engineering (CACEI), the National Council of Accreditation in Informatics and Computation (CONAIC) and the Accreditation Council for Teaching Accountancy and Administration (CACECA). All of these accreditations support the quality teaching

provided to 5,612 students.These accreditations and certifications have positioned TESCI as one of the HEI most recognized in the area, as shown in <Table 1-8>.

〈Table 1-8〉 Accreditation Assignment

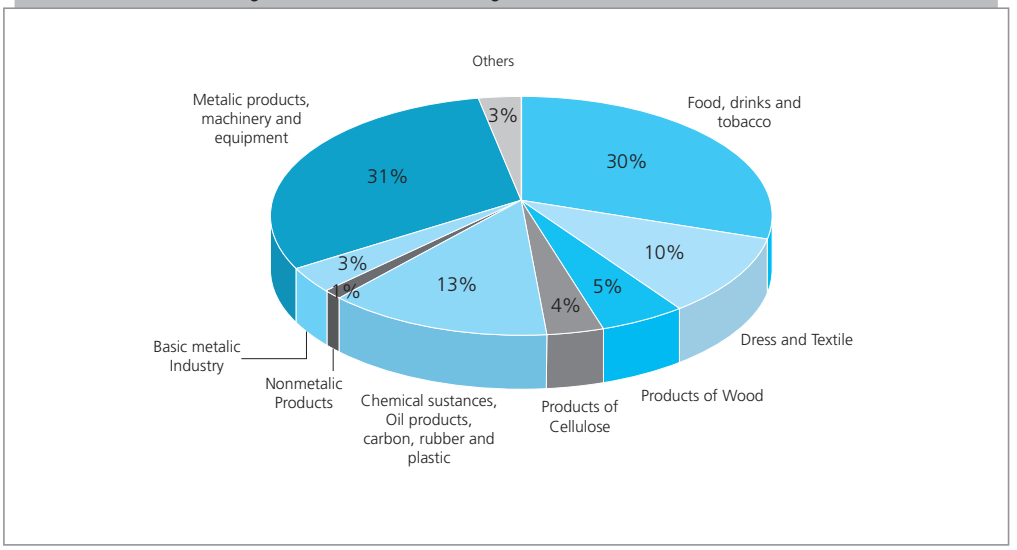
Career	Students	Accrediting Agency
Industrial Engineering	1,193	CACEI
Computer Engineering	426	CONAIC
Systems Engineering	992	CONAIC
Public Accountant	563	CACECA
Electronic Engineering	437	CACEI
Business Management Engineering	642	CACEI
Logistic Engineering	757	CACEI
Administration	602	CACEI

Source: TESCI.

To attend to several academic research and industrial needs, TESCI has four academic groups and 32 post-degree professors from several areas of knowledge.

The GDP in Cuautitlán Izcalli in 2014 was 313,669,540 USD, and it is considered to have the most important manufacturing products industry in Mexico. The distribution is shown in [Figure 1-30].

[Figure 1-30] Manufacturing Products in Cuautitlan Izcalli



Source: National Institute of Statistics and Geography (INEGI), 2014.

<Table 1-9> shows the industrial associations in Cuautitlan Izcalli and their representatives.

〈Table 1-9〉 Industrial Association

Industrial Association	Representative
Association of Colonists, Industrial Park La Luz, A.C.	C.P. Raúl Rodríguez Méndez
Association of Businessmen of Valley Mexico, A.C.	Ing. Nicolás Urbiola González
Industrial Center of Northwest of Mexico Valley´s M. S.P. COPARMEX	Lic. José Munive Torres Limón
National Chamber of Restaurant Industry and flavored food.	C. José Peza Fragoso
Association of Industrial of State of Mexico, A.C	Lic. Patricia Montes De Oca.
National Chamber of the Transformation Industry of State of Mexico, CANACINTRA.	Lic. Fausto Martínez Camarena
Association of Industries and/or Owners of Cuamatla, A.C.	Lic. Ernesto Mendoza Mendoza
National Association of Colonies and Merchants of Industrial Park Sta. Ma. Guadalupe de las Torres	C. Francisco Herrera A.
Chamber of Small Merchants of State of Mexico, A.C.	C. Javier Yañez G.

Source: TESCI.

2.5.2. IAC program for each university

2.5.2.1. TESE

TESE has already instituted several programs related to connecting academic activities with the industrial sector in order to allow students to be involved in industrial projects based on the academic programs in which students are registered. At the same time, these programs allow companies to get a variety of services at low prices that help them to achieve goals in the fields of technology projects and business perspectives. These programs are as follows:

1) **Academic Dual Education System:** This program allows students to start their careers in a company by participating in projects. Students are evaluated by the company's staff as well as academic professors. This program is one of the linkage activities that offer service solutions to the industrial sector.
2) **Professional Residences or Internships:** This program helps companies to create and implement projects with one or more students involved in every project as well as professors as advisors who help students understand requirements and the scope of the projects. Companies get benefits through academic collaboration and students get experiences in the sector and in projects aimed

at solving specific market, social or industrial problems.

3) **Research collaboration program:** This program offers the industry sector a collaboration agreement for the development of scientific or applied research, as well as technology development, in order to solve industrial or service sector problems and find solutions for those specific issues.

There is also a department in charge of promoting industrial projects that creates collaboration agreements with companies in all industrial areas. This department is called the Technology Management Department in TESE. This department seeks to strengthen outreach activities with the industrial and business sector through the formation of human capabilities, infrastructure, and the development of technology and technology development models, based on the guidelines of TecNM and TESE.

2.5.2.2. TESCI

TESCI has an area of 144,000m^2. TESCI infrastructure is composed of six buildings that each cover a certain career, one unit for graduate and e-learning, one unit for linking, one unit for the computing center, one unit for laboratories, and one unit for an information center. TESCI will initially allot 680m^2 for the CAI Center, as shown in <Table 2-10>, which illustrates the surface distribution for each department in the whole campus.

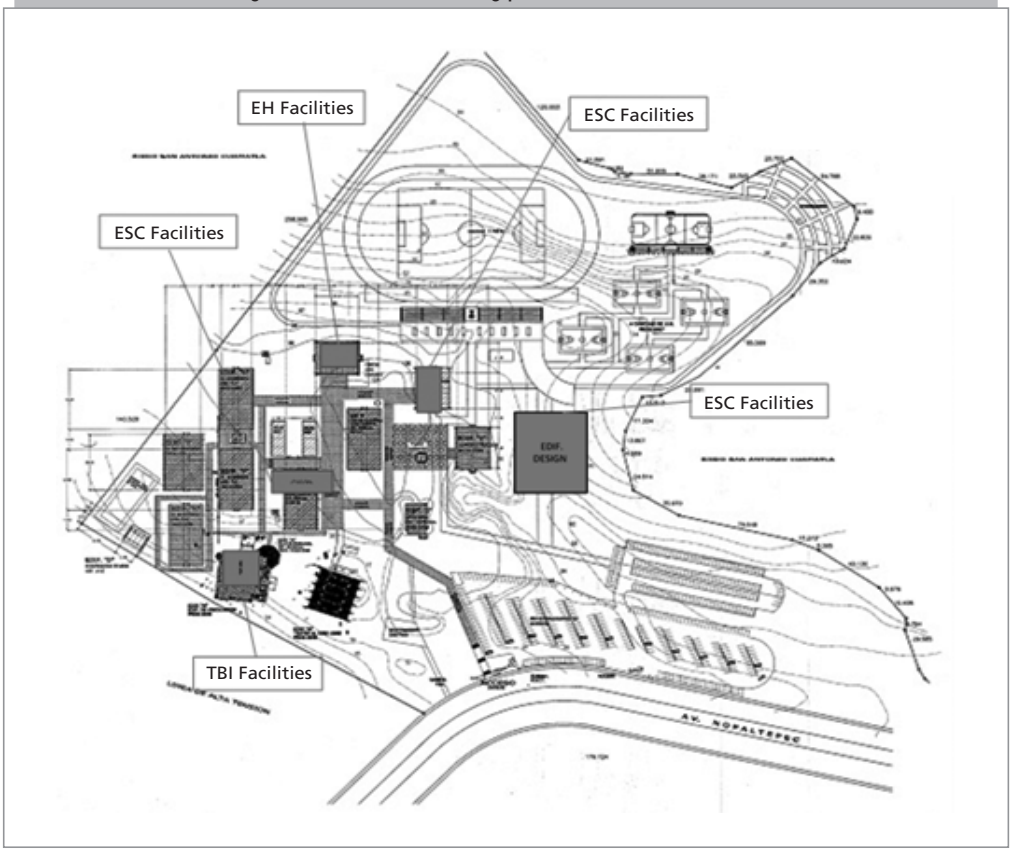
〈Table 1-10〉 Surface Distribution for each Department

Deparment	Facilities	Surface
Engineering House (E/H)	Second floor of Information Center	125m^2
Engineering Support Center (ESC)	CISCO Area (first floor on A Building)	122m^2
	Second floor of Major and e-learning Unit	
	Manufacturing Workshop	
Technological Base Incubator (TBI)	Second Floor of Linking Building	433.75m^2

Source: TESCI.

[Figure 1-31] shows the layout for the CAI Center at TESCI, including the TBI, ESC, and EH areas. TESCI does not currently have any plans for a new building because there is not enough space for one in the area.

[Figure 1-31] Manufacturing products in Cuautitlan Izcalli



Source: TESCI.

The technological area of TESCI is ICT, and the working lines are as follow:

- Advanced micro-processors
- Artificial intelligence and robotics
- Implementing robotics in manufacturing
- Mobile applications
- Computing using the cloud
- Distributed systems
- E-commerce
- Web Informatics solutions

TESCI also has a Laboratory of Virtual Instrumentation, which has the following equipment:

- Data Acquisition Cards
- Interface Modules

- NI ELVIS equipment
- 20 computers
- A projector

Students from TESCI can participate in CAI Center projects in either the dual education system or social service and internships.

2.5.3. Requirements for stabilizing each expanded CAI Center in universities

2.5.3.1. Ecatepec Technology Institute – TESE

As stated before, TESE participates in project development for businesses and companies that are involved in current programs such as the academic dual education system, professional residence and research collaboration, or as advisors and consultants. To broaden their horizons with solid development and growth, it is necessary to invest into infrastructure and equipment in order to expand and create new laboratories as well as facilities. Another key objective will be the promotion of the technology catalog.

TESE already has experience in information technology projects and communication with companies in the region. Using the methodology transferred from TESCo, technology development projects are hoped to multiply for the benefit of the companies in the region. In addition, including students in projects related to innovation and technological development will improve their competitiveness.

The current CAI Center TESE installations are shown in [Figure 1-32]. The assigned areas are temporary, but this center meets the demand for the development of technological innovation.

[Figure 1-33] shows the computer equipment focused on development and innovation technology for mobile devices and software development.

[Figure 1-34] shows the 180m^2 of facilities, which include cubicles with internet access, computer equipment, and office spaces where entrepreneurs can shape their projects to undertake and develop their businesses.

[Figure 1-32] Current TESE CAI Center



[Figure 1-33] Engineering Support Center (ESC)



Technological area: **Information and Communications Technology (ICT)**

[Figure 1-34] TESE Current Facilities



The E/H has been designed for a space of 400m^2 and will be prefabricated for purpose of developing technological projects. Companies developing of technology-based joint projects will be hosted in this space. [Figure 1-35] shows the status of the new area for the TESE CAI Center.

[Figure 1-35] Construction Zone for CAI Center TESE



2.5.3.2. TESCI

For reaching goals, it is necessary to determine which CAI Center will be supplied with infrastructure and resources trough policies developed by TESCI. It is also important that researchers and professors have training related to developing projects in accordance with the scheme of the CAI Center and have knowledge about getting funding.

Other politics that should be implemented at TESCI as soon as possible for the development of the CAI Center are:

- Human resources training
- Meetings with representatives of enterprises
- Participation in different calls for financial support
- Including students in technology development projects

3. LINC of Ministry of Education in Korea for Promoting IAC

3.1. Outline of the LINC Projects

In the beginning of the LINC project, local universities in Korea faced many problems. As the employment rate of young people declined due to the financial crisis, the employment rate of local university graduates was lower than those in the metropolitan area, and because the economy and employment were concentrated in metropolitan areas, students at local universities were trying to transfer to metropolitan areas for high-quality jobs or simply to get a job at all.

In addition, due to the policy of autonomy, the number of universities had increased, but the number of students who wanted to enter university was decreasing. Due to the excessive number of universities and departments, the identities of universities were insufficient and student quotas were not being filled.

Compared to the diversity of departments, education methods that did not reflect the demands of local industries led to mismatches in employment.

There were also problems with industry-academia cooperation projects. The Industry-academia Foundation, which was first introduced in 2003, was operated by most universities, but it was more focused on research expense management than industry-academic cooperation activities. In addition, industry-academia at the foundation operated only in engineering colleges, and its role was considerably low.

There was a big difference between the technology development pursued by local companies and the manpower cultivated by universities.

As a result, local companies were reluctant to participate in university-industry cooperation programs.

To bridge this gap, the government promoted the LINC project in order to improve the problematic industry-academia cooperation projects and to create a variety of industry-academia cooperation models to link local universities and local industries.

3.1.1. What is the LINC Project?

The Leaders in Industry-university Cooperation (LINC) project, which was promoted by the Ministry of Education, Science and Technology (MOE), aimed to create a variety of industry-university cooperative models for the "joint development

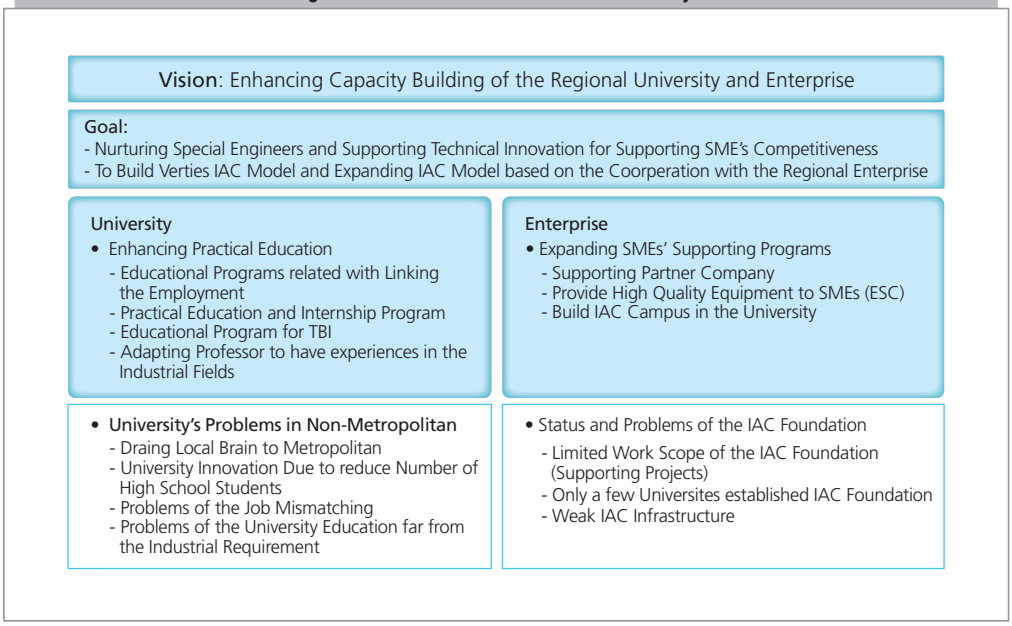
of local universities and local industries." It has cultivated excellent talents by spreading and supporting technological innovation.

The LINC project was a new way to integrate support projects for industry-academia cooperation. The Ministry of Education, through its board of directors, has been supporting more than 50 universities with about 170 billion won for the five years since 2012.

This project aimed at linking local universities with local industries by selecting specialization areas for universities and supporting students' employment and start-ups.

In addition, this project reorganized industry-university cooperation into a business-friendly system to support industrial-academic cooperation activities.

[Figure 1-36] The Outline of the LINC Projects



Source: National Research Foundation of Korea (NRF).

3.2. Vision and Goals

The main purpose of the LINC project is to create a variety of industry-university cooperation models for the joint development of local universities and local industries.

The three key strategies of the LINC project are to expand the scope of support for industry-academia cooperation, to diversify and characterize industry-academia cooperation, and to enhance the sustainable development of industry-academia cooperation.

The first strategy, expanding the scope of support for industry-academia cooperation, is to expand university-industry cooperation from engineering colleges to whole universities. The aim is to establish university-industry cooperation as a major activity of the university.

This is based on the opinion that industry-university cooperation promoted only by specific departments is insufficient to improve the university IAC support system. It includes not only the expansion of faculties but also the expansion and support of the entire scope of industry-academia cooperation, including new business start-ups and the employment of graduated students.

Also, in order to overcome the lack of linkage between the existing university-industry cooperation and local enterprise, the university's industry-academia cooperation foundation establishes an industry-university cooperation system tailored to each enterprise.

The establishment of such an industry-university cooperation system is possible through analysis of the development potential of the local company, the type of company that it is, and the stage of growth that it is in.

The second strategy is to build various leading IAC models through industry-academia cooperation between universities and companies, and to create specialization strategies for the local industry.

This could improve the university education system by preventing talent leakage from local universities, reducing mismatches in employment, and enabling modularized industry-university cooperation programs.

Through these systems, universities select their strengths as areas of specialization and expand their on-the-job training and internship programs in order to increase the likelihood of overseas employment.

In addition, the University supports entrepreneurial education programs in order to provide practical assistance to students through the LINC project.

Finally, in order to solve the lack of interest problem in existing industry-university cooperation, the university adopts the industry-university cooperation-friendly

system ensuring that industry-university cooperation grows continuously.

An industry-academia cooperation-friendly system is a system that supports the increase of participation in industry-academia cooperation within the university by allowing the evaluation of the professors, appointment, promotion, and upgrading to reflect the results of industry-academia cooperation.

Through this, universities can increase the participation of professors in industry-academia cooperation, enable them to manage their businesses in stages, and strengthen the role of industry-academia cooperation.

As these strategies enabled the creation of various models based on the industry-academia cooperation leading model, they eventually led to the recruitment of manpower and the development of technology, which brought about employment and technology innovations. These innovations succeeded in achieving regional development, and the final vision of mutual growth of local universities and local industries was seen.

3.3. Programs of the LINC Projects

3.3.1. Direction of the LINC Projects

The LINC project has supported industry-academia cooperation, entrepreneurship, education, and the activation of entrepreneurial culture for the mutual growth of universities and local industries. The project was conducted two stages from 2012 to 2016 over a period of five years (two years and three years for each stage, respectively).

As of 2016, the budget for the project was 224 billion KRW, which was applied to different universities according to the evaluation of their business plans and other related factors.

In 2016, 57 universities were supported by the LINC Project. Fifteen universities were supported by technological innovation type programs, and the average budget supported by the LINC Project per university was 34-36 billion KRW.

The 42 field-based type universities were supported, and the average budget for university-sponsored courses was 5-20 billion KRW.

〈Table 1-11〉 Results of the LINC Projects in 2016

	Metropolitan Area	Chungcheong Area	Honam & Jeju Area	Deakyung & Gangwon Area	Southeast Area	Total
Techno Innovation	5	2	3	3	2	15
Industrial Technology	6	9	9	9	9	42
Amount	11	11	12	12	11	57

Source: National Research Foundation of Korea (NRF).

1) Budgets for LINC Projects: $218.4 Million USD
2) Average Budget per University: $4.2 Million USD
3) Period: 2012-2016 (5 Years)

- Step 1: Creation and Development of IAC Infrastructure Development (2012-13)
- Step 2: Extracting Performance and Expanding the LINC Model (2014-16)

The main strategies of the LINC project, which was conducted in two stages over the course of five years, were as follows.

The purpose of the first phase (two years) was to establish and strengthen the foundation of the industry-university cooperation model.

During this period, the project team expanded the scope of their support for industrial-academic cooperation by combining academic fields within the university and encouraging local companies to participate.

In addition, the project team started to promote the diversification of industry–academia cooperation by creating a leadership model that took local conditions into consideration.

The university reorganized the overall system of industry–university cooperation so that industry-university cooperation could be sustainable, and has also strengthened the system of industry-academia cooperation by introducing an achievement evaluation system and academic system.

When Phase 1 project was completed, the LINC project was evaluated, and, finding the evaluation favorable, Phase 2 of the project was initiated.

In the second phase (three years), the LINC project created and disseminated the results of industry-academia cooperation.

The project team developed the sustainable development strategy by enhancing industry–university cooperation based on the business established during the first phase and by establishing a diffusion system.

Since then, the university has strengthened its industry-academia cooperation programs by focusing on cultivating a customized workforce and upgrading curriculum programs such as practical education, linkage major, capstone design, and job training.

In addition, the diversification of industry-academia cooperation and the model in Phase 1 was further extended.

These programs expanded industry-academia cooperation from involving only science and engineering to involving fields such as humanities and arts, and have led to the diversification of industrial-academic cooperation models abroad.

In the second stage, as in the first stage, the participation of universities and local industries was solicited.

These programs have promoted the transfer of the core technology of the university to the industry. Industry-university cooperation was expanded, and as a result, both sides benefitted from exchange and cooperation.

Finally, the project team reviewed the implementation plan for following up on the LINC project, and the project team laid the foundation for securing the continuous growth of the LINC project.

The process of selecting universities to support the LINC Project is divided into three stages.

In the first step, regions were evaluated by performance regardless of the type of industry–university cooperation.

The second stage of the evaluation was to evaluate the basic competency of each university and its university- industry cooperation from among the universities selected in the first stage.

The evaluation direction was based on the evaluation of the university 's business plan (70%) and industry survey (30%).

Finally, in the third stage, based on the results of the 2nd stage evaluation, the project management committee, composed of experts, finally selected universities by region and nationwide.

The LINC project demonstrates a type of industry-university cooperation that is carried out in order to reach a goal, and is divided into Techno Innovation and Industrial Technology.

In order to support R&D Technologies Transfer, Techno Innovation fosters creative talents and innovative research personnel, and runs advanced research manpower based on graduate and doctoral graduate programs linked to undergraduates.

Industrial Technology Type, on the other hand, aims to nurture department-oriented customized and creative technical manpower and to support technology development and technical application in the industrial field. To this end, this type improves the field of work by providing on-the-job training, internships, and field-oriented training (R&BD Technologies Consulting).

〈Table 1-12〉 Programs Target

Programs	Target	School
Techno Innovation	R&D Technologies Transfer	Graduate&Undergraduate
Industrial Technology	R&BD Technologies Consulting	Undergraduate

Source: National Research Foundation of Korea (NRF).

3.3.2. Promoting direction and the university's business performance

The goal of industry-academia cooperation is to create a variety of leading models. To do this, universities implement various programs by introducing SYSTEM, COMPONENT, and LINC as the strategic models of industry–university cooperation based on their vision.

In principle, universities should improve the performance of education and research through industry-academia cooperation, and strengthen their capacity for entrepreneurship. Therefore, it is necessary to lavishly provide support for a variety of characteristics and fields, adopt and evaluate professors friendly to industry-academia cooperation, and strengthen the capacity of industry-academia cooperation.

Universities should be prepared to carry out LINC projects effectively. First, the university sets the vision and goal of the industry–academia cooperation project. Next, a field of specialization linked with the local industry should be selected.

This is because universities and local industries have industry-academia cooperation councils. Universities help local industries with employment education and technology transfer, while local industries provide university-affiliated companies with a demand for industrial manpower.

In other words, by carrying out the LINC project, the university and local industry can coexist and develop together.

In order to achieve these goals, the university conducts the LINC project using three strategies.

The system strategy will improve the constitution of the university, strengthen the role of the industry-academia foundation, and establish various infrastructure and organizational committees for supporting industry-academia cooperation.

The component strategy is to reorganize the curriculum in order to nurture the talents needed by the current local industries, and to support specialized employment, start-ups and talent cultivation.

Lastly, the link strategy builds and operates industry-academia cooperation councils and implements related technology development tasks in order to strengthen linkage and support with companies.

If the overall system of the LINC project has been followed, the university will form its own LINC project team.

Considering the characteristics of local industries and universities, the project team must support human resource development and technology development, and operate an on-the-job training support center and an entrepreneurship education center.

3.3.3. Achievements of the LINC Project

To ensure that the LINC project was in place, universities conducted comprehensive auditing on the program and the government periodically did an evaluation.

The government set up a consulting team to solve problems and advise on the business operation of the university. The consulting group was divided into two groups and operated as a team.

The first consulting team consulted on the first stage of the LINC project for about two years, from 2012 to 2014, and the second team has been consulting the second stage for three years, from 2014 to 2017.

As of 2016, the foundation of LINC project has been completed, and now the second phase of consulting is currently in progress in order to create and disseminate the results of the LINC project.

The total consulting team consists of five committee members selected for each of the five regions for a total of 25 committee members. Each member of the consulting team was assigned one of each of the following areas: Vice Chair, Vision, System, Component, and Link.

Subsequently, the committee reviewed the university's business plan and problems, learned about the consulting and specialization fields that the university wanted, and conducted comprehensive consulting.

In the first step, written consulting was conducted. The committee customized their consulting process by analyzing the data submitted by each university's project team. Since then, the consulting team has been conducting intensive interviews at universities that are promoting LINC projects.

The team also held meetings to share the achievements of the LINC projects among universities, and provided opportunities for each university to effectively pursue projects based on the consulting results.

In order to share LINC projects among universities, the government regularly held LINC business forums, and together with the officials from each university, published best practices and produced excellent programs as manuals.

In addition, the universities discussed the achievements and problems of the industry-university cooperation projects that have been carried out so far, modified the direction of future industry-university cooperation, and devised practical action plans.

In this way, universities have been able to share their cases and spread more diverse models of industry-academia cooperation through good-natured competition.

In addition, LINC project performance, operation and management were all evaluated periodically.

The types of evaluation of the LINC project are as follows.

The first was a self-assessment by the university that evaluated the LINC project itself. The second was an annual evaluation that showcased the amount of projects being supported by the LINC project in the following year.

Finally, there was a comprehensive assessment at the end of the first stage that evaluated whether or not to continue to support the LINC project, and then evaluated the performance of the project after its end.

There are key performance indicators for the evaluation of each LINC project, and the university's self-assessment items are set by the university.

3.4. Progress and Achievement of the LINC Projects

3.4.1. Progress of the LINC Project

The promotion of the LINC project began with the 2010 New Year's report from the President.

The plan to foster the LINC project was made in April 2011, and after receiving comments on the contents of the project from various universities in December, the basic plan of the LINC project was confirmed.

Based on the basic plan of the LINC project, the Ministry of Education selected 51 universities in 2012 and started the project.

In 2013, the Ministry of Education selected 51 additional universities to continue the LINC project and provided comprehensive consulting services for the LINC project.

The second phase of the LINC project, which selected 55 universities, started in 2014.

In addition, an EXPO (Festival) for the LINC project was held to promote and spread the achievements of the project.

In 2015, 57 universities were selected to promote the LINC project. Among the selected universities, 15 promoted the technological innovation LINC project type, and 42 promoted the field-based LINC project.

In addition, the Ministry of Education has conducted comprehensive consulting on the LINC project in order to grasp the future improvement plan of the LINC project.

Through these analyzes, the LINC project in 2016 was revised and concluded. The table below summarizes its progress.

〈Table 1-13〉 Progress of the LINC Project

Year	Date	Progress
2010	12.17	President's business report (reorganization of industry-academia cooperation with financial support for business)
2011	1.28	'Report on the Education and Reform Council' joint development of local universities and local industries (Prime Minister)
	4.28	Established university-industry cooperation project
	5.20/10.25	Business plan university briefing session 5.20 (the first), 10.25 (the second)
	11-12	LINC business-related university opinion gathering
2012	1.11	Announcement of new LINC business
	3.28	51 schools selected by LINC business
2013	3-5	Annual evaluation of the first year of the LINC project and announcement of the results 51 more schools selected (14 technological innovation type, 37 field type)
	7-8	General consulting of the LINC project group (10.14 FAIR held)
	10.23-25	LINC festival held to spread LINC business performance
	6.4/11.27	LINC Forum for the Creation of Economic Creation 6.4 (1st), 11.27 (2nd)
2014	1.20	LINC project 2014 basic plan confirmation and 2 stage new announcement
	3-5	LINC business stage and new selection evaluation result announcement 55 schools (technological innovation type 15, field close type 40) / 15 new schools selected / 10 existing schools eliminated
	7.21-29	General consulting of LINC project team (11.18 FAIR held)
	10.15-17	LINC Business Industry-academia Collaboration EXPO (LINC Festival) held
2015	3.10	LINC project 2015 basic plan confirmation and new selection announcement
	3-5	Annual evaluation of LINC business and new selection and announcement of results 57 schools (technological innovation type 15, field type 42) / 2 new schools
	6.23-30	General consulting of LINC project team (11.17 FAIR held)
	10.29	LINC Business industry–academia Cooperation EXPO (LINC Festival) held
2016	2.19	LINC project 2016 basic plan and execution plan confirmed
	3-5	Annual evaluation of LINC business and announcement of results
	7.12-15	Conducted general consulting by LINC project team

Source: Ministry of Education, Republic of Korea, 2016.

3.4.1.1. Achievements of the LINC Project

The LINC project, a project promoted by the MOE, aimed to create a variety of industry-university cooperative models for the "joint development of local universities and local industries." It has cultivated excellent talents by spreading and supporting technological innovation.

The LINC project has supported more than 50 universities with approximately 170 billion won over the course of five years, beginning in 2012. The major achievements of each year are as follows.

〈Table 1-14〉 Achievement of the LINC Projects

Category	Before the start '12.2.	Phase 1		Phase 2		(Growth Rate/ last year)
		'13.2. (1st year)	'14.2 (2nd year)	'15.2 (3rd year)	'16.2 (4th year)	
Number of students on Practical Education	11,630	19,616	27,618	35,757	39,675	11.0%
Number of students on Capstone Design	42,170	42,744	70,145	81,858	94,240	15.1%
Customized training course	670	872	1,484	1,650	1,906	15.5%
Average time for start-up classes	41	53	79	94	108	14.9%
Number of partner company	23,620	31,135	40,663	48,992	57,463	17.3%
Number of contracts and transfer fees (Million KRW)	603/ 10,384	992/ 15,144	1,583/ 17,496	2,000/ 25,887	2,578/ 29,548	28.9%/ 14.1%
ESC equipment and revenues (Million KRW)	23,470	27,259	30,513	32,330	34,392	64.0%
IAC performance compared to one SCI thesis	56	76	105	112	132	17.9%
Percentage of IAC performance replaced with research results	70%	75%	81%	86%	91%	5.8%
Number of IAC Collaboration Professor	2,052	2,808	3,561	4,107	4,587	11.7%

Source: Ministry of Education, Republic of Korea, 2016.

3.5. Future Plan and Expected Results

3.5.1. Future Plan

On Aug. 29, 2016, the Ministry of Education announced a detailed implementation plan for the "Five-Year Basic Plan for Industry–academia Cooperation". This is a government-joint plan that sets out the vision of industry-academia cooperation centered on universities and is set up to promote the key tasks of the IAC projects for the next two years.

First, the Ministry of Education will promote LINC+, a business-oriented university-centered university-sponsoring project, for five years beginning in 2017 as a successor to the LINC project, which was promoted for five years beginning in 2012.

The basic principle of LINC+ is to expand the autonomy and openness of universities, and the sustainability and diversity in industry-academia cooperation.

In particular, this project will operate a core business focused on the individual needs of society and will promote the development of an excellent model with which to do so.

Universities will be encouraged to pursue more industry-university cooperation than in existing LINC projects by introducing a method with which to autonomously design business models.

In addition, the Ministry of Education and the Ministry of Employment and Labor will carry out the certification of engineering education and the training of female engineers to train engineers.

For students who have been certified in engineering education, they will be provided with additional benefits when acquiring the qualification of a professional engineer, and a female-friendly education system will be introduced to cultivate customized female talents as required by society.

In addition, the project provides step-by-step tailored support for university students to start their own businesses.

As of 2017, the project will begin to create a university foundation fund to support initial start-up funds for college students, and launch a business start-up system and start-up bachelor's system so that start-up education and education can be practically linked.

Currently, industry–academia cooperation has mainly focused on the engineering college. The LINC project is expanding its scope, but industry-academia cooperation in the field of culture and art is still lacking.

In order to improve this, the LINC + project will transform technology, which is the commercialization paradigm of the university, into 'knowledge' so as to extend the scope of the business to the category of contents and services and to protect the intellectual property rights necessary for this.

3.5.2. Expected Results

The existing industry-academia cooperation is uniform and limited in its industry-academia cooperation under the government initiative.

Although there was a one-sided approach at the university, there was little interest in university-industry cooperation, and therefore, students had no choice but to associate with employment with little information.

In addition, since the government supported a fragmentary model, local enterprises were less interested in local universities, and universities provided only theoretical education and research.

In the end, the lack of linkage between education and employment led local talent to escape to metropolitan areas and the existence of a passive, temporary industry–university cooperation.

To solve these problems, the government will promote the LINC + project for the symbiotic development of local universities and local industries. So, what changes can you expect to see in the LINC + projects?

As the existing industry-academia cooperation has been termed 'avoidant', the LINC project can be defined as 'friendly' industry-academia cooperation.

This new project features open and autonomous industry-university cooperation that both universities and corporations can engage in, and will help to make systematic projects possible by forming an industry-academia cooperation foundation.

Another change is that the professor is interested in the LINC project by reflecting the university-industry cooperation in evaluating the achievement of the professor, and the university can strengthen the relationship between education and employment by providing practical education and research.

As the education based on industry-academia cooperation has increased, interest in the cultivation of business-friendly manpower through industry-academia cooperation and the student's employment and field work ability will be accelerated.

The increasing number of industry-academia co-operative professors enables various educational opportunities such as start-up creation, job training, field-oriented education, technology development, on-the-job training, and the expansion of the departments participating in LINC project.

In the end, the cultivation of specialized labor suited to industrial demand may increase.

If the linkage between university education and employment is strengthened, and active industry-university cooperation is drawn up, local companies will also gain more interest in local universities and acquire information on universities, which can lead to universal and industrial cooperation between universities and companies.

Increasing the participation of industry-academia cooperation in local enterprises may eventually reduce the phenomenon of talent escaping into metropolitan areas by locating local talent in the region and finding them employment in local companies to alleviate the employment mismatch phenomenon.

In the end, the joint growth of local universities and local industries will be achieved, which is the final goal of the LINC project.

4. KPU's Evaluation Methods of the IAC Programs

4.1. Direction of the Evaluation of the IAC Programs

4.1.1. Background

Recently, the industrial structure paradigm is changing due to the rapid development of information and the industry.

Therefore, cooperation between local universities and local industries is becoming more important, and industry-academia cooperation is emerging as a key part of national competitiveness.

As a result, the Korean government has established new IAC programs for innovative systems with industries, and in order to effectively carry out such

government policies, the KPU established an industry-academia foundation in February 2004.

The IAC foundation is a sub-organization of universities that manage and support IAC projects. Universities can provide systematic support to IAC programs through the IAC foundation.

In addition, the Academic-Academia Collaboration Foundation supports academic-industrial cooperation education and academic-industrial cooperation programs, and develops relationships between universities and companies.

KPU was established by the Ministry of Trade, Industry, and Energy in 1997, and its objective is to foster the technological competitiveness of companies by cultivating the high-level technical personnel required by the industry. In other words, KPU is a specialized university of industry-academia cooperation.

Until recently, the KPU's Industry-academia foundation has carried out three unique industry/university-related programs such as the "Partner Company System", "Engineering House (E/H)" and "Practical Education Credit System".

Based on this experience, KPU was selected for the Ministry of Education's LINC project (2012-2016) and has achieved excellent results in industry-academia cooperation programs such as supporting business start-up universities.

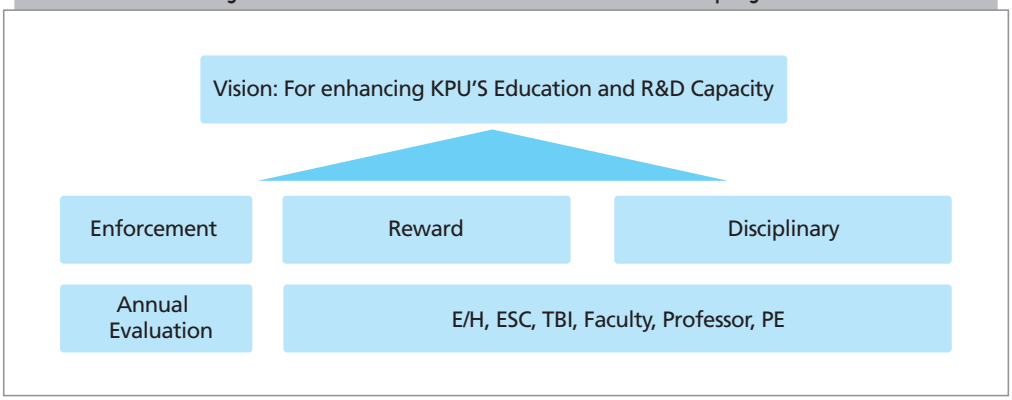
4.1.2. Purpose and Direction of Evaluation

IAC's programs have been difficult to implement effectively in existing university systems that focus on education and research. Therefore, KPU decided to establish the system and regulations separately and to carry out an evaluation of industry-university cooperation.

Through the evaluation of the IAC's programs, the university-industry cooperation foundation was able to enhance the university's education and research & development capacity.

KPU's Industry-Academic Collaborations conducts IAC's programs in various fields, reviews compensation and discipline, and conducts an annual evaluation of IAC's programs.

[Figure 1-37] Direction of the evaluation of the IAC's programs



Source: Korea Polytechnic University.

For the systematic evaluation of the IAC's programs, the Industry-Academic Cooperation Foundation prepared an operating regulation document for the IAC evaluation.

This document contains the purpose, scope, and items necessary for the evaluation of IAC's programs. All evaluations shall be conducted in accordance with these operating regulations.

In addition, the Industry-academia Foundation formed the IAC program evaluation committee for fair evaluation, and the evaluation committee has been evaluating the IAC's programs in various fields every year.

There are two evaluation directions for IAC programs.

The first is activity-based evaluation. This method evaluates various activities for educational and business support based on industry-academia cooperation, and provides an achievement score according to their performance on the evaluation items. This activity-based method evaluates the professors and departments within the university. Achievement points awarded through the evaluation are used for promotion, re-employment, and incentives.

The second method is an enterprise evaluation of the E/H, TBI, ESC and Partner Company System programs of the IAC. In addition, there are on-site educational evaluations linked to schools, students, and companies.

4.2. The Evaluation Tools of the IAC Programs

4.2.1. Basic Evaluation

The professors' evaluation is divided into tenured professors and industry-academia cooperation professors. This evaluation is given according to the score determined by the evaluation area, and tenured professors use this evaluation result for promotion and re-appointment.

The faculty evaluation includes the results of the IAC programs, including academic-industrial cooperation. And the department of Industry-Academia Cooperation Foundation will be evaluated by the societies about the target values of the industry–academia cooperation and business support departments.

In the composition of the professor evaluation committee, the chairman shall be the president of the academic affairs, and the chairman of the graduate school and the head of the department shall be the members. The E/H evaluation committee shall be chaired by the president and shall be no more than 10 members, nominated by the president.

In addition, the performance evaluation committee of faculties and departments shall be composed of up to 11 members, with the chairperson as the planning director.

The composition and activities of each committee shall formulate operational regulations for each department and carry out its work in accordance with the guidelines.

4.2.1.1. Tenured Professors

The evaluation index for evaluating tenured professors is shown in <Table 4-1>.

Professors who acquire 30% or more of the academic achievement standard score will be reappointed (Article 3, Section 2 of the Enforcement Regulations of the Personnel Regulations for Teachers) and can be promoted at an achievement of more than 50%.

If a professor acquires 2.5 times or more of the standard score (Article 6 of the Enforcement Regulations of the Personnel Regulations for Teachers), special promotion examination is possible. Professors with outstanding academic achievements can apply for a special promotion because there is no upper limit on the score for each area.

〈Table 1-15〉 IAC Evaluation Particles for Evaluating Tenured Professors.

	R&D Project			Consulting	Technology Transfer	TBI	Partner Company	ECS
Evaluation Article	R&D	Public R&D	Private R&D	Technology/ Management	Technology Transfer	Professor TBI	No. of Partner Company	Using of the Equipment in ESC
Score								

	Patent			Exhibition and Award			Consulting TBI
Evaluation Article	International Patent	Local Patent	Utility Model/ Design	Personal	Group	Exhibition Contest	Consulting New Business In TBI
Score							

4.2.1.2. IAC Collaboration Professors

Non-tenured professors, such as industry-academia cooperation professors, are professors dedicated to industry-academia cooperation.

Professors are considered every two years as an irregular track, and are evaluated in required fields and general fields.

〈Table 1-16〉 IAC Evaluation for Non-Tenure Professor in Required Fields

Division	Evaluation Field	Evaluation Index
IAC Education	Practical Education	Number of students in practical education with companies
		Number of consulting companies participating in practical education
	Employment & Incubating	Number. of support for student employment
	IAC Education	Consulting company participating in dual education
		Participating in dual education
		Inviting cooperative companies to engage in dual education
IAC R&BD	Project	Participating in public projects
		Participating in an R&BD project
	IAC Support (Service)	Partner Company
		Visiting and consulting with a partner company
		Operation of the IAC Committee

〈Table 1-17〉 IAC Evaluation for Non-tenured Professor in General Fields

Division	Evaluation Fields
IAC Education	Practical Education
	Capstone Design
	Employment & Incubating
	Education in IAC
IAC R&BD	R&D Project
	Book/Paper
	Patent and Technology Transfer
	Strengthening IAC Capacity
IAC Support (Service)	Common Equipment Support
	ESC
	Global IAC
	Fund Attraction
	Student Attraction
	Advertising

4.2.1.3. Faculty Evaluation

The IAC evaluation of the faculty evaluates the outcomes of the IAC program's implementation, which includes assignments and partner company scholarships.

The university will allocate the budget in the next year according to the result of the evaluation of the faculty, and will give incentives to faculty members with excellent evaluations.

4.2.1.4. Department Evaluation

The IAC evaluation of the department evaluates how effectively the IAC programs have been supported.

Evaluation is based on the work progress of each department.

Departments are also awarded incentives according to the result of the evaluation.

4.2.2. Evaluation Achievement of the IAC Programs

The E/H and TBI's evaluation focuses on the company, and it is performed using the relative evaluation method. In addition, there is a family company evaluation that assigns and supports grades based on industry-university cooperation results.

4.2.2.1. Engineering House (E/H) Evaluation

Professors have the opportunity to establish a new E/H once a year.

At this time, a professor will announce the operation plan for the new E/H, including the plan for IAC programs to be jointly pursued by students and companies at the E/H Operation Review Committee. The establishment of the E/H is approved according to the evaluation result.

The evaluation confirms whether or not the objectives for industrial-academic convergence and cooperation are appropriate in the context of the professor's proposal, and the project's feasibility is scored according to the evaluation items. The ability for the project to secure financing for the E/H operation is part of the evaluation criteria.

At this time, the E/H takes action when it receives an evaluation of C grade (lower 20%) for two consecutive times. This is to induce sustainable performance through competition among companies.

4.2.2.2. TBI

In the TBI, an evaluation of a new entrepreneur is done in two stages: review of the founder's proposed business plan, and evaluation of the contents of the business plan.

New entrepreneurs will graduate from the TBI when the two-year term of the tenancy agreement is reached or when the company's entrepreneurial initiative plan is achieved, if this happens earlier than expected. In addition, enterprises that intend to extend the tenancy of the TBI will be granted benefits, such as extension of tenure if evaluation reveals that they are excellent entrepreneurs as well.

4.2.2.3. Partner Company

A partner company is a company that has entered into an agreement with an IAC university. Companies that have entered agreements with universities will be given grades and support according to the results of the IAC.

Companies that have collaborated with IAC programs within the past three years have been selected as membership companies. Companies that have collaborated with IAC programs in more than two of the past three years will become partnership companies. Partnership companies will be prioritized when participating in IAC programs, which can be tailored to suit their needs.

4.2.3. Evaluation of the Practical Education

The results of the student's on-site training assessment are reflected in the evaluation of the company. These on-site education evaluations include a training evaluation that reflects the company's assessment in the grades of students participating in on-site training, and E/H course evaluation, in which corporate researchers participate and are trained as direct instructors.

Finally, companies participate in a comprehensive design evaluation that assesses the operation of the enterprise-type capstone design and works.

4.2.3.1. Evaluation of the Practical Education

On-the-job training evaluation conducted to assign grades to student education performed in the field of enterprise. The advisor gives students grades by combining the attendance of students participating in on-site enterprise training with an evaluation score of the company's performance, reports, and more. In addition, the evaluation of key professors in industry-academia cooperation is included.

4.2.3.2. E/H Curriculum

E/H courses are courses that are run for more than five weeks by assigning corporate researchers to act as instructors. Unlike the existing curriculum, the course provides one hour of theory and two hours of practical training.

Programs include team project-based case studies, seminar presentation training, entrepreneurship training, professional invitation training, industry/exhibition tours, and portfolio management training. At least three of these programs are applied to each E/H course.

4.2.3.3. Capstone Design

The university runs an enterprise-linked Capstone Design, which is a theme proposed by companies. Therefore, the company participates in the evaluation of the work, and it is possible to transfer the technology to the company according to the result of the work. In addition to the evaluation of participating companies, the final

evaluation is made by including the evaluation of the external advisory committee, composed for the certification of engineering education.

4.3. Achievement of the Evaluation of the IAC Programs

4.3.1. Achievement of the Evaluation

4.3.1.1. Achievement of the Basic IAC Evaluation

The following shows the achievements of all teachers in the basic evaluation condition during the past three years.

This evaluation confirmed that the achievement of professors in IAC programs linked to companies was higher than the achievement of professors doing basic research.

〈Table 1-18〉 Rate of the Professor's Evaluation

Field	Education	IAC	R&BD	Service
Percent	34.0%	46.9%	5.7%	13.4%

4.3.1.2. Achievement of the IAC Evaluation Related to the Enterprises

A total of 59 E/Hs were established in KPU over the past three years. 100 professors, 388 students, and 191 companies participated in the IAC programs of these E/Hs.

Twenty companies in TBI were started up and continue to grow. The average amount of sales and the number of hired employees of the 13 companies that have been in the business for three years or more are increasing steadily.

There are currently 4,000 partner companies, of which 810 are partnerships. Professors do several IAC programs with these partnership companies, with five companies per professor, in a confidential relationship.

ESC has provided various support activities and conducted more than 15 public equipment training sessions each year. The cost of using ESC equipment is 1 billion KRW per year at roughly 2,000 per enterprise.

4.2.1.3. Achievement of the IAC Evaluation of the Practical Education

As a result of evaluating KPU's on-the-job training for the last three years, it was estimated that 1,600 students participated in on-site training at an average of 8,000 companies. In addition, KPU operated an average of 26 E/H curriculums, with participation of about 600 students, and an average of 1,500 students were able to carry out 500 works through comprehensive design.

5. Evaluation of the CAI Center's IAC Programs

5.1. Direction of IAC Program Evaluation

Evaluation of Industry Academy Cooperation (IAC) programs is mainly conducted to establish whether all activities focused on satisfying industrial needs are being executed properly.

For this purpose, the general responsibilities of each department must be established. Below is a brief description of the responsibilities and functions of each of the areas that make up the CAI Centers:

1) The CAI Center Board of Directors should:
- Authorize the growth and development strategies of the CAI Center
- Authorize the companies that will access the CAI Center
- Define the policies, guidelines, rules and legal framework that will apply to the CAI Center organization
- Approve income and expenditure budgets

2) Advisory Council Mexico Korea should:
- Review and propose the transfer technologies that will be applicable to the CAI Center
- Propose the possible related companies between Mexico and Korea that will accede to the CAI Center
- Suggest proposals for improvement and orientation to strategic technological sectors for the CAI Center

3) The coordinator of the CAI Center should:
- Define the strategy for the growth and development of the CAI Center
- Disseminate the CAI Center model between companies and the academic community
- Supervise the development and the relationship generated with companies in the field of technology transfer, as well as with the academic community

and suppliers related to the CAI Center
- Monitor the scope of the objectives, as well as the solution of possible conflicts between the different areas that make up the CAI Center
- Link to companies with the different areas that make up the CAI Center
- Authorize the technical-commercial quotations for the development of projects, services and technology transfers of the CAI Center
- Authorize the technical-commercial quotations for the technology transfer, project development and services between CAI Center Mexico and CAI Center Korea

4) The Administration Division of the CAI Center should:
- Develop administrative documents linking industry to the CAI Center
- Review economic proposals for the execution of projects and services of the CAI Center
- Manage contracts and purchases required by the CAI Center
- Supervise the financial and accounting activities of the CAI Center

5) The Management and Finance department of the CAI Center should:
- Review quotations and receipts of goods and services for the CAI Center
- Coordinate the CAI Center Project Managers
- Develop the financial and accounting processes necessary to support the companies integrated to the CAI Center
- Manage the human and material resources for the CAI Center

6) The Division of Relations Academia-Industry of the CAI Center should:
- Review the technical proposals for the CAI Center
- Assign technical human resources and infrastructure to CAI Center projects.
- Supervise the activities of the TBI and E/H.
- Participate in calls for federal or state funding related to innovation and/or technological development
- Integrate the technological packages that the CAI Center creates
- Search for new companies for the CAI Center to associate with
- Promote ownership of knowledge and the development of papers for journals

7) The TBI should:
- Provide market analysis services, and review the potential impact of products and/or services for companies
- Provide technological monitoring related to needs of the companies and the technological areas of CAI Center
- Develop technology-based business plans
- Adopt, evaluate and execute business models with a technological base

8) The E/H of the CAI Center should:

- Develop technical proposals for CAI Center projects and/or services
- Execute applied research and technological development projects
- Execute the scientific and technological dissemination of the CAI Center
- Develop basic science research projects

9) The Technical Services Division of the CAI Center should:

- Plan activities in the workshops and laboratories
- Design and execute the certification processes for the laboratories
- Provide specialized training for personnel
- Coordinate and monitor the maintenance of workshops and laboratories
- Coordinate and execute the opening of new laboratories and workshops that will be integrated into the CAI Center

As mentioned in Chapter One, the CAI Centers have four linking programs for the participation of SMEs in technology transfer and development. Combining the responsibilities of each area with the programs listed results in the Key Performance Indicators (KPI) shown in Chapter One. Applying these for a year beginning in August 2016 and ending in August 2017 and conducting a quantitative evaluation on the results will determine whether the proposed activities and responsibilities contributed to the accomplishment of the goals and objectives of the CAI Center.

To ensure efficient support and continuous investment in CAI programs, evaluation methods will be established for every area related to industrial academic cooperation activities. These evaluation methods will be applied annually to determine rewards and investment support in order to enhance the program's capacity for company and project support.

The next section describes the evaluation process for the E/H, TBI, ESC, and professors involved in the CAI Center. The CAI Center is evaluated as a unit on three dimensions: structure, activities, and results after a period of a year.

The main evaluation objective is to define new strategies to increase results related to the CAI Center mission and vision.

5.2. Evaluation Committee

To begin the evaluation process, an evaluation committee with at least four members should be created. Members for the evaluation committee are called by the CAI Center's Board of Directors and must create an evaluation report at the end of the process.

To create the evaluation committee, Board of Directors should select two researchers from the same institute where the CAI is located; these researchers may be involved in CAI programs themselves. Additionally, the Board of Directors should invite a business person from the industrial sector to be part of the evaluation committee. The fourth member should be the CAI Center Coordinator.

The evaluation process is closed, with the approval of the Board of Directors. To ensure the transparency of the evaluation process, the executive summary of the evaluation report will be made public. It is necessary to indicate that the CAI Center has the opportunity to present amendments on the content of the executive summary, which must be validated by the Board of Directors before its publication.

The CAI Center may distribute the final report to guarantee the commitment to the community of the CAI Center in order to carry out the improvement actions that the report proposes.

As mentioned in Chapter One, there are four linked programs in CAI Centers that allow SMEs to participate in project development and technology transfer. Combining the responsibilities from each area with programs should result in the KPI detailed in Chapter One.

5.3. The Evaluation Tools of the IAC Programs

CAI Center evaluation tools correspond with key departments and are organized into professors and departments. The subheadings of these categories are:

1) **Professors:** Applied research and technology development professors, basic scientific research professors, and technology transfer professors
2) **Departments:** E/H, TBI, and ESC

In the case of HEIs such as TESE, TESCI, TESCo, and UPVM, professors related to the development of science and technology have permanent contracts. Among others, their main functions are basic scientific research, teaching, and education management. Only a few professors are primarily related to the assimilation and development of technology for SMEs.

In the case of CAI Centers in Mexico, three specific profiles were developed, which are detailed as follows.

1) Applied research and technology development professors
   Their main functions are to:
   - Develop technical proposals for government calls
   - Be responsible for the integration of proposals that request federal or state

financial support

- Establish the technical expectations of a project or service linked to a company
- Coordinate with other specialists to solve a linked project
- Support the activities of basic science researchers
- Support the activities of experts in technology transfer
- Review the postulated technology transfers from a technical perspective
- Ensure that basic research results are converted to technology transfer models
- Identify innovation processes in the project development to improve benefits for SMEs

2) Basic Scientific Research Professors

Their main functions are to:

- Remain an expert in a respective field of knowledge
- Participate in federal or state calls that support basic scientific research
- Support the technical development of proposals that request funding through federal or state funds
- Provide technical advice to researchers in applied and technological development
- Promote the participation of undergraduate and graduate students in the different projects that are developed
- Disseminate project results in international quality journals
- Write books or book chapters pertaining to an area of knowledge
- Develop intellectual property documents

3) Technology Transfer Professors

Their main functions are to:

- Develop incubation models as business models, technological business plans, market studies, state of the art, technological package, prototypes, pilot lines, early adapters of technology, and economic, technical, and financial feasibility
- Linking of technology developed to interested entrepreneurs or SMEs
- Development of technology business plans
- Technology marketing supported by applied research and technological development.
- Industrial property advisory to SMEs
- Market research and monitoring of technological trends in products and services

Each type of professor contributes to CAI Center operation; as such the results are collective. Each individual factor is the same as at KPU:

- Reassignment: CAI Center achievement of 30% or minus standard score
- Promotion: CAI Center achievement of 30% or more standard score
- Special Promotion: Acquired 2.5 times the standard score

The meanings of reassignment, promotion and special promotion at the CAI Centers in the State of Mexico, however, do differ from in Korea:

- Reassignment means to move the professor to the teaching process and not involve them in technology transfer projects.
- Promotion means to provide them with additional human and financial resources for research projects. In Mexico, additional economic benefits can be achieved through science and technology development. The government organization in charge of this activity is CONACYT.
- Special promotion means to give an additional payment for participating in technological base projects.

Each of the previous definitions are in agreement with politics and regulations, and are different for each HEI.

5.3.1. Evaluation Tools for Professor Profiles

For each kind of profile described previously, the same evaluation tool will be

〈Table 1-19〉 Evaluation Chart to Professor Profile Projects

	R&D Project			Consulting	Technology Transfer	TBI	Partner Company	ECS
Evaluation Criterion	R&D	Public R&D	Private R&D	Technology/ Management	Technology Transfer	Professor TBI	No. of Partner Company	Using of the Equipment in ESC
Score								

applied. This is because all profiles are responsible for several activities because the CAI Center is still in its infancy as a project, and evaluation tables and scores will change as the CAI Center evolves. This evaluation tool was transferred from KPU to CAI Centers in the State of Mexico.

〈Table 1-20〉 First Evaluation Chart to Professor Profile Products

	Industrial property			Exhibition and Award			Consulting TBI
Evaluation Criterion	International Patent	Local Patent	Utility Model/ Industrial design	Personal	Group	Exhibition Contest	Consulting New Business In TBI
Score							

〈Table 1-21〉 Second Evaluation Chart to Professor Profile Products

	Paper			Book		Government call
Evaluation Criterion	Journal Citation Report index	International index	CONACYT´s quality	Complete book	Book chapter	Financial fund acquired
Score						

5.3.2. Evaluation of Key Departments

At the beginning, all departments will be evaluated as a unit. The CAI Center must accomplish this by taking the following considerations into account. As before, this information was provided by KPU.

〈Table 1-22〉 General Considerations for all Departments

	Evaluation Fields	Evaluation Index
Education	Practical Education	Number of students in practical education with companies
		Number of consulting companies participating in practical education
	Employment & Incubation	Amount of support for student employment
	IAC Education	consulting company participating in dual education
		Participation in dual education
		Inviting cooperating companies for dual education
R&BD	Project	Participating in a public project
		Participating in an R&BD project
Support (Service)	Partner Company	Inviting a partner company
		Visiting and consulting with a partner company
		Operating on the CAI Center Committee

At this point, some issues will need to be resolved by the Academic Direction of each HEI, and scores will be assigned by the Board of Directors of each CAI Center.

5.4. Applying the Results of the IAC Program Evaluation

The evaluation process related to government calls is as follows:

- A report is sent to CONACYT or COMECYT
- Experts evaluate the project technically and financially
- If the experts require more information, a request is sent to the SME and HEI
- The report is either accepted or rejected as per the presented information
- A satisfaction format is filled out by the SME and the process is concluded

The first evaluation of the CAI Centers will be conducted in August 2017. The evaluation report created after the evaluation process will help establish the current status of the CAI Centers and will provide a direction for a continuous improvement plan aimed at strengthening the CAI Center´s programs and rewards for professors and consultants.

After evaluation, each institution will reward all professors who reach a given score established by the evaluation committee.

At the same time, every institution should create a human resource promotion plan for rewarding and compensating professors based on the score they have reached.

The results of the evaluation should help with the organization of the CAI Center, and enable management and researchers to make better decisions related to the future of the CAI Center's business management and research interests. The evaluation is judged on the following criteria:

- Quality, which makes it possible to measure the excellence of the center through regional, national, and international recognition and the innovative and business potential of the CAI Center, in addition to the level of its facilities and equipment.
- Productivity, which refers mainly to business and scientific productivity (e.g., companies housed, projects attended, publications, theses, patents, etc.), how the results of the center's activities are publicized, and cultural activities (such as services, conferences, exhibitions, among others) as socioeconomic (e.g., technology transfer) outputs of the CAI Center.
- Relevance, considering scientific, technical, and socio-economic aspects.
- Viability, which considers the external and internal dynamics of the CAI Center, the success rate of projects and activities.

6. Planning for Expanding the Pilot CAI Center

6.1. Achievement of the Pilot CAI Center

Current Mexican politics related to science and technologies are defined as per the National Plan of Development 2013–2018, as mentioned in section 2.4 of Chapter 2. The main concern of these policies is strengthening the quality of life in Mexico through the usage and implementation of products developed by basic scientific research. This includes promoting the development of technology and using technology as an engine for creating SMEs that will provide employment.

All science and technology programs in Mexico are regulated by the National Council of Science and Technology (CONACY), a federal and public organization. To apply for state programs, CONACYT uses the local councils in each Mexican state. For example, Mexican COMECYT provides regulation for programs that support science and technology in the State of Mexico.

The programs launched by CONACYT and COMECYT are divided into two areas: Academic and Industrial Development. If one person or organization wants to use become funded in one of these areas, they must go through HEI or SME channels, develop a research protocol, and send it to CONACYT or the local state council. This research proposal is evaluated, and financial funds are either given or refused.

As with any other organization, all CAI Centers can participate in calls and obtain financial funds to acquire the specialized machinery and equipment necessary to develop special projects proposed by SMEs and promote basic scientific research. The TESCo and UPVM CAI Centers are currently participating in a call named Mix Funds (FOMIX) to obtain $818,000.00 USD in order to buy machinery and equipment that would strengthen the technological areas of advanced manufacturing, design of mechatronic systems, control, and automation.

Previous comments have the purpose to illustrate how federal and state policies support science and technology in Mexico; however is important to mention who to achieve good results specific budget should be assigned to CAI Center programs. The funds will be used to support technology development and proposed projects by SMEs who are related to technology development, thereby strengthening the Mexican economy.

6.2. Direction of the Plan for Expanding the Pilot CAI Center

6.2.1. Goal of Expanding the CAI Center

The main concern about expanding CAI Centers is to support SMEs in several regions of the State of Mexico by applying the philosophy behind the LINC program. This program was created using the KPU model and the expertise of the Korean Ministry of Education.

Several universities in Korea apply this program to great effect. For example, Sungkyun Kwan University has the following description on its homepage:

"LINC is abbreviation for Leader in Industry-University Cooperation, and is a designated program from the government which supports the leading universities in collaborative projects between university and industry. The project team supports incubation for young business leaders, enhancement of global competence of medium and small size companies, and development of creative new industry.

The project team also provides on-the-job training programs and capstone design program for on-hands experience for the students."[10)]

This philosophy is needed to develop, assimilate, and transfer technology from HEIs in the State of Mexico to SMEs and strengthen the competitiveness of students.

The following information was kindly provided by KPU and is included to exhibit the focus of LINC program:

- Vision: To enhance the building capacity of regional universities and enterprises
- Goal:
  - To nurture special engineers and support technical innovation that supports SME competitiveness
  - To build and expand the IAC Model based on cooperation with regional enterprises

With this in mind, the following lines will demonstrate how the CAI Center will meet its expansion goals. There are currently four pilot CAI Centers in the State of Mexico which address specific research areas. The previous section demonstrated the achievements of the two pilot CAI Centers, which have been producing positive results. They are working with enterprises to perform cooperative projects between them which aim to improve their products or the processes of the enterprises.

10) http://www.skku.edu/eng_home/skku/organ/attachment_24.jsp

Cooperative projects involve students and researchers from the HEI working together with enterprises to improve a student's skills and help them gain experience with enterprise.

Another way to support technology transfer to SMEs is to develop projects related to the needs of SMEs, but which are not directly linked to SMEs. For this, the CAI Center would require its own industrial property and would have additional resources related to the commercialization of industrial property. Finally, the industrial property could be transferred to a student or entrepreneur and be used to found a new SME.

However, the State of Mexico has many SMEs, and the number of pilot CAI Centers and research lines is currently not vast enough to support them all.

The development of more CAI Centers is important for the development of the State of Mexico in order to support SMEs from different regions and in different research areas. It is also important that the students of the HEI have a high level of education, especially in practical education.

For these reasons, the main goal of expanding the CAI Centers is to support SMEs. Each CAI Center will function as a research and technology development unit for different regions and enterprises. The students participating in these projects will strengthen their practical knowledge and observe how to apply theory to engineering practice. This makes it very important to promote the expansion of the CAI Centers.

6.2.2. Direction of Expanding the CAI Center

The main concern when creating a CAI Center is the development, assimilation, and technology transfer. The following results are expected:

1) Strengthen SMEs through the improvement and optimization of the process and products.
2) Create specialized technology for SMEs
3) Provide scientific and technical support to develop technological base projects
4) Involve students in technological project development
5) Promote the creation of technological base SMEs
6) Improve competitiveness of SMEs through provide technological advisory
7) Improve competition of students by specialized capacitation
8) Help entrepreneurs to develop technological base ideas and marketing of technological products

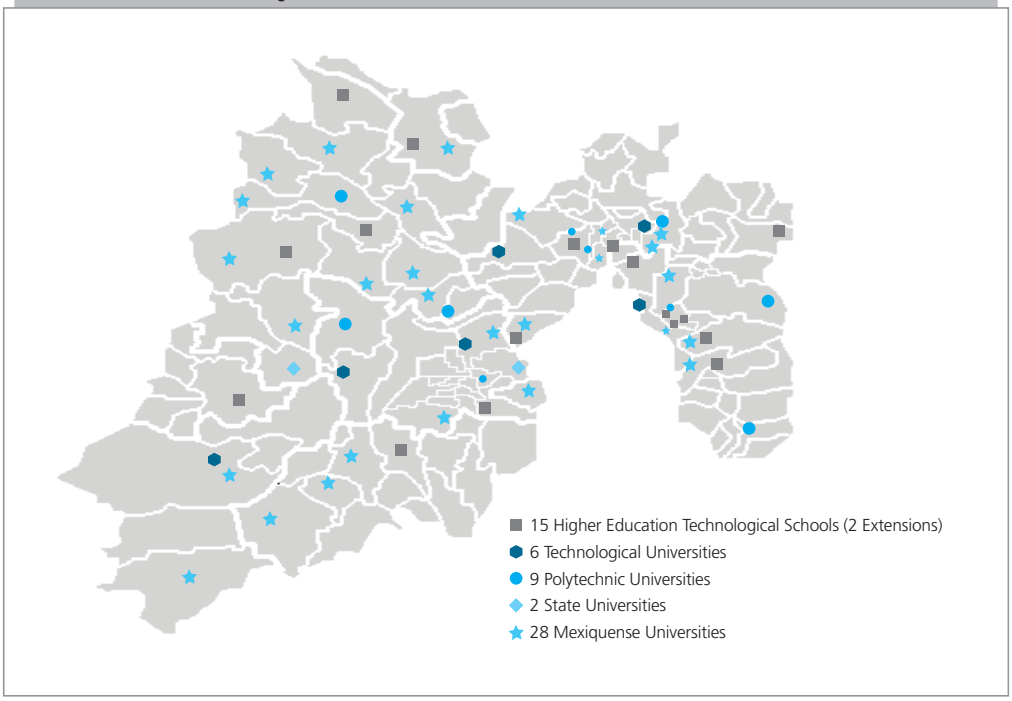
[Figure 1-38] shows all current HEI of the State of Mexico Government

- 15 Higher Education Technological Schools
- 6 Technological Universities
- 9 Polytechnic Universities
- 2 State Universities
- 28 Mexiquense Universities

All Universities that will have CAI Centers must define their technological area according the undergraduate and graduate programs which are offered by the institution. Specialized machinery and equipment present on campus is taken into consideration, as are human resources and previous experience in linked projects.

This analysis will help the Pilot CAI Centers to transfer the CAI Center model in an effective way and provide support for future activities.

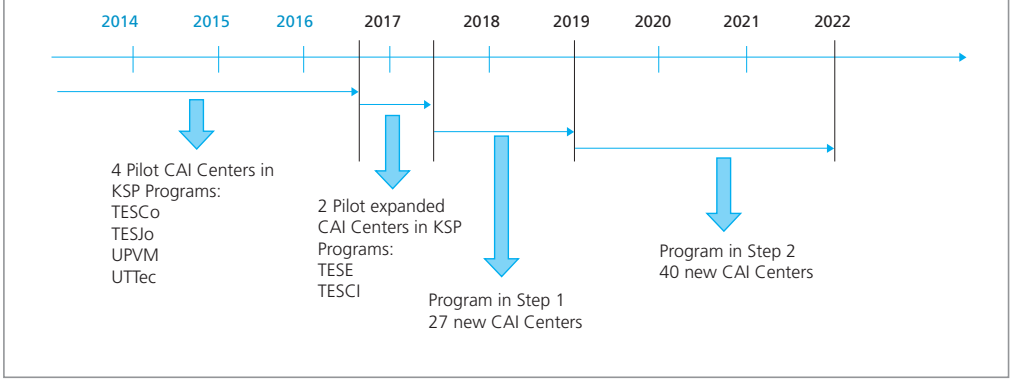
[Figure 1-38] HEI of the State of Mexico Government



Source: Modified from "Geographical Location of the Public Institution of Higher Education, 2017."

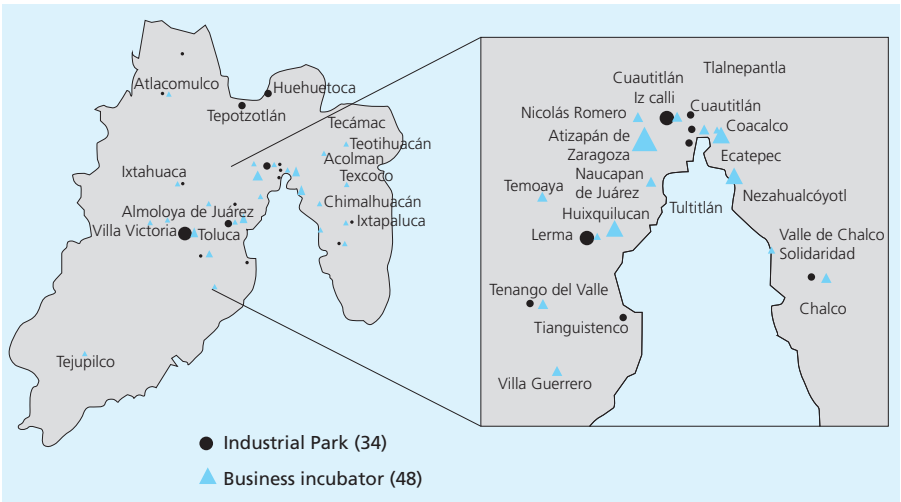
Considering the benefits of installing a CAI Center, development of CAI Centers in several State of Mexico regions, as shown in [Figure 1-39], should be considered. To achieve this goal, financial support and human resources must be considered, and policies and regulations must be followed when promoting the opening of CAI Centers.

[Figure 1-39] Chronogram for opening CAI Centers



[Figure 1-40] shows the main areas of industrial development. CAI Center opening is recommended to focus on these areas.

[Figure 1-40] Industrial parks and business incubator in State of Mexico



Source: Advisory Forum, scientific and technological, AC., Diagnosis in Science Technology and Innovation, 2004-2011.

The development of public and private HEI is integral to consider. All HEIs must participate in the technological development of a region. <Table 6-1> shows the proposal for transferring the CAI Center model to both public and private HEIs.

〈Table 1-23〉 Proposed Distribution of CAI Centers in Public and Private Universities

Model	Institutions
Public Universities	36
Private Universities	31
TOTAL	67

Using [Figure 1-40], it is possible to define the following regions for the funding of new CAI Centers:

- Coacalco, Ecatepec, Cuautitlan Izcalli and Chalco
- Nicolas Romero, Atizapan and Naucalpan
- Lerma, Huixquilucan, and Tenango del Valle
- Toluca, Villa Victoria and Almoloya
- All those not considered previously

〈Table 1-24〉 Proposed CAI Centers by Year and Region

University	2017	2018	2019	2020	2021	Total
Number of University	5	10	12	14	26	67
Public University	5	6	6	8	11	36
Private University	0	4	6	6	15	31
Region	B	D	C	A	E	

As a recommendation, give continuity to government calls to support CAI Centers is a good idea but also promote exclusive funds for CAI Centers will improve the results. Promote basic scientific research and transform it in industrial property with economic benefits is the first step to change from manufacturing society to knowledge society.

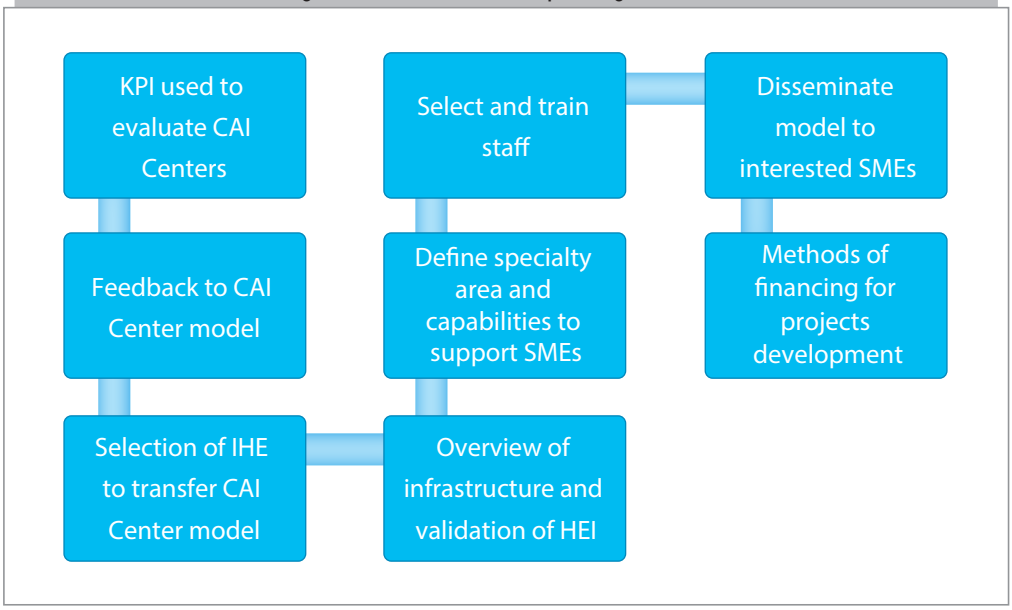
6.3. Strategy for Expanding the CAI Center

6.3.1. Detail Programs for Expanding the CAI Center in each Steps

The proposed name for expanding CAI Center program is the Improvement of Technological Capabilities by Industry Academy Cooperation (ITCIAC). The strategy for expanding the CAI Center is shown in Figure 6-4. This process will begin with an evaluation of the CAI Center that will be transferring the model to another institution, and will end with a thorough explanation of the ways that government

financial funds could be applied to CAI Center projects. Each section is explained in detail below.

[Figure 1-41] Method for Expanding CAI Center



1) KPI used to Evaluate CAI Centers

The KPI should be consistent, correct, and available as needed. When KPIs are defined, the acronym SMART is typically applied because KPIs should be:

- Specific
- Measurable
- Achievable
- Realistic
- Timely

The KPIs that can be used for the evaluation of each CAI Center are the following:

- Number of projects submitted to and supported by calls, federal or state, that support the research applied or development of technology.
- Number of technology services provided by the IAC
- Number of undergraduate and/or graduate students participating in the IAC
- Number of graduates with a bachelor's degree or postgraduate degree due to their participation in the projects developed in the IAC
- Number of scientific and technological documents produced and disseminated
- Number of partner companies housed in the premises of the IAC

- Number of technology packages transferred to the companies
- Number of companies and/or technology-based business lines created from the research developed
- Number of joint projects networking Mexico-Korea

The first concern of the KPIs is evaluating whether the CAI Center is providing the expected results and how this will improve the region in economic terms.

2) Feedback on the CAI Center Model

In this phase, the CAI Center Board of Directors must communicate to operative personnel the improvements that must be developed to reach the KPIs. These experiences will be used by other CAI Centers to reach their goals in a more effective way, and this process is expected to create a collective consciousness for continuous improvement.

3) Selection of HEIs to transfer the CAI Center Model

The HEIs selected must be oriented towards strengthening the area of influence of HEI and must consider:

- Infrastructure
- Academic personnel
- Technological needs of the specific region
- Technological capabilities of HEI
- Financial support for the CAI Center
- Equipment required for strengthening the technological area

If all these conditions are integrated with previous experience, the new CAI Center will be successful.

4) Overview of the Infrastructure and Validation of HEI

Once all data has been collected in the previous step, the Board of Directors must evaluate which HEI will install their own CAI Center. Financial support must be considered in this step.

5) Define Specialty Area and Capabilities to Support SMEs

Using previous information, selected HEI must define which equipment and personnel will be assigned to CAI Center per specialty area. In addition, funding for acquiring additional equipment must be assigned.

Pilot CAI Centers will provide their experiences and all supporting information for a successful opening. It is important to mention that all CAI Centers are a technological net and provide support not only for project development but also for management and specialized training.

6) Select and Train Staff

In this phase, all involved personnel will be trained in specific topics for specific areas according to CAI Center organization chart (Figure 16, Chapter 1).

7) Disseminate Model to Interested SMEs

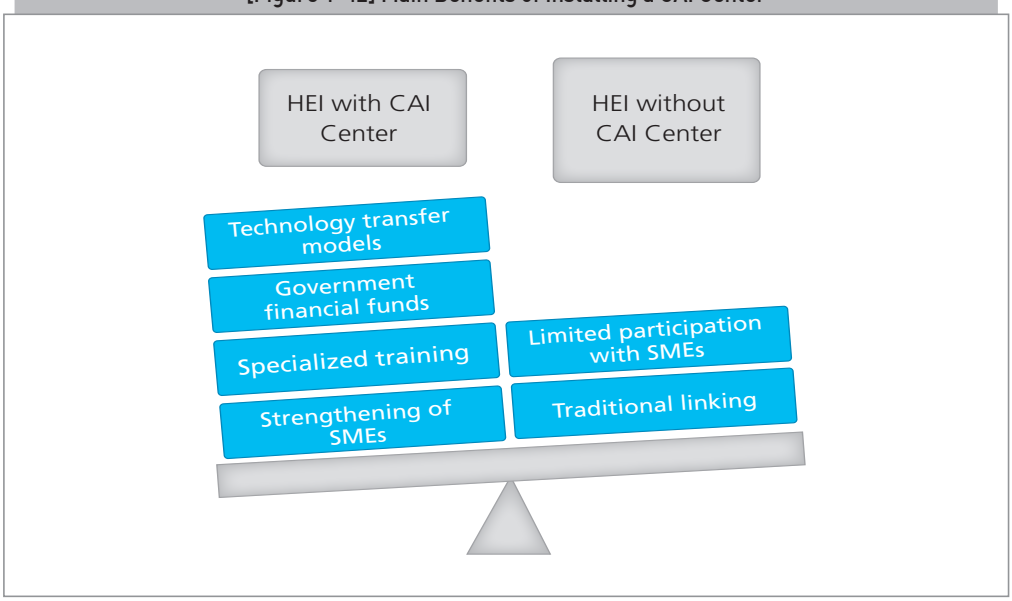
With the goal of opening one CAI Center at least every six months, disseminating the model will be an important commission and must be executed in a continuous way.

8) Methods of Financing for Project Development

In this phase, all members of the TBI will receive specific training on how to reach government calls and obtain financial funds, as discussed in Chapter 1. It is important to remember the importance of having a specific fund assigned to each CAI Center.

The main benefits to HEIs that install a CAI Center are shown in Figure 6-5 with each criterion detailed below.

[Figure 1-42] Main Benefits of Installing a CAI Center



In the first stage, how an HEI without a CAI Center works must be established. The participation of HEIs with SMEs is limited because there is more than one way to solve technologically-based projects. All efforts to satisfy industrial needs are applied individually. The solution, if is archived, does not produce real satisfaction in enterprises, and professors involved in projects are usually overworked because their primary job is teaching, not solving technological projects for SMEs.

Another consideration is which students are the focus of linkage (i.e., who will go to SMEs to participate in traditional engineering problems); one professor is assigned as a guide and advisor, but is not directly involved with the project. The traditional way is developing professional residences or industrial stays.

The benefits of having a CAI Center are detailed below:

1) Strengthening of SMEs

All transnational enterprises have special facilities for research and development. These activities engender the creation, improvement and optimization of products and processing, allowing sizeable economic profit.

Most SMEs in Mexico do not have departments for research and development. In addition, most personnel involved with scientific activities work in HEI and develop scientific basic research projects.

The CAI Center will function as a special facility to develop technology for SMEs that do not have access to these activities and do not have the financial support for facilities with specialized machinery and equipment.

2) Specialized capacitation

In the CAI Center, several specialized courses will be offered to benefit students, teachers, and the personnel who work in SMEs.

3) Government financial funds

In order to have the funds to develop technological base projects, the personnel of the CAI Center will help SMEs develop research protocols so that they can participate in federal or state calls that will give them financial support.

4) Technology transfer models

As detailed in Chapter 2, the way to satisfy technological industrial needs

is through the usage of one of four technology transfer models. These allow researchers to focus on supporting industrial needs as well as sharing their knowledge with students and including them in technological projects.

All CAI Center personnel will have ample time with which to pursue their own research interests and will have access to collaborative work that they can use to obtain a comprehensive solution to suit industrial needs.

6.3.2. Budgets for the expanding the CAI Center

As mentioned in a previous chapter, Mexico currently lacks a specific program from which to obtain the funds for the creation of a CAI Center. However, some calls from federal and state government support the development of science and technology, and can provide financial support. The pilot CAI Centers are varied because each HEI has used different resources, both from calls and from their own funds. This section considers the budgets used to establish the pilot CAI Centers in TESCO and UPVM. These budgets are merely examples and not guidelines.

〈Table 1-25〉 Projected Investment for CAI Center Opening

Item	Description	Amount in USD
1	CAI Center Building: Construction and finishes	Investment: $730,000.00
2	Personnel for E/H, TBI and ESC - Three PhD - Five MSc - Eleven Specialist for equipment - machinery operation and maintenance	Operation: $260,676.00 per year
3	Specialized workshops that will include: - Equipment - Machinery - Software	- Investment: $818,000.00 - Operation: $25,000.00 annual maintenance
4	Facilities: Office consumables, electric energy, high speed internet, office maintenance, government taxes, others	Operation: $100,000.00 per year

6.4. Expected Results

The expected results of current CAI Centers are shown in Table 6.4. The first four are the pilot CAI Centers, and the last two are the expanded CAI Centers.

〈Table 1-26〉 KPI of Current CAI Centers

Criteria being evaluated in August 2017	TESCo	TESJo	UTTec	UPVM	TESCI	TESE
Proposed projects for financial funds	10	1	2	30	2	4
Project supported by financial funds	5	1	2	15	2	2
Technological services	4	4	2	5	0	4
Students with participation in projects	4	10	6	10	15	20
Graduated students	2	2	2	2	10	20
Scientific and technical productivity	2	3	2	4	5	2
SMEs in CAI Center facilities	4	4	2	4	2	1
Technology transfer from CAI Center to SMEs	1	1	0	1	4	1
SMEs created with the TBI	0	1	0	1	2	1
Joint projects between Korea and Mexico	1	1	1	1	0	0

All CAI Centers are expected to accomplish the following macro activities:

1) Participation of SMEs in call for funds related to technological development with support of TBI
2) ESC facilities giving support to SME´s technology base projects
3) Improvement of organization manual and operating manual
4) CAI Center facilities occupied by SMEs
5) Scientific research projects oriented to obtain industrial property
6) Commercialization of developed technology
7) Promotion of Korean applied research and technological development in Mexican SMEs

The future expectations of the ITCIAC model are described below:

1) Expectations for Mexico's industrial development
   - Create new technology
   - Identify technological needs and develop a solution

- Open new markets and compete with imported products
- Improve the margin of utilities
- Reduce timing for process
- Provide the customer with high-quality products and low prices
- Promote Mexican products for exportation

2) Expected development of each university in Mexico
- Develop projects related to the development and assimilation of technology
- Promote entrepreneurship among students
- Strengthening competitions between students
- Increase employability
- Promote incomes for universities separate from the federal and state budget
- Create technology and industrial property
- Provide industry with specialized human resources
- Create a society of knowledge

3) Expected development of exchange and cooperation with Korea
- Interchange of technology and equipment with special applications
- Development of industrial property and technology base projects
- Interchange and commercialization of products and services
- Development of specialized courses for students and teachers
- Interchange of researchers and industrial stays
- Interchange and commercialization of knowledge

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2016/17 Knowledge Sharing Program with Mexico:
SMEs Development Strategies towards Revitalizing
Sustainable Regional Economy in Mexico

Chapter 2

Public Policy for Extending SMEs' Financing Support Programs in the State of Chihuahua

1. Introduction
2. Economic Status in Mexico
3. Economic Status in State of Chihuahua
4. Korean Financial Support Programs
5. Concluding Remarks

Public Policy for Extending SMEs' Financing Support Programs in the State of Chihuahua

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Summary

The 2016/17 Knowledge-Sharing Program (KSP) with the State of Chihuahua in Mexico, titled "Public Policy for Extending SMEs' Financing Support Programs in the State of Chihuahua," is a study aimed at sharing experience and information on SMEs' financing support programs in Korea. Globally, including in Chihuahua, the role of SMEs has been crucial for stimulating the ripple effect of foreign direct investment (FDI), which boosts the regional economy with the belief that SMEs are fundamental to the rise of the regional economy by expanding the job market and leading innovative management approaches. In this context, Chihuahua has been interested in Korean SME policy while seeking proper approaches to significantly galvanize the ripple effect of FDI.

To achieve our purpose, this study has analyzed the current status of Mexico and Chihuahua State to find relevant approaches to Chihuahua's circumstances. Furthermore, we have briefly reviewed Korean SME support programs, such as government venture capital (GVC) and the credit guarantee scheme (CGS). Based on the analyses, this study has suggested basic directions for Chihuahua State's public policy for SMEs' financing support programs. First, as we excluded central government-centered programs from CGS, the regional CGS and re-guarantee scheme are addressed in this study. Second, we particularly discussed the Fund of Funds (FoF), a GVC program, as one of the suggestions given that FoF has created surprising achievements for financing high-tech enterprises in Korea, which is

a highly desirable outcome for Chihuahua State. Third, we have proposed to implement entrepreneurship programs rigorously in the State in terms of FDI's ripple effect.

It should be pointed out that this study was a synthesis of the efforts and interests of Korean and Mexican researchers. Since Chihuahua State is in a relatively good position to implement SME programs thanks to a large pool of highly trained workers as well as a basic economic infrastructure supported by FDI, the Chihuahua government was eligible for the proposal of various SME programs to allay vulnerability in accessing finance.

1. Introduction

1.1. Research Background and Objective

Chihuahua State, which shares approximately one-third of border areas between Mexico and the U.S., has substantially benefited from large-scale foreign direct investment (FDI). Since Chihuahua has accessibility to the U.S. and low labor costs, it has risen as an international border community. Unfortunately, however, the positive effect of FDI has not trickled down to the domestic economy because domestic corporations in Mexico have not been prepared to employ the benefits of FDI without government assistance. Confronting the limited public infrastructure, Chihuahua State has embarked on an enlightening plan for small and medium-scale corporations by supporting financial aid independently.

Not only in Mexico, but throughout the world, the role of SMEs has been the main factor in stimulating the regional economy, since small enterprises are optimal for precipitating the ripple effect in that the business population is located mostly at the bottom of the economic structure. With the belief that SMEs are fundamental to regional economic growth, SMEs are perceived as a vital tool for expanding the job market and also often referred to as crucial for alleviating economic stagnation and reorganizing the economic ecosystem.

In this context, it is inevitable that Chihuahua State has been interested in examining diverse SME support policies that are currently successfully executed worldwide while seeking proper approaches to galvanize the ripple effect of FDI in its local economy. Although the Maquiladora program applies a preferential tariff under the trade agreement between Mexico and the U.S., creating numerous benefits, the critics state that large-scale enterprises have obtained most of the advantages of the program. Meanwhile, SMEs, which are removed from the benefits, are faced with a considerable financial quagmire. Indeed, most of them

are experiencing hardships in operating manufacturers and facilities. To manage the unbalanced benefit distribution, the role of the government cannot be emphasized enough to design and implement a financial support program for SMEs.

In particular, the Economic Commission for Chihuahua State has long held the belief that the biggest barrier to SMEs' growth is attributed to a lack of attractiveness. They think that Chihuahua State lacks merits for attracting foreign investors in the State because its domestic SMEs have a dearth of technological innovations to satisfy foreign investors. Thus, Chihuahua State scrutinizes a wide range of policies that other countries have implemented for SME growth prior to designing its own financial support program. Collaborating with Korean researchers under the 2016/17 Knowledge Sharing Program (KSP) is clearly one of their attempts to discover an optimal SME policy and make their own. For the last few decades, Korea has attempted to foster its government capabilities corresponding to the needs of a better environment for SMEs' entrepreneurs. Therefore, we expect that the agency officers in Chihuahua State will be able to trace clues through this co-research project by sharing some valuable experiences of the Korean government.

1.2. Research Scope and Approach

Before determining the subject of this research, cooperation and communication between researchers in Korea and Chihuahua State are essential to reach a consensus. Staff in Chihuahua State had initially suggested that Korean researchers should conduct co-research with a topic "Public Policy for broadening SMEs' financing support programs in the State of Chihuahua" before Korean researchers visited the State for the "High Level Demand Survey & Pilot Study" from the 19th to the 23rd of September. After the pilot study, the two parties discussed revising the first research topic to "Public policy for the creation and development of Startups in the State of Chihuahua with public–private collaboration" as they agreed to broaden the view to weigh more on private components for the advancement of the small enterprise economy rather than focus on the role of public power. This was an attempt to allay the economic structural conflicts with the market's own capabilities. However, the co-researchers finally determined to revert to the first research topic. The critical reason for this is that in the environment of the state, it is premature to execute an SME financial support program mainly depending on the private sector, such as venture capital or angel funding. When the research agents conducted the second pilot study (Nov. 27th-Dec. 4th), they realized the need to consider the extent to which public activities compared to the private sector for the SME growth initiatives, so they have studied the economic status of the state to assess the applicability of fund-related policies, especially for which the government can take the main role, such as Israel's "Yozma Fund" and the Korean FoF. However, eventually, these fund-related tools demand a well-built infrastructure for innovative industries to be securely promoted.

Clearly, we can assume that we may expect profit sharing when we fund.

Accordingly, venture capital investment in Silicon Valley in the U.S. was concentrated in specific industries, such as software, biotech, media, and entertainment; the proportion of these industries is over 60% of total venture capital investment. In response, it was observed that Chihuahua State may take extra time to apply a venture capital system as one of the financial support policies driven by its government since the economic structure is still untenable. To be specific, most corporations in Chihuahua State are at a nascent stage of industrial structural maturity that is just entering the third generation of Maquiladora. Lately, it has been experiencing a tremendous economic shift from assembly-centered production manufacturing to design and engineering-centered manufacturing. Nevertheless, traditional manufacturing dominates the industrial regions throughout Chihuahua State. Based on the market principles, we can easily assume that an aim of private investment is ultimately profit earning. Regarding this point, an approach depending on public sectors is preferentially examined rather than relying on the help of the market based on the estimation that a significant number of investors will go through to find certain enterprises to fund in Chihuahua. As mentioned above, Chihuahua State would barely satisfy the needs of investors since mid- or low-tech industries have limitations for attracting investors. Overall, the Chihuahua Council for Economic Development and KSP agents decided to conduct co-research on "State-leading approaches for alleviating the financing gap for small and medium enterprises."

Under the consensus of studying for attenuating the financing gap with the help of public organizations, the researchers identified that the federal government of Mexico has been committed to organizing and establishing various policies and legislations with the goal of supporting the rise of SMEs, while the volume of the policies is not necessarily considerable. Surprisingly, Chihuahua State has not perceived the fact that the federal government-driven support programs for SMEs have been implemented in various ways, including loans, credit guarantees, angel funds, and FoF by the federal government. As a result, financial support programs advocated by the Mexico federal government are necessary before examining Korean cases based on the 2016/17 KSP with Mexico.

1.3. Research Construction

This chapter consists of four sections. Following the introduction, the second section reviews the economic structure of Chihuahua State and a myriad of small-scale financial support programs currently executed by the federal government of Mexico. In this section, we expect that the knowledge gap in SMEs' relief policies between the federal and the state government will be narrowed. Agreeably, policy

executors in Chihuahua State have not fully perceived federal-level actions. In fact, the Mexico federal support programs are currently restricted to expanding their own influence to the State of Chihuahua since each one neither has sufficient scale for covering the whole Mexico region nor overcoming the physical distance constraints, so the federal government has tendentiously distributed the supporting infrastructures of the capital city of Mexico. Thus, the need for alternatives to the federal-driven policies is highlighted to complement the ongoing deficiencies. In the third section, we discuss Korean financial support programs and the regional CGS. The aim of the section is to trigger motivation for regional government-led economic support programs for SMEs. The KSP assures that study of Korean regional programs for SME financial procurement will clearly contribute to attracting applicable and feasible ideas for relief methods for SMEs in the State of Chihuahua. Furthermore, we intend to introduce the background and development progress of FoF under the belief that understanding the tool of the mechanism will help Chihuahua State to prepare the incoming venture capital market, which is driven by private institutions. Lastly, in the fourth section, we suggest several promising measures for Chihuahua State that would be helpful to allay the vulnerability to accessing financial resources by examining the government-driven incentives of Korea, especially the regional credit guarantee and the FoF.

2. Economic Status in Mexico

Since the beginning of the 2000s, Mexico has emerged as an SME-centered country. According to <Table 2-1>, the enterprises, including micro, small, and medium enterprises, in Mexico constitutes about 99.3% of those in 2009, and the share of SMEs is not minute compared with that of other countries. Furthermore, employment triggered by SMEs in Mexico reached 67.9% in 2013, as shown in <Table 2-2>. Based on the figures, we identify that the economic structure in Mexico largely relies on small-sized enterprises.

In this regard, the Mexican government has emphasized the key role of SMEs, which are anticipated to accelerate economic prosperity by pronouncing the agenda of "more and better jobs, more and better enterprises, and more and better entrepreneurs" under the action of the Entrepreneurial Development Plan (2001-2006). After that, the effort to fortify the capacity of domestic SMEs continued with an aid program named the Economy Sectorial Program (2007-2012). The helpful action driven by public assistance for the first step was laudable in that it allowed the establishment of a systematic infrastructure for supporting SMEs in the early period so that ensuing policies and programs associated with SMEs could be naturally operated.

The Mexican government embarked on anchoring seven sub-objectives in response to SME-related initiatives: 1) to improve policy coordination, 2) to better communicate the SME policy framework, 3) to enhance the capacity of states and local authorities to absorb federal policy impulses and to take policy initiatives, 4) to create an efficient evaluation culture at all levels of government, support units, and intermediate organizations, 5) to increase micro firms' take-up of programs, 6) to increase recourse for SME policies, and 7) others. Based on the consideration of each objective, the government tried to consider the reliability and feasibility of the policies on the list and determined to take action on operating policies.

Besides, Mexico created governmental agencies, such as the Ministry of Small and Medium Enterprises in the Ministry of Economy in the early 2000s that have responsibilities for thorough tasks associated with SMEs. In addition, the federal government was eligible to manage and offer a coherent set of SME policies as it became possible to extract essential policies that meet both central and regional government needs while it eliminates redundancy that unnecessarily overlapped among the initiatives. Unfortunately, these well-ordered plans do not always yield benefits because the risk of uncertainty exists all the time. However, we never neglect proper preparation against risks to minimize losses and side-effects. Thus, examining the economic status in Mexico has been conducted before making a recommendation for financing support programs for Chihuahua State in this section.

〈Table 2-1〉 Size Distribution of Enterprises in Mexico and Various Countries (2009)

Country	Micro	Small	Medium	Large
France	93.2%	3.4%	3.1%	0.2%
Greece	96.3%	2.2%	1.5%	0.1%
Mexico	93.1%	3.2%	3.0%	0.4%
Portugal	95.0%	2.8%	2.1%	0.1%
Spain	93.8%	3.5%	2.6%	0.1%
United Kingdom	89.1%	5.8%	4.6%	0.4%
United States	79.3%	10.5%	9.7%	0.6%
Brazil	84.6%	9.1%	5.9%	0.4%

Source: OECD Structural and Demographic Business Statistics.

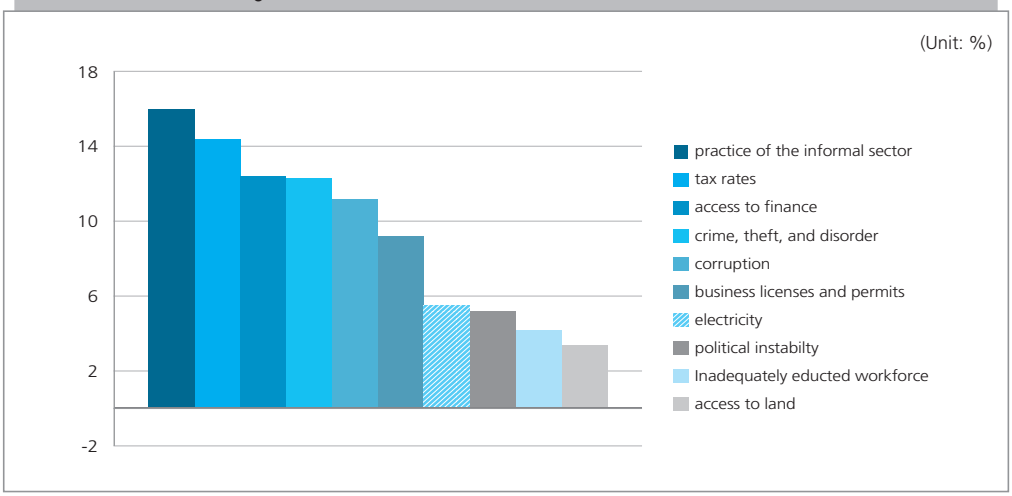
〈Table 2-2〉 Employee Distribution of Enterprises in Mexico and Various Countries (2013)

Country	Micro	Small	Medium	Large
France	29.3%	7.8%	25.9%	36.9%
Greece	59.0%	7.8%	19.5%	13.6%
Mexico	30.6%	12.6%	24.7%	32.1%
Portugal	42.1%	9.3%	27.0%	21.5%
Spain	40.8%	9.1%	23.4%	26.7%
United Kingdom	18.0%	8.5%	26.7%	46.8%
Brazil	22.2%	10.8%	28.2%	38.8%

Source: OECD Structural and Demographic Business Statistics.

Since SMEs constitute a substantial part of the economic structure in Mexico, the rise and all of Mexican economy, whether positive or negative, is quite highly related to what SMEs experience. Therefore, the Mexican government has apparently realized that commitment to enriching SMEs' economy is important to pursue efficiency throughout the home economy by providing proper initiatives. As [Figure 2-1] shows the major obstacles normal entrepreneurs experienced in Mexico in 2010, "access to finance," just after "practice of the informal sector" and "tax rates," is heavily considered a factor and mainly points to difficulties in terms of operating businesses. The gravitas that entrepreneurs perceive regarding the financing dearth may precipitate public application.

[Figure 2-1] Obstacles to All Businesses in Mexico (2010)



Notes: Regional averages of indicators are computed by taking a simple average of country-level point estimates. For each economy, only the latest available year of survey data is used in this computation.
Source: World Bank Enterprise Survey, 2017.

Furthermore, as shown in [Figure 2-2], the results from the cross-national comparison demonstrate that companies in Mexico are experiencing restrictions regarding financing. Compared with Latin American and Caribbean (LAC) countries, financial resources provided to Mexican entrepreneurs are about a half of the percentage of GDP and entrepreneurs in OECD countries approximately five times likelier to be financed than those in Mexico. Meanwhile, in terms of domestic credit by the financial sector in Mexico, lower financial resources have been provided than in other countries, as it has a similar tendency to the private sector, which includes loans, purchases of non-equity securities, and trade credits and other accounts receivable.

Domestic credit not only to the private sector, but also collected from the banking sector appears much lower than in OECD member countries and LAC countries. The fundamental reason generating those malfunctioning banking system indicates the oligopolistic market feature; a few large banks are likely to avoid financing micro-sized firms due to cost inefficiency. This barrier to accessing finance through the bank system has led firms in Mexico to supplement their financial resources from other sources, such as trade credit, internal investment, and equity.

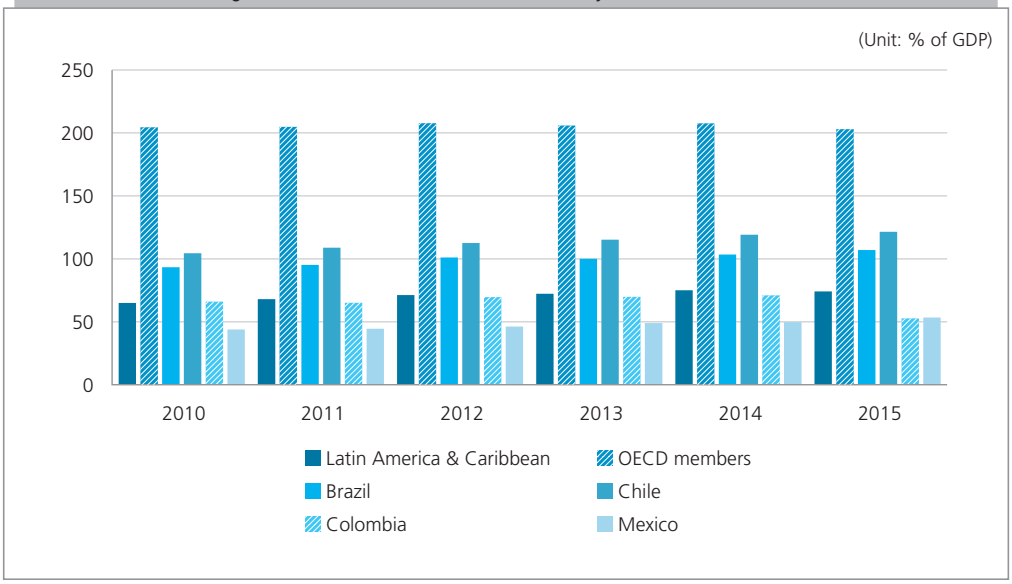
[Figure 2-2] Domestic Credit to the Private Sector



Note: Domestic credit to the private sector refers to financial resources provided to the private sector, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment (definition from World Bank, 2011).

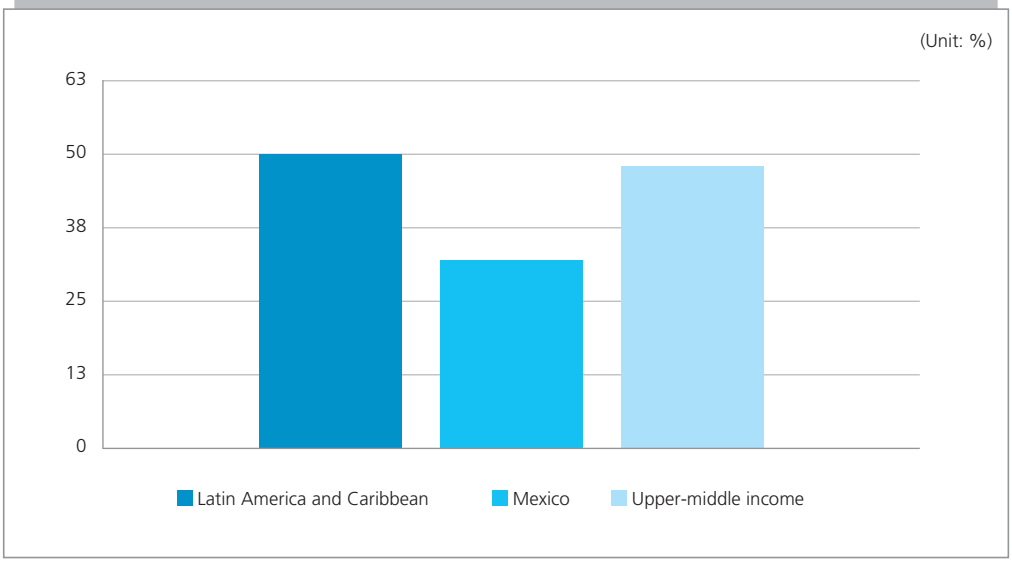
Source: World Bank, World Development Indicators Database.

[Figure 2-3] Domestic Credit Provided by the Financial Sector



Note: Domestic credit provided by banking sector refers to all credit to various sectors on a gross basis, except to the central government, which is net. The banking sector includes monetary authorities, deposit money banks, and other banking institutions for which data are available (definition from World Bank, 2011).
Source: World Bank, World Development Indicators Database.

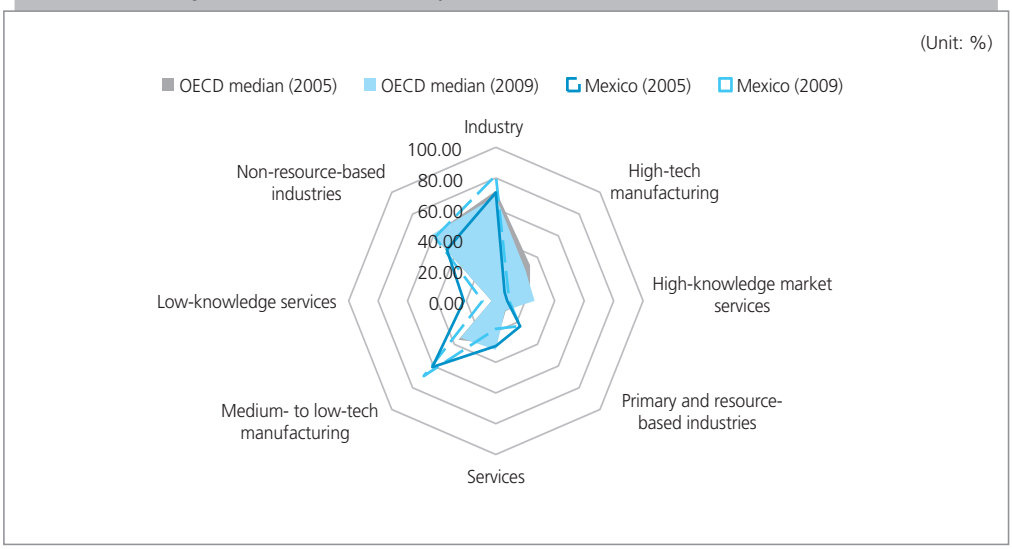
[Figure 2-4] Proportion of Firms with Access to Finance (2010)
Access to a bank loan/line of credit



Note: Regional and world averages of indicators are computed by taking a simple average of country-level point estimates. For each economy, only the latest available year of survey data is used in this computation.
Source: World Bank, Enterprise Survey, 2017.

We cannot deny that affluent investment in R&D is the main driver of effective innovation in the economy. However, unfortunately, the business composition in Mexico appears to be distant from the mainstream since businesses in technology-centered industry has been weakened, while other countries in the OECD mainly invest efforts in prioritizing boosting technological innovation. In 2009, government and public expenditure on R&D stood at 0.25% and 0.18% of the GDP, respectively, in Mexico; in contrast, the expenditure of OECD members was 0.72% and 1.12%, respectively. [Figure 2-5] shows the national policy composition of multiple aspects, such as the total economy (industry vs. services), manufacturing (high-tech manufacturing vs. medium-to low-tech manufacturing), market services (high-knowledge market services vs. low-knowledge services), and resource-based industries (primary and resource-based industries vs. non-resource-based industries). The results comparing the structural composition between 2005 and 2009 indicate that OECD countries have a growing willingness to promote 1) high-knowledge market services, 2) the service economy, and 3) non-resource-based industries. In contrast, Mexico expanded its 1) primary, resource-based, and 2) services economy, but the other structural compositions show a decline. Interestingly, low-knowledge services in Mexico resulted in an explosive expansion from 9.12% in 2005 to 21.77% in 2009. Regarding the OECD median, a slight shift in the national policy composition is shown for all aspects, but the change does not ruin the tendency to seek innovation. However, businesses in Mexico highly rely on low and mid-tech industries (60.99%) and low-knowledge services (47.14%). In addition, the movement toward anti-innovation was strengthened in 2009 compared to 2005.

[Figure 2-5] Structural Composition of Business R&D in Mexico (2009)



Source: OECD (2012), Science, Technology and Industry 2012.

Apart from the issues related to expenditure in R&D and businesses composition, we can also determine the deficiency in seeking to innovate businesses with other evidence. <Table 2-3> presents every year's activities associated with patent applications and awards. Foreigners accounted for the vast majority of patent activities, with 93.5% of patents applied for by non-Mexican nationals. In addition, 97.6% of awarded patents were contributed by foreigners in 2010; 9,170 patents registered by foreigners were awarded, while only 229 patents from nationals were granted. As well as expenditure on R&D, patent-related achievements in Mexico suggest a weakness of domestic innovation capacity as well as dependence on knowledge drawn from other countries for pursuing economic growth. Without sacrificing to raise the innovation level in domestic industry, dependence on other countries equipped with higher innovation may continue. Thus, people in Mexico need to recognize the severe innovation crisis.

〈Table 2-3〉 Patents Applied for and Awarded in Mexico (2005–2010)

Year	Applied			Awarded		
	Nationals	Foreigners	Total	Nationals	Foreigners	Total
2005	584	13,852	14,436	131	7,967	8,098
2006	574	14,926	15,500	132	9,500	9,632
2007	641	15,958	16,599	199	9,758	9,957
2008	685	15,896	16,581	197	10,243	10,440
2009	822	13,459	14,281	213	9,416	9,629
2010	951	13,625	14,576	229	9,170	9,399

Source: Mexican Institute of Industrial Property, Annual Report, 2011.

From overviewing the recent economic status in Mexico, some indicated features are salient. First, large enterprises including over 100 employees consist of only 2% of businesses. Second, most of the conflicts that small and medium-sized enterprises have suffered lately have been pointed out as involving practices of the informal sector, tax rate, and access to finance. Lastly, the movement in Mexico toward R&D has been hindered and reverted to traditional industries, such as medium-high or low-technology manufacturing as well as low-knowledge services, although businesses in OECD countries have attempted to develop high-knowledge market services and non-resource-based industries.

3. Economic Status in State of Chihuahua

Based on knowledge of the economic status of Chihuahua, we are concerned by the extent to which public policies can positively influence the regional economy in this section, since the recommendations were hastily proposed without carefully understanding it, making them implausible. We determined that the two key drivers of economic development in Chihuahua State are geographical location and the free-trade agreement (FTA), called Maquiladora. Chihuahua State has utilized the merits of its physical position, as it shares one-third of the border area between Mexico and the U.S. by sitting immediately below U.S. territory. The proximity to U.S. territory delivers considerable benefits to Chihuahua State, such as lowered transportation costs and fast communication. These two nations under the trade agreement have been involved in unswerving solid relationship thanks to expectations that the FTA will create wider prosperity for both. In the U.S., cost-saving for the manufacturing industry is obvious under the agreement with Chihuahua State because the labor cost in the region is shown to be four times less than in the U.S. and the relationship also brings economical transportation costs. On the other side, Chihuahua State supported the agreement because it expected a spillover effect once the Maquiladora program was embarked on by spreading technologies such as automobile assembly and electronic manufacturing and knowledge, including well-systemized administrative methods in their domestic regions from the U.S. Thus, Chihuahua State has agreed to implement the Maquiladora program for a few decades, but it is difficult to assert that the international program has exclusively attracted positive outcomes.

Now, we will discuss how Chihuahua State has experienced successes and challenges from economic perspectives. In advance, the economy of Chihuahua State can largely be described with the term "despondence," because the regional capacity rarely engages with autonomy to catalyze its economic growth and it requires unavoidable buttressing from external help (mostly from the U.S.).

3.1. Economic Development Model

Since the end of the 1990s, the external and internal economic crisis has threatened Chihuahua State. The crisis in Chihuahua State was attributed to internationalization since the enterprises in well-developed countries keep pursuing large-scale businesses because mergers and acquisitions allow effective coverage of broad markets worldwide. Similarly, mechanization is another factor that has led to the crisis in the State of Chihuahua in that the merits of low labor costs in Chihuahua State have been weakened by replacing human assets with machines. Simultaneously, the emergence of China, recognized as a preeminent country featuring a cost-saving way of manufacturing, has accelerated the crisis by fortifying international competition among certain nations that receive advantages from low-labor costs. In this external

shift, Chihuahua State could not have avoided damage. It is too vulnerable to withstand the over-heated competitive environment because it largely depends on the manufacturing industry, which is well-known to be weak from external impact. <Table 2-4> Nevertheless, manufacturing accounted for 21.8% of the state's GDP in Chihuahua in 2015, and the rate shows an unstable tendency in that rises and falls are not predictable from the rate from 2003 to 2015. Additionally, real estate and rental and leasing account for a large share of the State's GDP, although it decreased from 16.4% to 14.4% from 2003 to 2015. At this point, Chihuahua State seems to be well-prepared for stimulating manufacturing industry growth because real estate and rental and leasing are recognized as an essence for meeting what manufacturing industry demands; for instance, manufacturing inevitably requires land to construct factories or buildings for making products.

Meanwhile, the ceaselessly developing technologies may debilitate the job market in the state. Machinelike innovation no longer uses human assistance, but prefers to apply mechanical automation in accordance with cost-saving for a long-

〈Table 2-4〉 Economic Structure in State of Chihuahua (2003, 2009, 2015)

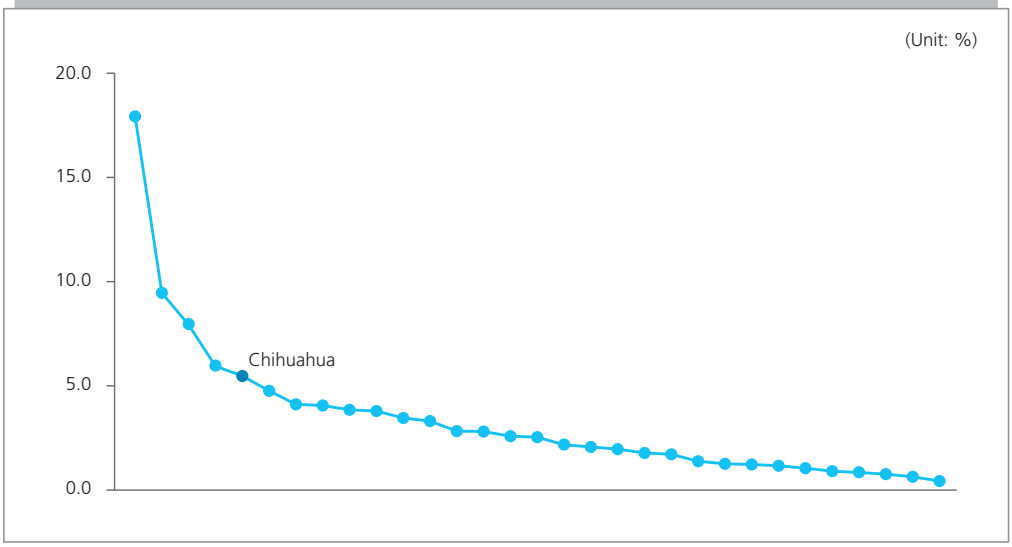
Industry Type	GDP			Employment Rate
	2003	2009	2015	2014
Agriculture, Forestry, Fishing, and Hunting	5.7%	6.9%	6.7%	0.1%
Mining, Quarrying, and Oil and Gas Extraction	1.3%	1.9%	2.0%	1.3%
Energy	2.7%	3.7%	3.5%	0.6%
Construction	9.8%	8.7%	8.5%	2.1%
Manufacturing	22.1%	20.7%	21.8%	46.6%
Wholesale and Retail Trade	15.5%	14.0%	15.5%	22.9%
Transportation and Warehousing	4.5%	3.8%	4.5%	2.7%
Information	1.9%	3.8%	4.0%	1.3%
Finance and Insurance	1.3%	2.4%	3.3%	0.5%
Real Estate and Rental and Leasing	16.4%	15.9%	14.4%	0.9%
Professional, Scientific, and Technical Services	1.3%	1.5%	1.3%	1.5%
Admin. & Support and Waste Mgmt. & Remediat. Svcs.	2.2%	1.8%	2.2%	3.6%
Educational Services	4.4%	4.5%	3.8%	2.0%
Health Care and Social Assistance	2.2%	2.1%	1.6%	2.8%
Arts, Entertainment, and Recreation	0.3%	0.3%	0.2%	0.7%
Accommodation and Food Services	2.1%	1.9%	1.5%	6.0%

Note: Constant GDP 2008 price proportions.
Source: CODECH based on BIE-INEGI (2016) for GDP data and Economic Census 2014 for employment data.

term perspective. In fact, Chihuahua State has been struggling due to the drastic shift to secure the employment environment and has tried to acclimate to the new work environment, which needs new skills. To be specific, labor in Chihuahua State has harshly attempted to meet new demands, such as producing flat-screen and plasma TVs, but the capacity for a new segment of technology is limited for covering all residuals so that the remaining laborers have been replaced by machines.

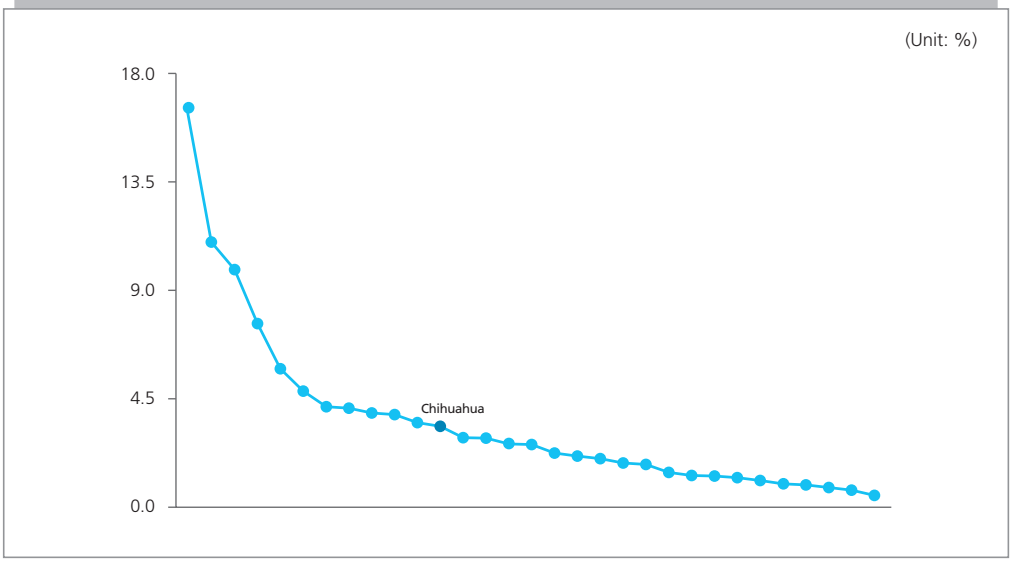
As much as the economic structure unbalances in Chihuahua above, the economy in Mexico dominantly relies on a few municipals out of 32 states; five precursors — CDMX, Nuevo León, Jalisco, Guanajuato, and Veracruz — led approximately half of economic growth between 2003 and 2015. Specifically, Chihuahua State has contributed to 3.5% of overall national growth (see Figure 2-7); the State placed 11th for contributing to increasing GDP in Mexico based on analysis of GDP growth rate among all the states from 2003 to 2015 and it shows that 2.0% points dropped and six other states surpassed Chihuahua compared to the level of contribution for the early period (1995-2003) when the state placed fifth (see Figure 2-6). Therefore, the situation worsened over the last decade as the golden era of Chihuahua State ended. This unexceptional drop in the GDP growth rate is subject to turbulences caused by external shocks, which it has already experienced twice in less than 10 years.

[Figure 2-6] State Contribution to National Growth (2006 with respect to 1995)
Ordinal ranking of state's share of national increase in GDP



Note: States are ranked in the horizontal axis according to their growth contribution.
Source: CODECH calculations based on Banco de Información Económica, INEGI (2016).

[Figure 2-7] State Contributions to National Growth (2015 with respect to 2003)
Ordinal ranking of state's share of national increase in GDP

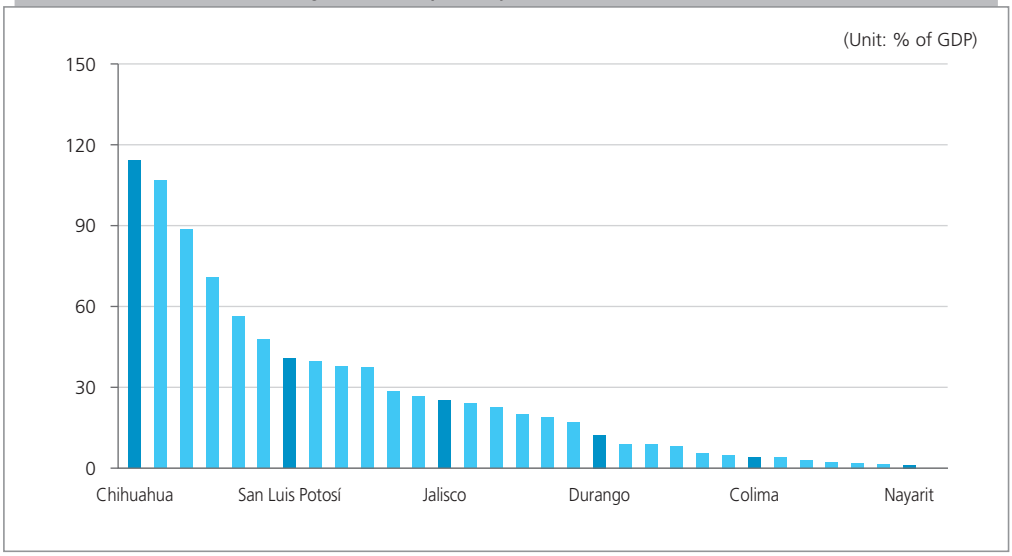


Note: States are ranked in the horizontal axis according to their growth contribution.
Source: CODECH calculations based on Banco de Información Económica, INEGI (2016).

Next, we need to examine the positive aspects of the economic circumstances in Chihuahua. We may conclude that there is outward economic prosperity, which is largely due to its proximity and openness. Mexico determined to introduce the Maquiladora policy in 1965 under the Border Industrialization Program, which aimed to promote the Mexican domestic economy. The policy was implemented in certain export-oriented zones by centralizing a high level of governmental support. It is undeniable that Maquiladora industry helps Chihuahua State to thrive through achievements such as job creation, the attraction of FDI, and revenue earnings from taxation. Additionally, a considerable number of employees have been newly introduced in workplaces around Chihuahua as well as factories and program-related facilities have been built in the state in response to the implementation of the Maquiladora program. As a result, the state has accomplished successful achievements in terms of exports as it shows 114% of the export rate as a proportion of its GDP in 2015. This is also a far greater achievement compared with those of other states in Mexico (see Figure 2-8). Along with this achievement, we may question why Chihuahua State has been struggling from the stasis of economic growth despite the merits of the Maquiladora program. The answer is that it could not have overcome several side-effects by operating the program. We recognized the fact that the program truly aimed to promote quantitative growth to increase exports as much as possible, but the State was, unfortunately, blinded to the need to link the positive effect of FDI with its domestic economy. Thus, the simple-minded manner of the program management led to fewer opportunities to ameliorate the

gloomy regional economy in Chihuahua State. Furthermore, social problems ensued, such as the oblique development of the economy between border states and others so that the gaps in economic opportunities among the regions attracted countless migrants from rural sites to the regions of the border states. The movement of excessive residents toward a few cities in Chihuahua State has elicited additional social and environmental concerns, such as a shortage of both public services and housing and land as well as air and water pollution.

[Figure 2-8] Exports by State in Mexico (2015)



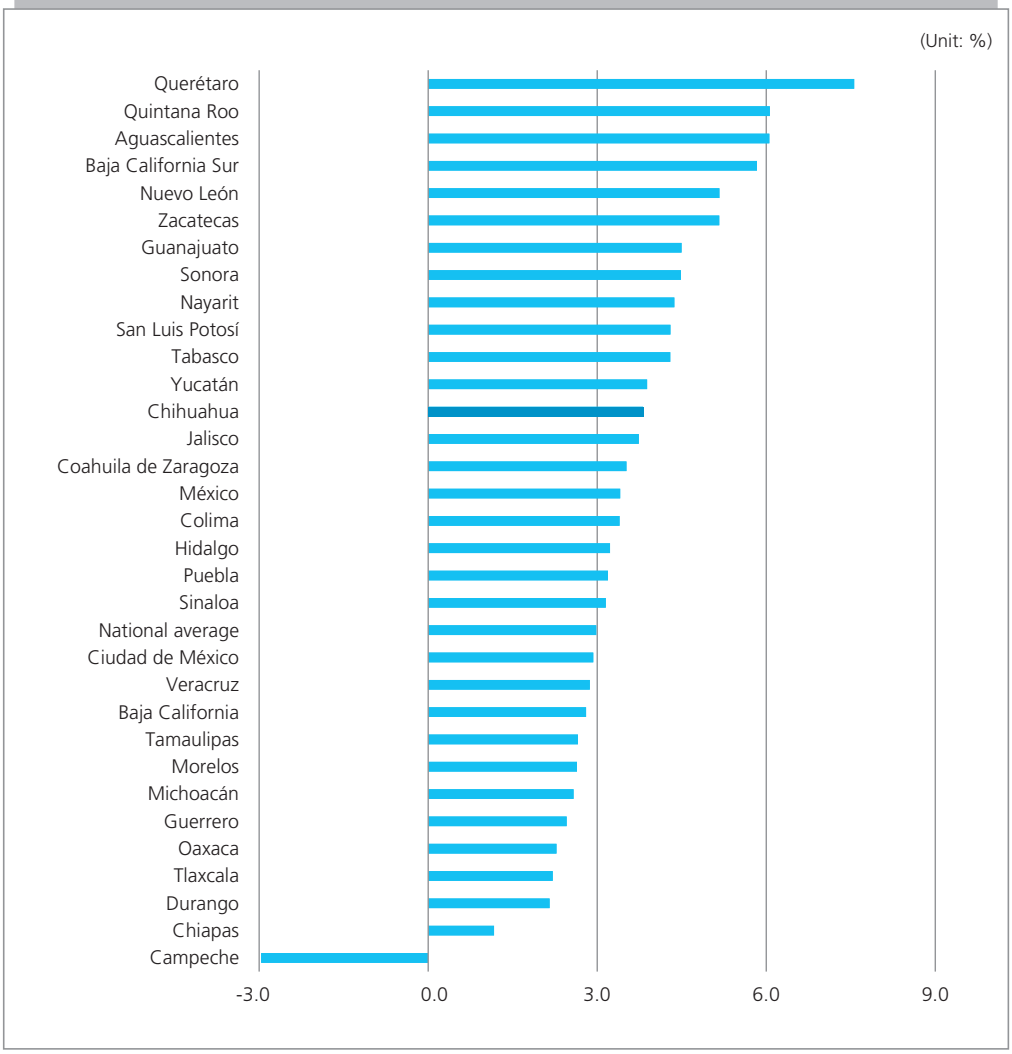
Note: Constant GDP 2008 prices in US dollars estimated by CODECH.
Source: CODECH based on BIE-INEGI (2015).

Although the effect of FDI in Chihuahua State has played a vital role in positively changing the economic environment, it has raised significant concerns as well. In particular, income differences have emerged as a domestic concern. Employment has been limited to contain the entire labor supply originating from countless immigrants from bucolic regions. Relatively, the economic productivity of Chihuahua State has not met expectations because of excessively low labor costs. Highly productive regions are usually devoted to certain types of industries – such as tourism and oil production – with which Chihuahua State does not close. Therefore, productivity in Chihuahua is considered to have greatly fallen behind the Mexican national average.

As a result, we addressed a wide range of challenges associated with the economic status in Chihuahua State: 1) isolated industrial development, 2) weakness of productivity, 3) inactivity increase, and 4) myriad social conflicts, such as environmental pollution and a dearth of land and housing. These negative

performances have interfered with the growth of the regional economy and led it to lag behind 25 other states. The annual economic growth rate was 0.25% from 2004-2009, while the Mexico national rate was 1.34% over the same period; fortunately, the economic growth rate improved by 3.8% in 2015 compared to that of 2003 (see Figure 2-9). Through examining the economic status of Chihuahua State, we can determine how heavily external shocks influenced the regional economy. In this regard, federal and state government has made decisions to remedy economic and social issues.

[Figure 2-9] Economic Growth among Mexican States (2003–2015)

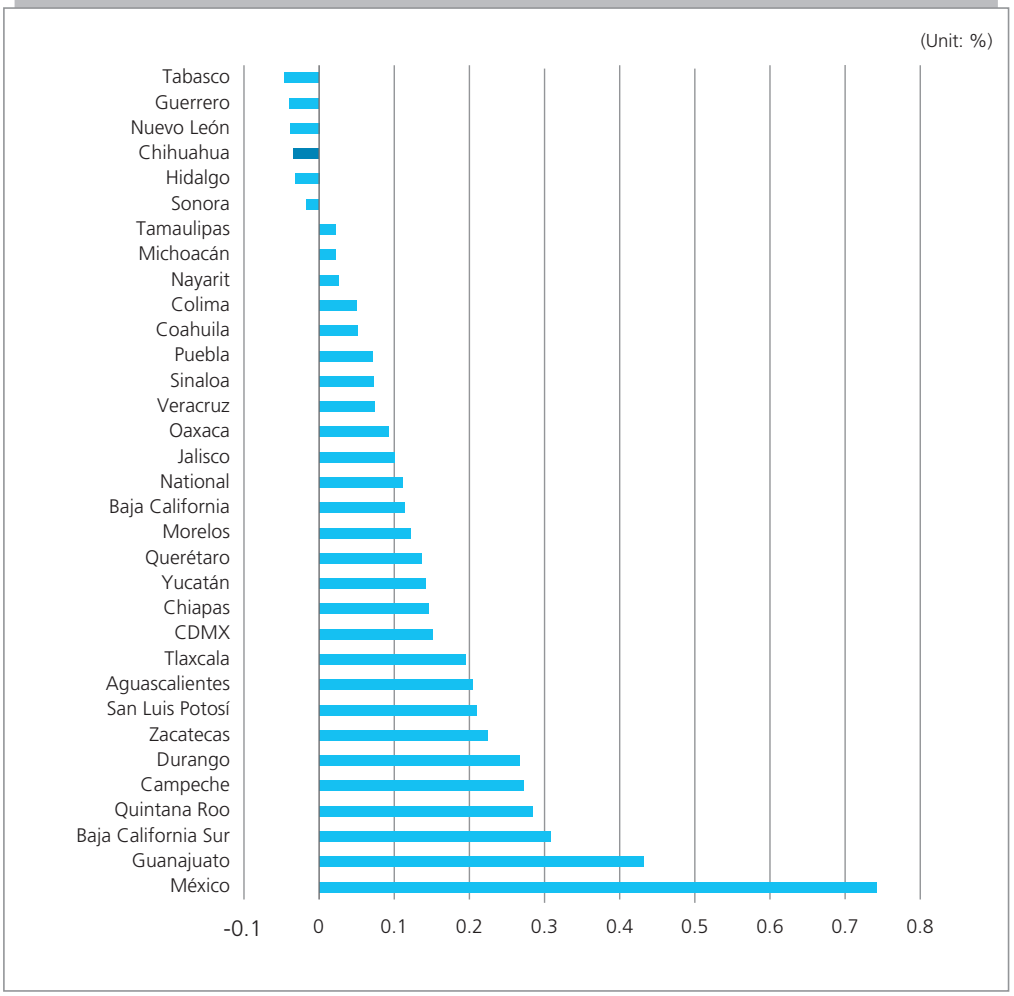


Note: Real average annual growth rates using GDP (2008 prices).
Source: CODECH based on BIE-INEGI, 2016.

3.2. Public Involvement in State Economic Development

Generally, agency officers determine the assignment of government capital to public investment with the goal of ameliorating economic stagnation. Activities such as building tangible and intangible regional infrastructures and the establishment of social service policies, in fact, have demonstrated the invigoration of the economic circumstances case by case. As shown in [Figure 2-10], the level of public investment in Chihuahua State has lagged far behind in Mexico, and it was even involved in the atrophy tendency. To be specific, the annual growth rate for public investment in Chihuahua State was -3.4% from 2003 to 2015 in spite of the increasing propensity for public investment in most states, with a national average of 74.2%.

[Figure 2-10] Public Investment by Mexican State (2003–2015)

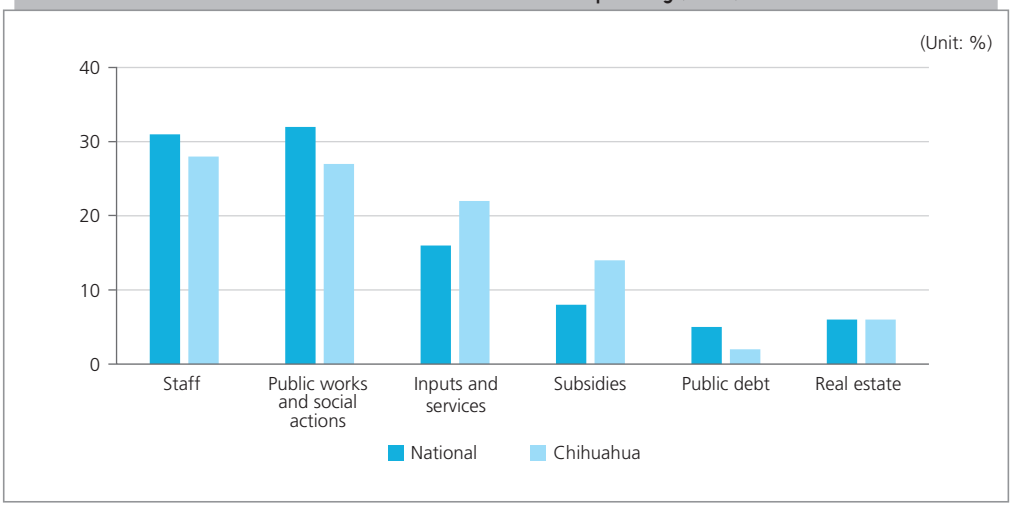


Note: Real average annual growth rates using GDP (2008 prices).
Source: CODECH based on BIE-INEGI (2015).

The rate corresponding to public projects and subsidies shows an 11% increase annually, and the volume of investment allocation was more than 12.4 billion (MXN) in 2015. The growth rate of public investment in Chihuahua State decreased by 3.4% from 2003 to 2015. This reflects a big cleavage and that Chihuahua State should catch up by allocating significant public investment.

Indeed, the controversy regarding public investment points out underutilization driven by the state-level capacity to control investment. The activity of the state has been derided in that it restrained the expansion of the public investment impact, neglecting the anticipation to precipitate economic motilities. It is estimated that the state lacks the sophistication to choose appropriate fields that are likely to create divergent economic activities. Although we completely accept the fact that education and security are important fields public organizations should consider, it would be difficult for Chihuahua State to avoid the blame from underrating the effect of investing assets in infrastructure construction (public works), while it spent 17% (MXN 1.7 billion) of all its investment in an aqueduct (water system maintenance and sanitation) in 2009. For more details, [Figure 2-11] shows the comparison of public expenditure between Chihuahua and Mexico.

[Figure 2-11] Public Expenditures by Municipality in Chihuahua and Mexico Gross spending (2009)

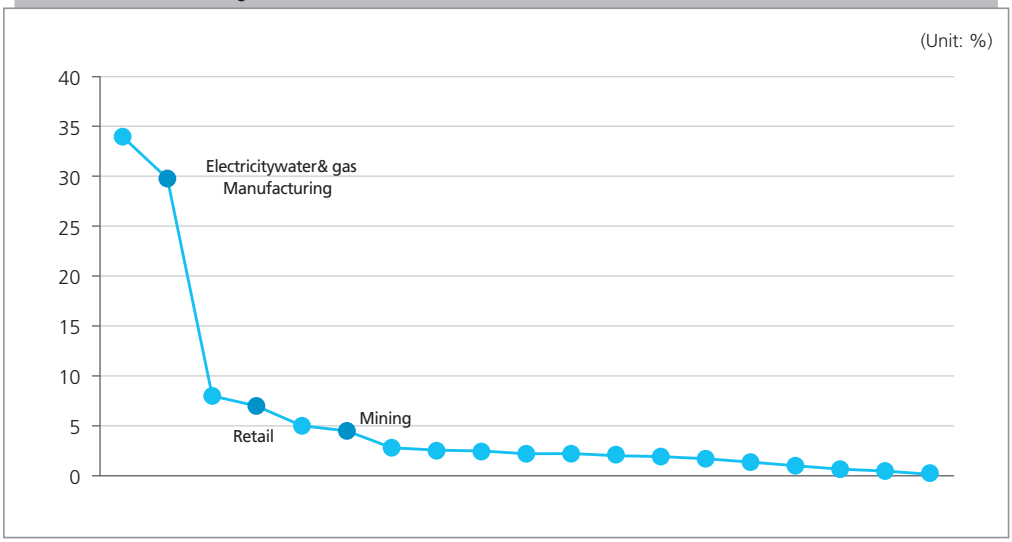


Source: Author's calculations based on INEGI (2005) and Sistema Estatal y Municipal de Bases de Datos (SIMBAD), accessed online at http://sc.inegi.org.mx/sistemas/cobdem/ on June 15, 2011, Instituto Nacional de Estadística, Geografía e Informática, Mexico.

Apart from the issues of public investment, has private investment been committed to stabilizing the economy in the state? The answer is no. Private investment is well-known to prioritize profit earning. In this regard, we cannot

ignore the market principle when considering how the properties of private investment differ from the public investment and assume that the most important objective for private investment is earning benefits. Thus, private investment has brought asymmetric problems, which means that investment assets are allocated partially to a certain industry, ensuring profit returns for the future. Indeed, two sectors, "electricity, water, and gas" and "manufacturing," obtain a large proportion of private investment, with a steep growth rate from 2003 to 2008 (see Figure 2-12). Although some sectors have achieved a revolutionary rise in investment (106% for agriculture, cattle raising, forestry, and fisheries, and 31% for business management), these sectors still constitute a minute portion of investment. However, no matter whether the rising rate is less rapid rather than others, three sectors – mining, manufacturing, and wholesalers – consist of about 63% of total assets (see Table 2-5).

[Figure 2-12] Sectoral Investment Growth and Shares (2008)



Note: Shares and growth rates were calculated using fixed total assets by sector in Chihuahua on the basis of the Economic Census.

Source: Author's calculations based on data from INEGI (2004), Censos Económicos 2004, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico; INEGI (2010a) Censos Económicos 2009; Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico.

〈Table 2-5〉 Private Investment in Chihuahua by Sector (2014)

(Unit: million MXN)

Sector	Total fixed assets		Share of total assets (2014)	Average annual growth rates
	2004	2014		
Total	109,699	145,175	100%	3%
Agriculture, cattle raising, forestry, and fisheries	10	118	0%	106%
Mining	2,263	17,062	12%	65%
Electricity, water, and gas	33,398	6,182	4%	-8%
Construction	2,468	4,053	3%	6%
Manufacturing	37,735	54,738	38%	5%
Wholesale	2,828	9,817	7%	25%
Retail	8,401	19,353	13%	13%
Transport	5,112	10,379	7%	10%
Media	2,380	2,423	2%	0%
Financial services	125	312	0%	15%
Real estate	5,611	2,882	2%	-5%
Professional services	817	1,061	1%	3%
Business management	21	85	0%	31%
Business services	650	1,360	1%	11%
Education	1,102	2,120	1%	9%
Health and social services	1,033	2,700	2%	16%
Cultural sports and recreational services	1,017	1,589	1%	6%
Accommodation and catering	2,781	4,824	3%	7%
Other services	1,946	4,114	3%	11%

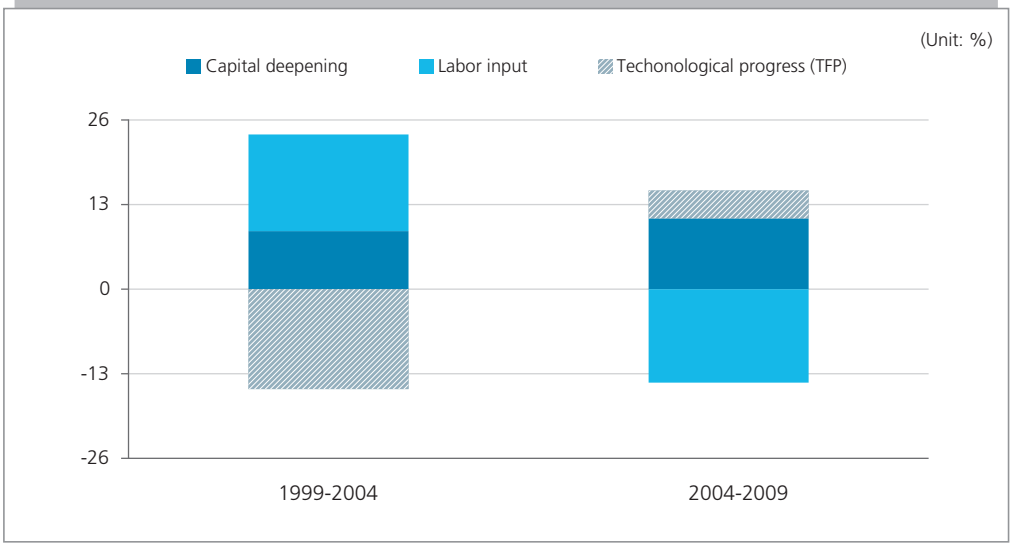
Source: CODECH based on SAIC-INEGI, 2015.

Through examining investment both in the public and private sides, we identified not only a schism in development among industrial sectors, but also a need to adjust the asymmetric allocation of investment assets to increase the national average of Chihuahua State. Thus, regulation of the investment distribution based on the strategic study of a certain regional government is an essential step to prevent the inefficiency of government activities for operating financing and ultimately fostering stable economic growth.

3.3. Growing Needs for Capital Deepening

Economic difficulties are largely driven by external shock and a lack of capabilities to control public and private financial aid and it threatens their residents to be the poor. With these considerations, the government in Chihuahua State has continued to ameliorate the inappropriate features on economic structure. Indeed, since the beginning of the 2000s, Chihuahua State has relied heavily on labor capacities for domestic wealth, while technology clearly did not contribute to economic growth in Chihuahua in that period (see Figure 2-13). In contrast, we can determine that "technology" has surged as a crucial component that contributed to state growth since the mid-2000s, accounting for over 15% of the total share of development factors. In this context, we may assume that Chihuahua State has attempted to stimulate technological advancement to weaken the impact of external shocks. Additionally, dependence on capital assets for strengthening state growth increased

[Figure 2-13] Chihuahua's Growth Factors Growth accounting for Chihuahua in different periods



Note: 1. Growth accounting followed the methodology in OECD (2008) Productivity Compendium, OECD Publishing, Paris. See Annex A for a full description.

2. The 1999-2004 and 2004-2009 periods are not necessarily comparable as GDP data for both stem from different sources. The former uses data from the OECD Regional Database, whereas the latter uses INEGI data.

Source: Author's calculations based on different sources. GDP data for the 1999-2004 period: OECD (2011) Regional Database, accessed online at OECD.Stat on 22nd June 2011. GDP data for the 2004-09 period: INEGI (2011), Banco de Información Económica, Instituto Nacional de Estadística, Geografía e Informática, http://dgcnesyp.inegi.org.mx/cgi-win/bdieintsi.exe, accessed 24 August 2011. Data for capital stocks and employment levels from INEGI (1999) Censos Económicos 1999, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico; INEGI (2004), Censos Económicos 2004, Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico; INEGI (2010) Censos Económicos 2009; Instituto Nacional de Estadística, Geografía e Informática, Aguascalientes, Mexico.

at the end of the 2000s, as shown in [Figure 2-13]; capital deepening constitutes over 10%. Common sense dictates that a technological breakthrough never comes without financial affluence. Apparently, if Chihuahua State is inclined to prolong its technology progress in a long run, it should keep in mind that capital deepening is highly correlated with technological innovation.

In conclusion, capital-intensive efforts require reinforcement in this economically weakened situation for Chihuahua State. While Korea has experienced identical conflicts before, effective means to overcome the hardship have been contrived. After carefully scrutinizing the economic circumstances of the state, we have determined that two public policies, the CGS and FoF, should be introduced.

As a result of overviewing the economic status from micro and macro perspectives, duplicative controversies have been discovered. The main difficulties are attributed to blocking accessibility to financial resources regardless of excessive shares of SMEs for business composition. There are myriad reasons why financial institutions avoid allocating assets to SMEs. First, the investment in SMEs results in a glut of transaction costs, which inevitably brings inefficiency in the market. Second, information asymmetry highlights the risk of failing to invest in SMEs because SMEs are barely able to provide official reports, which may demonstrate their achievements or appealing potential to enter the market successfully only if their financing needs are satisfied. Therefore, finance institutions tend to establish devices to protect their losses by not only asking about indemnifying values, such as collateral, guarantees, and compensating balance, but also agents from financial institutions monitor the debtors' behaviors and whether they unnecessarily spend the financial resources. We analyze different situations from both sides. SMEs normally lack the ability to satisfy the demands for supplements on losses, and financial institutions have a responsibility to secure financial resources for customers. In this respect, we call for public roles to share the burdens of SMEs and financial institutions by seeking a compromise.

4. Korean Financial Support Programs

In this section, we will address some suggestions for Chihuahua State to appropriately implement to ameliorate the stasis of SME growth based on the overview of the micro and macroeconomic environment of Chihuahua State in the previous section. First, the CGS is necessarily discussed. With a bird's eye view, we briefly discuss the basic attributes of the CGS, including its definition, role, and underlying mechanism. Then, we precisely narrow it down in a frame that exclusively describes the Korean environment. Next, we examine the FoF as the other remaining suggestion, which is renowned as a GVC program in Korea. As we are convinced

that the effect of both programs on Chihuahua State is transient, determination to suggest those was made without any hesitation.

Generally, the mutual guarantee scheme, which was unveiled in the 19th-20th century in European regions, is considered the origin of the CGS. Since World War I, Germany has aggressively sailed through boosting SMEs even while it has struggled with terrestrial devastation, currency inflation, and the burden of indemnification against consequential damage. In this respect, they attempted to activate SME-related laws and establish a guarantee association by benchmarking one of Switzerland's. The output of the effort was the foundation of a Berlin guarantee association with 100 thousand members in 1933. Experiencing incessant vicissitude, it shifted the Credit Guarantee Association and expanded its influence to the extent of other European countries by enlightening the needs of the scheme. As a result, it gave birth to the CGS in Spain in 1978, Portugal in 1994, and Greece in 1995.

Aside from European history, Japan initiated the scheme across the Asian continent as it had established the Tokyo Credit Guarantee Association in September 1937. The Great Depression played a significant role in debasing SME investment value in that period. The decision of the government in Japan to found the Guarantee Association in five regional cities including Kyoto and Osaka was the cornerstone that aided other Asian countries, where Korea (1976), Indonesia (1971), Malaysia (1972), Taipei (1974), and Nepal (1974) were catalyzed to adopt the innovative scheme. For North America, the Loan Guarantee System (LGS) was activated in the mid-20th century, and it is well-known that the approach in the U.S. and Canada saw the swift dispersion of the system by taking advantage of their copious assets. The precipitated expansion of the guarantee system was connected to the Southern America in the mid-1980s, but most African regions experienced failure in applying the CGS except to some of the northern areas throughout Morocco and Egypt. In addition, an attempt to introduce the system has continued over the past 10 years without achievement in Australia.

Through a brief discussion about the history of the CGS with a bird's eye view of the world, Mexico, part of South America, is expected to obtain broad opportunities when it adopts the CGS properly because the golden era of the scheme has not arrived yet.

4.1. CGS

The Credit Guarantee system, which is operated by 2,250 institutions in 100 countries, is perhaps difficult to define in accordance with a few attributes because each one has its own distinguished characteristics as it has experienced localization and differentiation. We are attempting to employ criteria (the operation subject and

operation mechanism) to examine the CGS precisely. Thus, we suggest the following three types of credit guarantee system: 1) Public Guarantee System (PGS), 2) Mutual Guarantee System (MGS), and 3) LGS.

4.1.1. PGS

4.1.1.1. Asian Nations (Korea, Japan)

The public guarantee policy prevailing across the Asian regions, including Korea and Japan, has been noteworthy by offering a credit guarantee to firms suffering from a deficiency of financial resources by building related organizations that are a charge of them. To be specific, the newly founded organization plays a primary role in mediating two direct agents involved in the credit guarantee relation. One of the different agents represents financial institutions that supply tangible assets, and the other is a firm and counterpart that receives the assets from the institute. Adding an agent between credit guarantee relations is expected to adjust the discordant needs between the financial institutions and debtor firms ask for. This approach, which adopts an independent institution to administer the credit guarantee system, has brought merits in that the PGS is perceived as highly reliable and secure compared to other approaches among financial institutions and SMEs. Regarding this point, the PGS is exploited most widely throughout the world.

4.1.2. MGS

4.1.2.1. European Countries (Switzerland, Germany, and France)

The MGS, which has the oldest history, is operated by an association composes of the entrepreneurs of SMEs guarantees one of the association members. It is prevalently known that the organization is financially advocated by the government. Regular investment installments among members have enabled the organization to run so far. Generally, the beneficiary of the members asks for additional investment to indemnify the liability that it owes for obtaining the first investment and, in the contingency that a subrogation payment is not demanded, additional investment is available. The main subject of the MGS runs in the form of an individual corporation or a non-governmental organization. Lately, the MGS has been widely employed throughout European regions, such as Germany, Italy, and Switzerland, and the adoption rate of the MGS is growing in Latin American countries through the technical assistance of Spain. The Mutual Guarantee associations in respective countries have internationally interacted through Association European de Cautionnement Mutual (AECM), Association Latinoamericana de Antidades de Garantia (ALEGE), and Red Iberoamericana de Garantias (REGAR).

4.1.3. LGS

4.1.3.1. North America and United Kingdom

The LGS has been developed in North America and England with the purpose of offering better financial resources. Some financial institutions consigns to apply the guarantee system and guarantee some chosen firms directly without the establishment of an independent agent. Furthermore, the government specifies the requirements to determine the participating firms. Thus, the financial institutions screen candidate firms according to qualifications and assume a duty to cover the losses the firms make. Other remaining supports are additionally executed by the government. Thereby, the LGS is distinct from other guarantee systems in that some qualified financial institutions mainly practice and manage loan guarantee-related tasks with the cooperation of the government.

To be specific, it is necessary to discuss how the CGS works in Mexico, although we have previously mentioned its failures throughout most countries in South America. According to OECD (2013), the Mexican government invested in a credit guarantee system by seven times greater in the second period (2007-2012) compared with the first period (2002-2006); from 1.2 billion to 11.9 billion MXN. However, the total volume of SME lending has rapidly decreased since 2009, reached the peak of the investing volume, 77.6 billion MXN, and resulted in 19.3 billion MXN in 2012 (Table 2-6). From 2009 to 2012, the total amount of the credit budget kept decreasing by one-fourth. Regarding this point, we may want to determine what brings this side-effect to the scheme in Mexico.

〈Table 2-6〉 Activities of the Mexico Credit Guarantee System (2007–2012)

(Unit: million MXN)

Year	Invested	Credit leveraged
Subtotal: 2002-06	1,209	47,896
2007	825	21,854
2008	1,136	63,751
2009	1,935	77,656
2010	2,300	67,390
2011	3,002	74,285
2012	2,794	19,275
Subtotal: 2007-12	11,992	324,212

Note: For 2012, results are until March.
Source: Ministry of Economy.

At the early stage of the CGS, the Mexican government was determined to exploit the auction system for gathering private investments from banks. The banks are allowed to specify the extent to which they participate in the public initiative and the interest rate they will request through making bids. The introduction of a credit guarantee system by applying an auction approach seemed successful at first because the social economic cost kept decreasing, while profit increased. Admitting that banks competed to attract more bids drove the increase of the total volume of budgets. Also, this competition led to high-risk economic situations as it ignored scrupulous screening to pursue quantitative development. In Mexico, up to 100,000 loans were covered in 2011 (in the U.K., not only the budget of the program was half the size of Mexico, but also around 2,000 loans were covered; in Canada, 7,466 guarantees were in operation; the guarantee program in the U.S. covered only 53,706). As a result, the losses of the banks have been transferred to SMEs, exceeding 21% of the interest rate in 2010. For the future, it is recommended that Chihuahua State prepares to avoid those kinds of problems.

This section will focus on the Korean CGS with the expectation of eliciting insights befitting Chihuahua State. The CGS in Korea has been defined as a financial procurement policy by providing a guarantee that is available for SMEs to use as collateral (Kang, 2014). The advent of the credit guarantee policy was in 1961 with a SME bank foundation, and systematic operation began in March 1965. Underlying the Act of the Korea Credit Guarantee Fund, an independent institution, the "Credit Guarantee Fund," was established in 1976. In this respect, the fundamental system was completely prepared. After this, segmentation of the CGS proceeded, which means that the tendency to pursue a certain perspective was reinforced by establishing both KOTEC, which exclusively supports tech-oriented ventures, in 1989 and the Credit Guarantee Foundation (CGF) with a goal of regional SME prosperity. Furthermore, the KOREG was established to gratify the growing need for a re-guarantee in the middle of implementing the CGS. <Table 2-7> shows the Korean credit guarantee or re-guarantee institutions currently in service.

〈Table 2-7〉 Credit Guarantee & Re-guarantee Institutions in Korea

Category		Credit Guarantee			Re-guarantee
		CGFs	KODIT	KOTEC	KOREG
Establishment		1996-2003	1976	1989	2000
Legal background		Regional credit guarantee	Korea Credit Guarantee Fund Act	Korea Technology Credit Guarantee Fund Act	Regional Credit Guarantee Foundation Act
Supervisory authority		1. Small & Medium Business Administration (SMBA) 2. 16 Local Governments	Financial Services Commission (FSC)	FSC	SMBA
Target group		Small & Micro Businesses	General SMEs	Tech-Oriented Ventures	16 CGFs only
Max. outstanding guarantee (KRW)		800 million	3,000 million	3,000 million	400 million
Outstanding guarantee	Amounts (KRW)	13.5 Trillion (19.2%)	39.2 trillion (55.8%)	17.6 trillion (25%)	6.8 trillion
	Cases	829,578 (74.2%)	230,252 (20.6%)	57,738 (5.2%)	728,289
Gearing ratio		5.0%	8.1%	7.2%	-

Note: As of 2012-end.
Source: Lee (2013).

Although the CGS was concerned only with the positive aspect mentioned above, to facilitate the tool, we need to scrutinize all facets. Now, addressing the drawbacks of the scheme will be committed to explaining the reason why the regional scheme emerged. Freshwater *et al*. (2001) point out that the traditional scheme has a limitation in applications in small regions because the traditional version of the scheme tends to be preliminarily examined by focusing on metropolitan areas so that applying the traditional scheme brings occasional side-effects. The Korean CGS constitutes two main clusters: the credit guarantee and re-guarantee. As we discussed above, three institutions are involved in the credit guarantee system, and one distinguished institution serves in the re-guarantee scheme. According to the primary goal of this study, we decided to concentrate on the regional CGS that the CGF and KOREG serve in the remainder of this section because we are convinced that the regional credit guarantee system is a relevant approach for Chihuahua State.

4.2. Regional CGS

The advent of regional governments in Korea has brought not only various advantages, but also conflicts mainly caused by discrepant political interests in compliance with somewhat dogmatic operational styles by the hierarchical structure of the central government setting a barrier to cooperating with diverse parochial governments that have different demands. Thus, inconsistent political goals between central and regional government may ruin the effect of policies, which drove the establishment of regional-centered policy implementation. CGFs, which are widely spread throughout 16 regions (see Table 2-8), were established to satisfy the demands of local businesses.

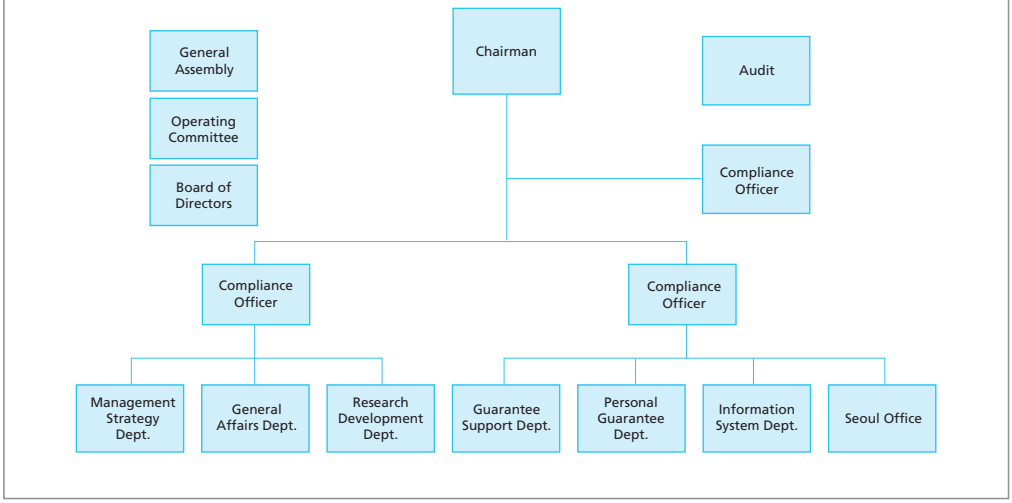
〈Table 2-8〉 General Status of 16 CGFs

Regional CGF	Establishment	No. of employees	No. of Branches (including headquarters)
Gyeonggi CGF	Mar. 1996	212	20
Gyeongnam CGF	May 1996	62	10
Gwangju CGF	Jun. 1996	39	5
Daegu CGF	Nov. 1996	52	7
Daejeon CGF	Mar. 1997	28	4
Busan CGF	Jun. 1997	55	7
InCheon CGF	Dec. 1998	56	7
Chungnam CGF	Sep. 1998	48	6
Chungbuk CGF	Mar. 1999	31	4
Gangwon CGF	Apr. 1999	38	6
Seoul CGF	Jun. 1999	287	19
Gyeong buk CGF	Mar. 2000	43	11
Ulsan CGF	Apr. 2000	24	4
Jeonnam CGF	Jun. 2001	40	11
Jeonbuk CGF	Dec. 2002	34	5
Jeju CGF	Aug. 2003	21	2
Total	1996–2003	1,070	110

Note: As of December 2015.
Source: KOREG Annual Report (2015).

Under the Regional Credit Guarantee Foundation Act, enacted in September 1999, the CGF has been operated by cooperation with the SMBA and respective local governments. To examine the organizational frame of the CGF, [Figure 2-14] may help in recognizing how it is organized. The fact that the responsibility of operation of the CGF cedes to an arbitrary regional CFG reflects that each organization is perhaps not uniform.

[Figure 2-14] Organization of CGF



Source: KOREG Annual Report (2015).

Comprehending the mechanism of how funds are garnered is highly important for determining the possibilities of using the CGS by helping to imagine the workflow at the bottom line. Capital funding indicates the notion that the CGF can provide SMEs with the use of a credit guarantee. The main source of capital funding in CGF funding is composed of three different types: 1) government contribution, 2) financial institutions no matter whether this is voluntary or by law (annually, 0.02% of the total amount of loans by SMEs is demanded), and 3) guarantee fees from SMEs. <Table 2-9> shows the changes of CGF capital funding according to the source origination from 2010 to 2015. The overall amount of funding presents a gradual increase; 3,222 billion won was collected in 2012 compared to 2,216 billion won in 2010.

〈Table 2-9〉 Capital Funding, Contributions, & Retained Earnings

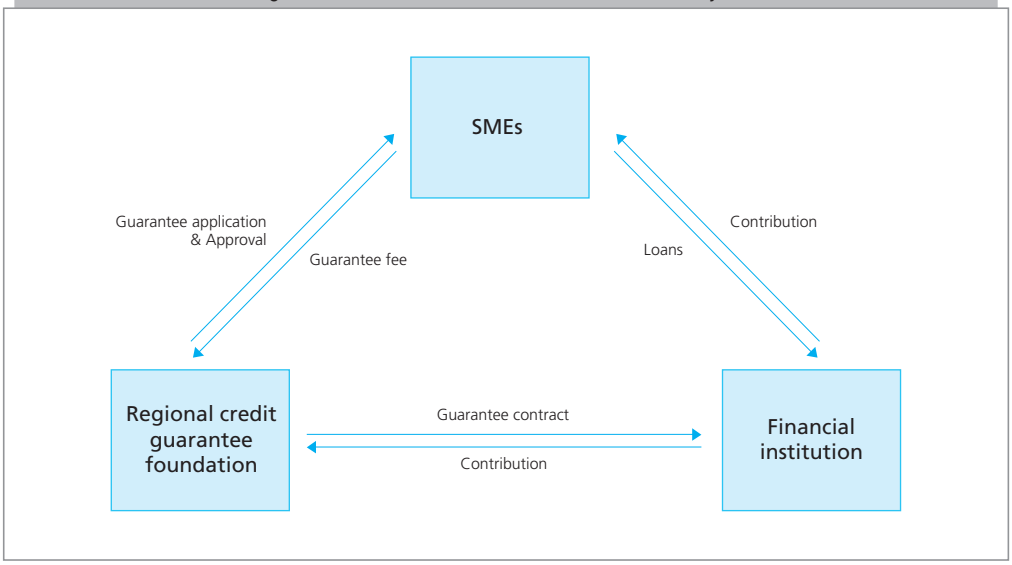
(Unit: billion KRW)

Category	2010	2011	2012	2013	2014	2015
Capital funding	2,216	2,463	2,693	2,892	3,038	3,222
Contribution	2,284	2,643	4,343	3,336	3,567	3,882
Central government	609	655	678	689	697	704
Local government	1,177	1,314	30,441	1,555	1,662	1,792
Financial institutions	498	674	874	1,091	1,239	1,386
Retained earnings carried over	-68	-180	-300	-444	-559	-660

Source: KOREG Annual Report (various years).

The flow by which a credit guarantee system works is somewhat simple. The main actors of the system are the CGF, small and micro enterprises, and financial institutions, and these play the roles of guarantor, debtor, and creditor, respectively. In detail, financial institutions can ask for the guaranteed amount of money according to the contract between CGF and financial institutions in a case of default. Therefore, we can easily understand this framework as a tertiary agent is added into a debt relationship between financial institutions and SMEs (see Figure 2-15).

[Figure 2-15] Framework of Credit Guarantee System



Source: KOGEG.

[Figure 2-16] Flow Chart of Guarantee Service

Procedure	Content
Consultation & Survey	- Survey the small/micro enterprise's overview - Review the use of the loan, and explain the related procedures
Guarantee application & Collection of documents	- Collection of the application letter from applicants - Collection of the necessary documents for a guarantee
Guarantee investigation & Evaluation	- Credit investigation through a visit to applicant's business site, etc. - Decision of approval of guarantee after a credit evaluation through Credit Scoring System (CSS-ME, CSS-SB)
Guarantee contract & Guarantee issuance	- Making a guarantee contract with an application and collection of guarantee fee - Issuance of letter of guarantee

Source: Lee (2013).

Interestingly, there are qualifying conditions for enjoying benefits from the CGF. The following attributes, mostly related to default issues, are eliminated from the list of companies which are eligible to receive support from the CGF: 1) A company with a history of unpaid debt to a financial institution, 2) a company owned or operated by a person responsible for the default of the above company or by a guarantor of the above company, 3) a company that is currently in suspension, 4) a company owned or operated by a bad credit holder or a company that has a subordinate or dominant relationship with a bad credit holder, 5) a company that presents false credit information, and, lastly, 6) a company that has overdue bank loans.

The credit guarantee that the CGF serves is diversified into six clusters: the guarantee for a bank loan (borrowing money from financial institutions), for the payment guarantees of banks, for loans of non-banking financial institutions; for the commercial bill, for leases (renting facilities), and for performance (solvency liabilities). The guarantees of bank loans and loans from non-banking financial institutions are largely composed of total outstanding guarantees, accounting for 99.7% in 2011 (see Table 2-10).

〈Table 2-10〉 Outstanding Guarantee by Guarantee Types

(Unit: 100 million KRW)

Type	Outstanding guarantee	Percentage
Guarantee for bank loans	83,793	59.41%
Guarantee for payment guarantee of banks	17	0.01%
Guarantee for loans of non-banking financial institutions	50,789	40.29%
Guarantee for commercial bill	191	0.15%
Guarantee for leases	-	0.00%
Guarantee for performances	358	0.14%
Total	135,148	100%

Note: As of 2012–end.
Source: Lee (2013).

As previously discussed, the guarantee fee is garnered from SMEs directly and the feed rate ranges from 0.5% to 2.0%. (1.1% on average in 2011). Therefore, how is the extent to which SMEs earn benefits stratified? The answer is the credit rating. Common sense dictates that a higher credit rating reflects a lower risk. <Table 2-11> reflects the principle that enterprises with a higher credit rating assure a lower fee rate upon a credit guarantee. In addition, the guarantee lasting term and coverage amount are apparently associated with the fee rate. For example, a 0.1% rate is more weighted if the coverage range is over 100 million KRW and the guarantee span lasts more than 3 years (see Table 2-11). In contrast, the fee rate is saved occasionally; in the case of a disaster, a 0.5% subtraction is anticipated (see Appendix Table 2-1 and 2-2).

〈Table 2-11〉 Guarantee Fee Structure Based on Credit Ratings

Credit Rating	AAA	AA	A	BBB	BB	B	Below B
Fee Rate	0.7%	0.9%	1.1%	1.2%	1.3%	1.4%	1.5%

Source: Lee (2013).

The maximum value of the credit guarantee a single company seizes is limited to 800 million KRW based on the Enforcement Decree of the Credit Guarantee Foundation Act, though an exception is allowed only with the approval of the head of local government and the Board of Directors. Nonetheless, approximately 80% of enterprises are involved in a guarantee range of less than 50 million KRW (see Table 2-12). Overall, 829,578 enterprises participate in the CGS, for which the 106,386 million KRW scale of funding was buttressed in 2015.

〈Table 2-12〉 Acceptance of Guarantee by Amount

(Unit: million KRW)

Category	≤ 30 million	≤ 50 million	≤ 100 million	< 100 million	Total
2014	49,955	16,954	6,986	11,162	85,057
2015 (increase rate)	63,456 (59.6%)	21,644 (20.4%)	8,135 (5.6%)	13,131 (5.3%)	106,386 (100%)
Variation	13,501	4,710	1,149	1,969	21,329

Note: As of 2015–end.
Source: KOREG (2016).

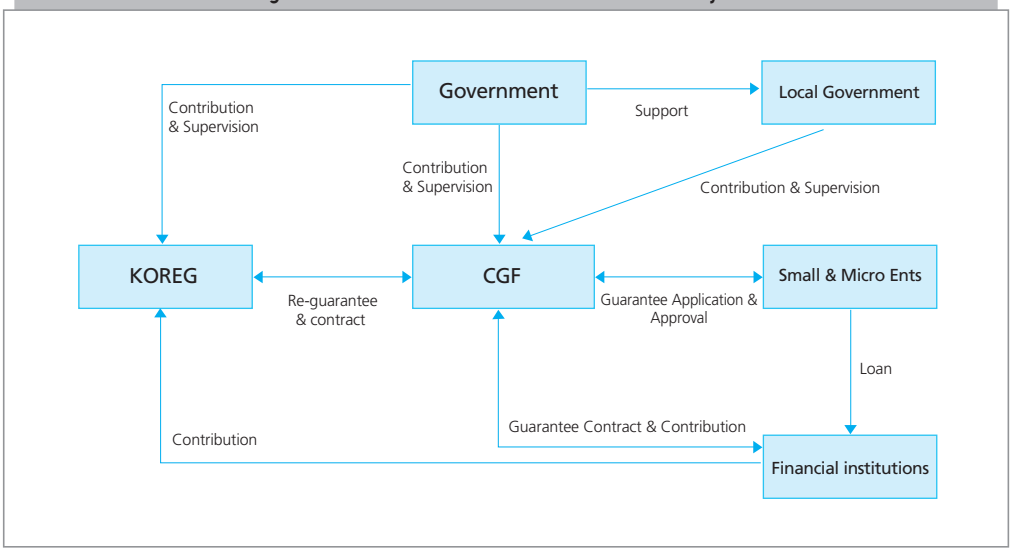
The CGS is devoted to stabilizing the regional economy through propping up the efforts of SMEs to overcome limited access to credit. In line with the stabilization of the local market, a secondary device appeared called the re-guarantee scheme. This is another concept we need to concentrate on for fully understanding the Korean regional CGS. The following part will contribute ideas about the re-guarantee scheme.

4.3. Re-guarantee scheme

To reinforce the goal of boosting local SME business growth, the credit re-guarantee concept was adopted in 2000 through establishing the Korea Federation of Credit Guarantee Foundation (KOREG). As we discussed above, although the CGS includes three parties in a transaction relationship (a debtor, a creditor, and a guarantor), the re-guarantee scheme only consists of a bilateral direct relationship between an original guarantor and a re-guarantor. In other words, the KOREG backs up as a re-guarantor when a firm fails to defray liabilities guaranteed by the CGF. The re-guarantee scheme is being implemented with an expectation of precipitating the economic social function of the CGF through preventing the risk of defaulting.

[Figure 2-17] outlines the underlying mechanism of the re-guarantee scheme, and we can determine that an agent is added compared to the framework of the CGS. The central government and financial institutions also buttress the KOREG as they play identical roles in the CGS. The main difference in the re-guarantee scheme is that the KOREG is not able to collect funds from the regional government and never approves guarantee applications to SMEs because the interrelation disconnects local government and SMEs from the KOREG.

[Figure 2-17] Framework of Credit Guarantee System



Source: Lee (2013).

To operate the re-guarantee system, the KOREG and CGF annually renewed the contract, which requires consensus among the agents involved in the re-guarantee scheme on essential matters, including the maximum amount, term, qualifications, and the rest of the re-guarantee. If the CGFs implement the CGS for SMEs directly, they reap guarantee fees from SMEs in return for assuring business financing, and under the re-guarantee contract, KOREG collects re-guarantee fees from the CGF and applies for a re-guarantee. Then, if a default incurs from any of the SMEs in a guaranteed contract with the CGF, the CGF defrays the debt to financial institutions first. After subrogation, the CGF asks to discharge the amount of the re-guarantee to the KOREG, which redeems the payment for the re-guarantee after examining the validity of the discharge request from the CGFs. The remaining necessary expense is multiplied by a certain ratio that the two parties agreed on prior and returned to the KOREG (see Figure 2-18).

[Figure 2-18] Flow of Re-guarantee Service

Procedure	Content
Contract	- The KOREG & CGFs make a re-guarantee contract
Guarantee provision & Guarantee fee collection	- CGFs extend guarantee to businesses - CGFs collect guarantee fees from businesses
Re-guarantee provision & Re-guarantee fee collection	- The KOREG extends re-guarantee to CGFs - The KOREG collects guarantee fees from CGFs
Subrogation & request for Re-guarantee amount	- In the case of a default, CGFs make a payment in subrogation to financial institutions - After subrogation, CGFs request a discharge of the re-guarantee obligation to the KOREG
Screening for request	- The KOREG screens whether the amount requested by CGFs and the motivation for such a request are appropriate
Payment	- In the case of a proper request, the KOREG pays the re-guarantee amount - Re-guarantee amount = (amount subrogated - amount collected) × (re-guarantee ratio)
Return	- In the case where CGFs collect the subrogation amount, they return the amount multiplied by the re-guarantee coverage ratio - Re-guarantee coverage ratio = (amounted collected - necessary expenses) - (re-guarantee ratio)

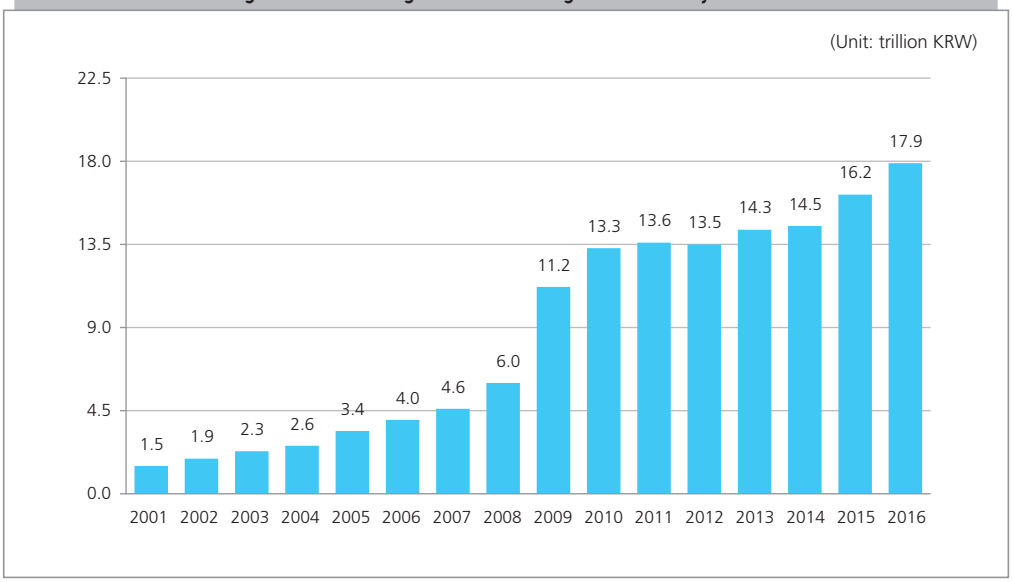
Source: Lee (2013).

Similar to the CGS, some of the businesses are restrained from qualifying for the re-guarantee. Most of the restrictions concern business segments so that financial businesses and real estate businesses are exclusive from recipients of the re-guarantee scheme (more details are available in the Appendix Table 2-2). Additionally, the fee rate is approximately 0.75-0.85%, although it still fluctuates slightly from time to time and 16 regions in which CGFs are placed are separated into five groups to assign a particular fee rate (see Appendix Table 2-3). A criterion for discerning five classes is based on the paid ratio, recovery ratio, and profit ratio of the re-guarantee. The maximum financing cost of 400 million KRW per enterprise is stipulated in the Enforcement Decree of the Credit Guarantee Foundation Act, but the limit of 400 KRW is not impregnable under permission from the head of the SMBA in the case of economic stagnation, the occurrence of natural disasters in a region, or a strong

need for a re-guarantee scheme. In line with the exception of the total funding for a single firm, the head of the SMBA may allow an aberrant increase by a maximum of 80% of the original credit guarantee fund for the coverage ratio during the re-guarantee; in general, it is a maximum of 50%.

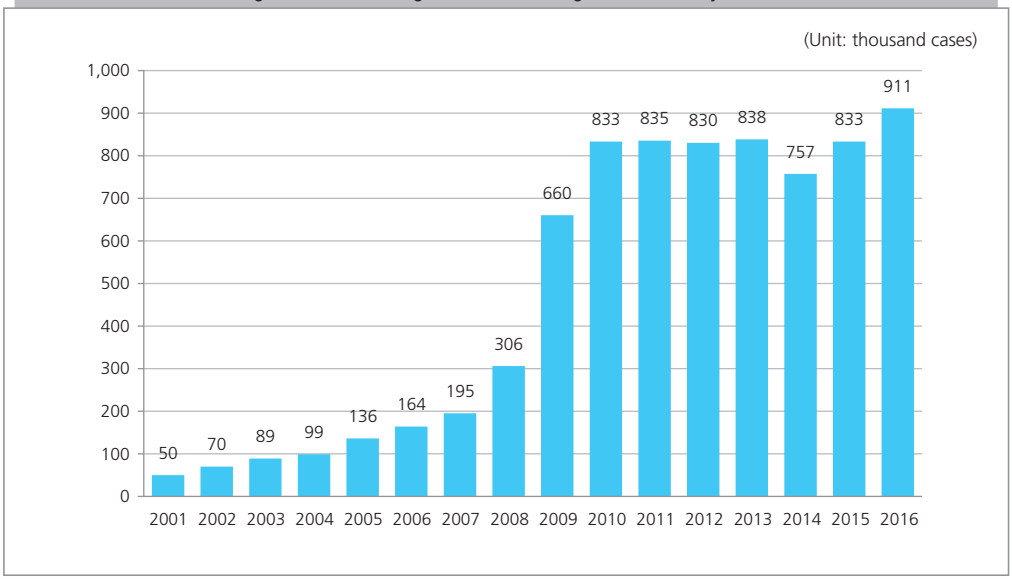
To see how well the CGS works for SME development, please refer to [Figure 2-19]. It is notable that 16 regional CGFs have vitalized local small and medium businesses while they have established a trustful relationship between them. The increase in the guarantee fund amount reflects the prosperity of SME financing sources; 910,813 enterprises were financed with 17.9 trillion KRW at the end of 2016. Apparently, it only took 3 years to raise the amount of funding by approximately 20% in 2016 and the rate of fund assignments for SMEs increased by 1.1% in 2015 compared to the previous year, which reached 89.1% of the total funding. This result represents that the CGS is largely responsible for encouraging local SMEs to access credit (see Figure 2-20).

[Figure 2-19] Change in Outstanding Guarantee by Amount



Source: KOREG Annual Report (various years).

[Figure 2-20] Change in Outstanding Guarantee by Cases



Source: KOREG Annual Report (various years).

Korea has continued to adjust the CGS range from the fee rate and guarantee amount to qualifications to harmonize with the national conditions even though the situations and needs incessantly change. Regarding this, we suggest that Chihuahua State also persists in endeavors to discover a well-localized method by itself.

4.4. FoF

4.4.1. Background of Korean FoF

Venture businesses have recently been considered a key factor for vitalizing the economy during recession, which has been faced across the world lately. During this gloomy period, the desultory use of the term "venture business" leads people to be confounded about its relevance, while theorists and practitioners define it in many different ways in accordance with the conditions. Surprisingly, researchers of the U.S. where the concept of "venture business" appears has confessed that it still fails to employs the clear-cut definition of venture capital (Kim, 2008). A venture business is popularly perceived as a company backed by venture capital under the assumption that "private equity" investors lead the venture business industry according to the principles of the free market economy. In contrast to the U.S. case, the government's role in the venture capital industry is heavily concerned with Korea. In this regard, recognition of venture businesses causes a gap between Korea and the U.S. in that the Korean government largely intervenes in the market of the venture business industry. Thus, the statutory definition of a venture business is extensively used in Korea.

Generally, a venture business has certain attributes, including innovative ideas and technologies, venture entrepreneurs, high growth and risk, and small capital assets. The Korean government has anchored the meaning of venture business by enacting the special Act for the Promotion of Venture Business to establish policies for venture businesses and trimming beneficiaries.

Under Article 2-2 of the Act, a venture business firm is defined as an SME that is 1) a venture capital-backed company, 2) business with superior technologies from the SMBA, or iii) company guaranteed by a technology credit guarantee fund or that has obtained loans from government-designated institutions (Kim, 2008).

There are four specific approaches that the government uses to successfully patronize the venture capital market: first, legislative and institutional manipulation related to investor protection, tax accounting, and insolvency; second, the government stimulates the venture capital market by offering incentives to major investors in venture capital; third, indirect investment, such as tax benefits and subsidization for venture capital investment, is also helpful for triggering more public and private sector investment; lastly, the government directly operates venture capital funding and invests its own funding to venture firms or through different venture capital institutions (KCMI, 2015). In this section, we discuss the indirect and direct support means of the Korean government for venture capital.

GVC is a well-known technique that contributes to attaining economic goals in four dimensions: 1) support for business development, 2) regional growth, 3) the outward promotion of enterprises, and 4) the movement of government social responsibility. To succeed in these goals, the approaches of GVC are mainly distinguished into equity investment and investment guarantees associated with equity investment in firms experiencing the start and growth stages in the business lifecycle. Furthermore, one of the investment approaches can be executed in direct and indirect ways according to whether it is driven by the government or co-investment with the private sector. A growing number of countries have been experimenting with GVC to allay domestic economy-related conflicts. To be specific, in Korea, implementing diverse venture capital programs has been inevitable to alleviate critical issues, particularly those associated with the polarized business structure between large enterprises, the excess of over 199 employees, and SMEs. <Table 2-13> represents the fact that Korea highly depends on GVC (over 60%) compared to the other 24 countries; the Korean government has aggressively implemented the GVC program, which includes 1,365 enterprises, for 8 years (2000-2008), and this table shows it is quantitatively ranked fourth out of the top 25 countries that apply the GVC program all over the world. Surprisingly, Korea is where enterprises utilize GVC the most; more than 60% of enterprises either in the first round or all rounds employed public assistance for financing their businesses.

However, at the bottom line of GVC activities, Hong Kong and Malaysia show less than 10% dependence on GVC.

〈Table 2-13〉 Government Venture Capital Activities by Country

Country	Number of enterprises	Enterprises with GVC finance, first round (%)	Enterprises with GVC finance, all rounds (%)	Enterprises with an exit (%)
USA	10,269	13	17	20
UK	1,394	21	24	18
South Korea	1,365	60	62	16
China	1,226	22	23	22
India	833	18	19	21
Japan	735	33	36	19
France	674	41	45	18
Australia	636	18	20	21
Germany	456	41	44	15
Canada	396	49	55	31
Israel	332	9	13	19
Sweden	266	16	20	18
Spain	231	30	32	10
Finland	181	44	45	11
Brazil	166	52	53	13
Denmark	153	47	54	13
Singapore	149	23	23	20
Belgium	141	28	35	13
Ireland	137	36	47	19
Netherlands	133	11	14	12
Italy	129	14	16	11
Hong Kong	124	7	8	21
New Zealand	117	51	56	14
Switzerland	104	12	16	22
Malaysia	99	5	6	60
Full sample	20,446	22	26	19

Note: The figure shows the venture capital activities of 25 countries between 2000 and 2008; the "Number of enterprises" is those that were financed by VCs, "Enterprises with GVC finance, first round" shows those that were financially procured by at least one GVC in the first financing round, "Enterprises with GVC finance, all rounds" shows those procured by at least one GVC in all financing rounds, and "Enterprises with an exit" indicates the proportion of enterprises that successfully exited.

Source: J. A. Brander *et al*. (2014)

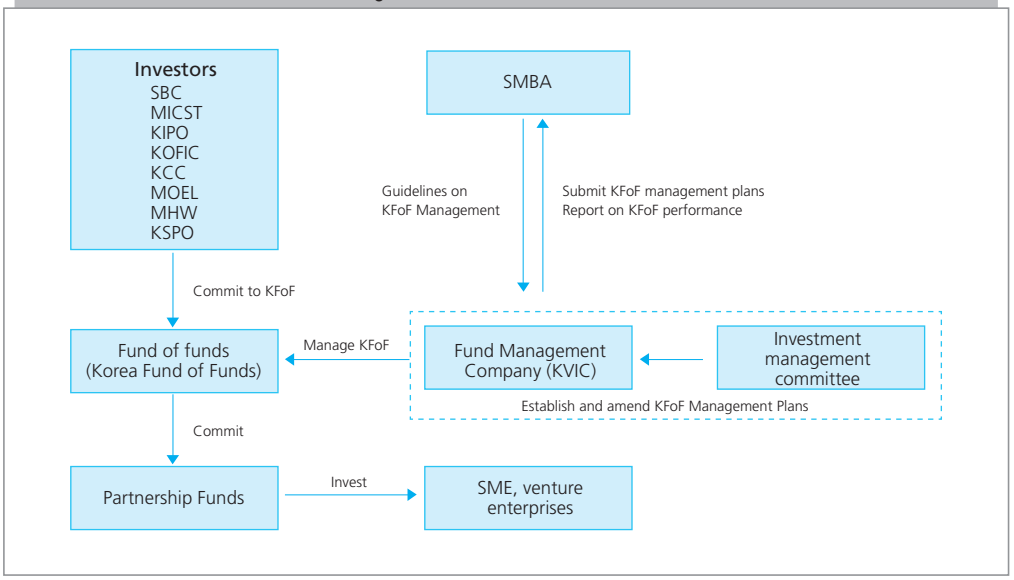
Chihuahua State reports economic controversies regarding the difficulties in having to finance, especially regarding accessing credit and being funded. According to the research, limited access to finance has led Chihuahua State to be a barren environment for innovative and cutting-edge technology businesses. In fact, Mexico describes Chihuahua State as having poor conditions to attract promising business, and it is ranked 27th out of 32 states. Thus, financial procurement is the key for Chihuahua's economic development, and Korea is prepared to share appropriated knowledge on this since Korea has experienced equivalent problems before and successfully addressed them.

As we discussed, GVC can play a role in helping gain access to financing. Surely, the Korean government has well-contrived, diverse systematic gears for catalyzing GVC, which include the "angel fund," "matching fund," "growth ladder fund," "future planning fund," and "assurance-linked investment." We have determined to scrutinize the FoF, a GVC initiative, since it has made preeminent achievements compared to others, so we agreed to deliver the FoF rather than the alternatives.

4.4.2. Introduction of FoF

Since the Korean government embarked on a new GVC program by establishing the FoF in 2005, large budget commitments have been attracted from some organizations — e.g., the Small & Medium Business Corporation (SBC), the Ministry of Culture, Sports, and Tourism (MCST), and the Korean Intellectual Property Office (KIPO) — aimed at boosting certain industries with which the Korean government is strongly interested so that FoF investors cannot be identical since the targeted industries, which the government is willing to promote, vary ceaselessly. To be specific, we have observed which industrial fields are currently encouraging the FoF according to a report from KOVIC; mainly, these include the SME, venture, local, culture, sports, film, and patent industries. Additionally, multi-level management is indicated as the key to stabilizing the FoF. Accrued funds from investors are managed by the Korea Venture Investment Corporation (KVIC), and the SMBA supervises the activities of the KVIC.

[Figure 2-21] Framework of FoF



Source: KVIC.

The FoF operates to attain the ultimate goal of investors, such as SME funds, culture funds, patent accounts, film funds, and broadcasting funds or small and medium business corporations. For example, it creates the individual account for a goal, such as promoting a certain industrial field, boosting the employment of SMEs, or supplying financial capital, and each account is administrated independently. The individual account liquidates its funds while creating diverse small-scale funds; then, it forms a hierarchal, parent-child-like relationship. A child fund normally lasts 5 to 7 years until it completes a goal, the tactic that is deployed by its parent fund. Then, the fund resources can be assigned to entrepreneurs if the SMEs are highly promising to meet the goal of the sub-fund. For the entire procedure, KVIC takes a role in monitoring whether the fund investment aligns with the objective of the fund. Lastly, in contrast to the drop-down approach of fund distribution, the profit return acts from bottom-to-top (see Figure 2-22).

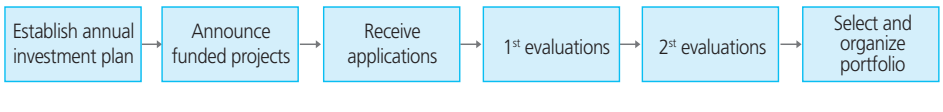
[Figure 2-22] Management System of FoF



Source: KVIC.

To understand the underlying process regarding filtering firms that deserve to be funded, refer to [Figure 2-23]. Basically, the KVIC is in charge of the selection of firms. Out of six procedures, two rounds containing the fourth and fifth are allocated to diagnose the qualification of venture firms and SMEs through multi-ladder assessment with such criteria as financial stability, the expertise of the investment group, the flexibility of requesting funding investment, and exiting.

[Figure 2-23] Fund Management Firm Selection Process



Source: KVIC.

The sources of FoF have five different origins: SME funds, cultural funds, patent accounts, movie funds, and broadcasting funds. The cumulative sum of each fund reached 1.4791 trillion KRW in 2012. Interestingly, 63.7% of the total was from SME funding, and 24.5% was from cultural funding. Other contributions driven by other institutions – patent accounts, movie funds, and broadcasting funds – constituted the remaining 11.8%.

〈Table 2-14〉 Yearly Progress of Fund Sources

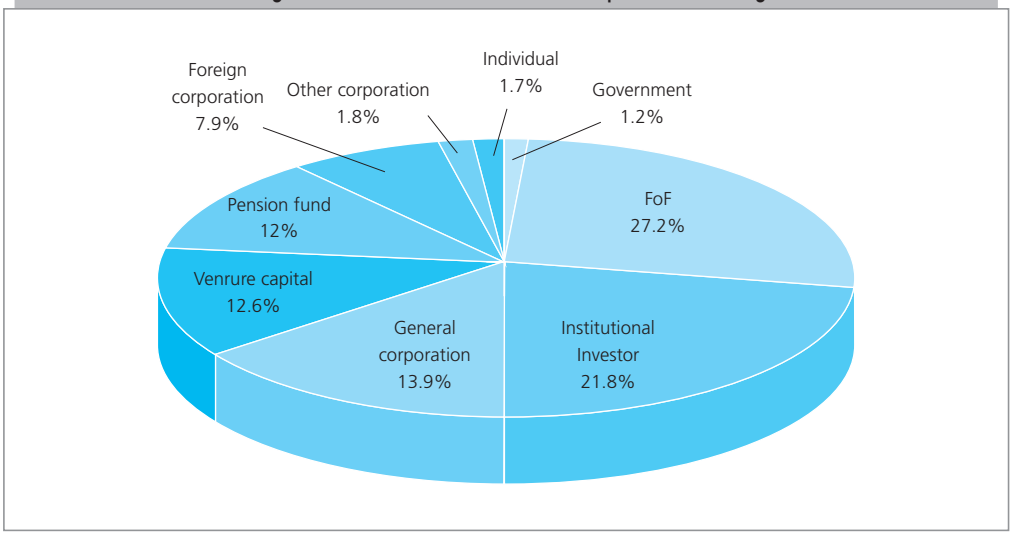
(Unit: 100 million KRW)

Class	2005	2006	2007	2008	2009	2010	2011	2012	Total
SME fund	1,701	1,100	900	800	2,850	1,000	345	725	9,420
Cultural fund	-	500	1,000	-	1,200	-	520	400	3,620
Patent account	-	550	550	-	330	-	-	-	1,430
Movie fund	-	-	-	-	-	110	60	50	220
Broadcasting fund	-	-	-	-	-	100	-	-	100
Total	1,701	2,150	2,450	800	4,380	4,380	1,210	925	14,791
Sum	1,701	3,851	6,301	7,101	11,481	12,691	13,616	14,791	

Note: As of late June 2012.
Source: Kim & Kim (2013).

Apart from the public contribution to the parent fund shown above, the components of a drop-down fund (called also a child fund) show a wider range of participants, including private institutions, ranging from private institutions, such as institutional investors, general corporations, and foreign corporations, to other corporations. Information asymmetry and ethical issues are the biggest obstacles to management venture capital investment, but the emergence of the FoF with control and monitoring by public assistance has brought credibility to venture capital investment. In addition, public interrelationships in the venture capital industry increased the interest of foreign investment institutions in domestic venture funds.

[Figure 2-24] Distributors of FoF Drop-down Funding



Source: Kim & Kim (2013).

In mid-2012, 4.303 trillion KRW of drop-down funds were distributed to 3,269 firms. Specifically, the industries that account for a large amount of the funds may reflect the industrial fields the Korean government has been concerned with recently. We largely classified industries into four segments: 1) manufacturing, 2) IT, 3) bio/environment/energy, and 4) entertainment/others to discern which industries attracted FoF investment. Clearly, the industries well-known for state-of-the-art attracted the most investment assets; in detail, through drop-down funds, 4.303 trillion KRW was invested in 3,269 SMEs in the early growth stages in not only general manufacturing industries, but also various areas, such as IT, bio/environmental/energy, and culture, such as movies and music. Looking at the investment amount by industry, 27.4% was invested in IT enterprises, 27.2% in manufacturing enterprises, 7.3% in bio, environment, and energy, and 38.1% in other areas, such as the entertainment industry, while the IT industry had the largest number of firms invested in at 475 (28.8%).

〈Table 2-15〉 FoF Investments in Industries

(Unit: 100 million KRW)

Class	Manufacturing	IT	Bio/ environment/ energy	Entertainment/ others	Total
Investment (Rate)	11,697 (27.2%)	11,789 (27.4%)	3,128 (7.3%)	16,415 (38.1%)	43,029
Invested corporation (Rate)	365 (22.1%)	475 (28.8%)	106 (6.4%)	730 (44.3%)	1,648

Note: As of late June 2012.
Source: Kim & Kim (2013).

Then, the question of the effect of the FoF is examined to attest to its ultimate objective, the precipitation of employment and increase of sales. Consequentially, net earnings by implementing the FoF were 134.4 billion won in 2012, which created 1.45-times benefit against the principal 295.7 billion won. The result drew on the salubrious sales and employment of SMEs. In detail, the FoF allocated 229.2 billion won to 158 businesses in 2005 and further created 4,504 jobs and increased sales by 1.13 trillion won in the first half of 2007. We are also able to identify that the merits of venture investment are transparent when we compare the outcomes of venture investment with either an alternative tool or the absence of support (see Table 2-16). Stunningly, a 132.9% increase in sales shows the significant effect of FoF investment; the sales and employment of businesses with fund support from a policy or average SME represent 15.8% and 5.9% increases, respectively. Meanwhile, the increasing gap in employment shows a much-alleviated level rather than the gap of sales between businesses with venture investment with fund support from the policy.

〈Table 2-16〉 Effect of FoF Investment

Class	Businesses with venture investment	Businesses with fund support from policy	Average SME
Percentage of increase in sales	132.9%	15.8%	5.9%
Percentage of increase in employment	57.5%	10.0%	3.4%

Source: Kim & Kim (2013).

Venture capital has been generally considered a representative device for improving promising industries, such as IT, biotech, energy, and entertainment. However, in terms of Chihuahua State, we are not convinced that it has fully satisfied

the need for contingency on the innovative level in that venture capital works in cutting-edge technology-based industries successfully. Nevertheless, based on the Yozma Fund once designed and operated by the Israel government from 1993 to 1998, we can identify an aberrant case. Israel barely contains innovation-oriented industries at the nascent stage in the process of the Yozma Fund. However, the Israel government has remarkable prescience because Israel's officers prepared for the domestic needs of growing high-tech industries by reading the social shift. In 1991, a considerable number of high-educated engineers returned to their home country due to the collapse of the Soviet Union.

Moreover, some countries that currently apply public policies associated with venture capital are interested in allocating investment assets to manufacturing industries, although, in fact, they are assigning a small portion of investment to manufacturing. Apparently, the effect of investing VC in the manufacturing industry has rarely been reported so far through venture capital investment as this industry constructs a small proportion as usual. We are quite sure that Chihuahua will require VC in the near future, so it would be better to bolster its technological capabilities.

5. Concluding Remarks

This research seeks to contribute to establishing an appropriate public policy for financial support for SMEs, which Chihuahua State is capable of implementing. Therefore, our main aim was to inspire policy practitioners in Chihuahua State to develop some great ideas while following the thought process in this report. Prior to making suggestions, we have discussed the micro and macro economy in terms of Chihuahua State and Mexico to employ applicable tools in comparison with a wide range of Korean public support programs. In consequence, we have gained some implications from analyzing the economic background of Chihuahua State and examining Korean government financial support for SMEs.

In this research, we selectively addressed two different programs that the Korean government is currently operating because we are convinced that they help Chihuahua State to offer relevant financial support policies to micro and small high-tech firms. By emphasizing that the FoF and CGS target different segments, we specifically addressed the details of the FoF and CGS in terms of underlying legislations, the scale of the financing amount, and additional buttressing devices, such as the credit re-guarantee scheme and child funding. Since the ultimate goals, as we studied in Section 3, show distinctions between the two initiatives, the FoF has been developed as a GVC program focused on high-tech firms. In contrast, the role of the CGS is supporting micro-businesses, such as self-employment. Therefore, we carefully suggest that agency officers in the State of Chihuahua consider the following recommendations.

First, we are firmly convinced that the CGS is the most efficient tool the State of Chihuahua could choose for public financial support in that, once operation of the scheme is stabilized in the state, financial resources will be regularly funded by financial institutions through this scheme. For the last two decades, before setting the Korean regional CGS unswervingly, the CGS has been irregularly financed by the Korean government. At first, the government was required to provide seed capital funding to help successfully initiate the scheme. After that, other financing aids were applied when Korea was mired in a severe financial crisis. Except public financial support, the scheme has been quite well operated so far, as the quantity of funds invested in the scheme has been persistently growing. In addition, the Chihuahua economy represents high reliance on the manufacturing industry, which is comparatively shown to be outdated, as well as small-sized corporations with fewer than nine employees, which are dominant in this region. Thus, we suggest that the adoption of the CGS should be the first step for the State of Chihuahua to initiate public policies because the CGS has been clearly found to attenuate risk in investment and yield effectiveness by absolving public actors from the duty to invest financial aid on a regular basis. Indeed, the government is responsible for investing initially assigned funding in the preparation stage; after that, in the underlying mechanism, the CGS is no longer dependent on financial aid from public assistance. In contrast, the legal obligation to finance the CGS is necessarily involved in regional financial institutions. Therefore, the State of Chihuahua is able to share its financial burdens with regional financial institutions.

The fact that policymakers employ two different tools (improving access to finance and upgrading the regulatory framework) to foster the field of private investment is well-known. In the case of access to finance, firm size largely determines the attraction of investment. Although large average firms, such as steel, automotive, and IT firms, are located in Mexico, the opportunities to invest in these large-scale firms by the private sector are constrained, since they are interrelated to FDI, especially in Chihuahua State, under the title the "maquiladora program." In addition, investment activities have a tendency to create a barrier for labor-intensive firms because they are easily recognized as having low innovation.

From this perspective, we recommend the credit guarantee system to overcome the concern caused by the lack of innovative technology in Chihuahua State. In fact, the federal government of Mexico operates a national credit guarantee program, which aims to improve access to finance for SMEs, although it has not been successful, as we pointed out in Section 4.1. It has varying aspect compared with other countries; it follows the system of auctioning guarantees among commercial banks. To attract more SME entrepreneurs to the credit guarantee program, the government reduced the regulations of commercial banks to the higher leverage ratio of nearly thirty times greater credit than the guaranteed amount, which is

significantly higher than in various other nations, and limited their loan losses to a maximum of 3.8%. As a result, the activity of the Mexico government for SME lending activity in the private banking sector led to failures because the commercial banks were not able to take on much of a burden due to delays in the payment of guarantee. In this respect, we propose that policymakers in Chihuahua State refer to following points:

- The critical concerns about the credit guarantee program operated by Mexico are indicated as larger in scale than those of the loan guarantee programs and are aimed at the total SME population rather than specific target groups.
- Thus, rather than seeking to scale down the program, the immediate challenge is to help bank finance reach the target SMEs by setting the priority based on the strategic plan of Chihuahua State.
- In terms of the regulatory framework, it would be better for Chihuahua State to revise this program when it applies a more comprehensive and systematic form; for example, an independent agency could be added to monitor or support the activities of the credit guarantee program.

Second, unlike CGS, which mainly targets general micro enterprises, the FoF is expected to be applied for cutting-edge tech-based SMEs. The FoF was designed with the purpose of supporting the growth of innovation-oriented firms, especially in certain clusters of industries, which the Korean government is eager to promote — e.g., movie, broadcasting, patent, and others — so the FoF set up the infrastructure in accordance with the goal of high tech-oriented firms' development. Thus, agency officers are required to carefully use this program, as the role of the government is highly necessary compared to the CGS because they monitor whether subsidized funds are properly distributed by targeting relevant segments that are committed to the industries prioritized by the government. In addition, interestingly, the FoF sets an annual plan to assign the amount of funding by government departments, such as the SMBA, Ministry of Culture, Sports and Tourism, and Korean Film Council. Participant agencies are not anchored because government agencies also experienced a shift as the regime of the government has undergone change so that, according to the need to encourage certain industries, corresponding agencies are allowed to be members of the FoF. Thus, annual funding is required and public agencies have a right to contribute to it regularly. Regarding this point, the State of Chihuahua should carefully examine benefits and damage concerning the FoF before adopting it. Again, the FoF could be a better choice to promote a certain industry the government prefers, but a lack of sophisticated preparation would lead to a disaster driven by side effects.

Last, for attempting to find a way to promote SMEs in the State of Chihuahua, we believe that Chihuahua State should take a positive attitude toward exploiting

immaterial tools to maximize the effect of the financial support policy. According to microeconomic research on the State of Chihuahua, we acknowledge that the state has suffered from attracting a ripple effect from FDI. We have clearly determined that immaterial-based tools would essentially contribute to spreading the fruitful outcomes of FDI throughout the domestic economy, as it stops to work exclusively for a country in an agreement. Chihuahua State should be proud of having countless skilled laborers who have been committed to Maquiladora industry, which is the FDI program, for a long time in that it represents higher potential to surge as one of the main sources of wealth only when the State is capable of facilitating these full-fledged laborers effectively. To be specific, the skillful laborers may become leaders of the regional economy through gaining the opportunity to be educated or consult with others about how to start a business because they are already prepared to be an entrepreneur because their qualifications as a business manager are fully satisfied. They have understood a series of tasks in the factory and expanded their personal networks with the suppliers and vendors while working at an FDI-related workplace. Thus, assisting experienced employees to establish a sub-contracted firm that is affiliated with FDI and supply semi-finished goods to multinational corporations would create the greatest effect by exploiting human capital's ability the most.

This study has emphasized that obtaining cutting-edge technology determines the time at which the FoF is started. In this respect, offering an entrepreneurship training program may play a key role in accelerating the autonomy of state government until it administers the managing region itself.

- Introduce initiatives to increase the participation of pre-entrepreneurs in federal government-led local SME programs through offering guidance to apply for the programs and encourage them to participate in the training programs whatever the state and municipal and federal level by delivering information and offering a system that links a policy to an entrepreneur.
- Plan an annual event for entrepreneurs in the incipient stage of the business to perform networking activities. This would include lectures, workshops, forums, and exhibitions.
- Offering awards to recognize entrepreneurial and pioneering achievement can give pre-entrepreneurs the motivation and opportunity to find successful cases they may follow.

Fortunately, Chihuahua State has a good perspective on its potential to obtain innovative technology in the future since the education level of the population in Chihuahua is slightly higher than in other states in Mexico. In particular, 40% of university students in Chihuahua State chose an engineering or technology degree, a figure higher than 33.7% of the nation, and 12.7% of the total population in the municipality of Chihuahua have a university degree, which is significantly higher than the state average (7.5%) in Mexico (OECD, 2012).

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Appendix 1

SME Financial Support Programs in Mexico

This appendix is intended to help identify and overview the SME financial support programs in Mexico. Since the venture capital program is examined in-depth in the body of the study, we may have missed opportunities to grasp broader perspectives on the financial support programs for SMEs. Therefore, summarizing and reviewing a set of entrepreneurship programs in Mexico could enable the current flow of SME-associated policies to be determined. In this respect, OECD (2013)[1)] was committed to shedding light on the integrated entrepreneurship programs provided by the federal government and, thanks to their efforts, this appendix is available to refer to part of the summary; this appendix shows a set of finance programs out of all entrepreneurship programs and reviews them briefly.

1. Seed Capital Program

The seed capital program, which was launched in 2006, provides loans for the creation of new businesses operating within or graduating from the national business incubation system. It has a goal to fill the finance gap caused by a lack of credit history and collateral for debt finance. Before giving an award, an assessment is made of the technical, commercial, and financial viability of proposed projects through evaluation committees operating in each state. In the initial phase of the program, the loans were managed by incubators. However, the incubator staff did not have the necessary skills and experience of collecting credit, which caused many administrative problems. Consequently, the management of the loans was transferred to non-banking financial institutions.

- The loan terms depend on the project's technology, with loan amounts ranging from MXN 50,000 to 1.5 million (USD 2,400-70,000) over periods of 42 to 48 months.
- The average loan size since the beginning of the operation of the program has been about MXN 29,000 (USD 12,800).
- The program budget to cover administration and loan losses increased from MXN 44.9 million (USD 1.9 million) in 2006 to 150 million (USD 6.4 million) in 2010.

However, only about 40% of accredited incubators presented projects to the program in 2010, although the proportion has been increasing, and only 1,012 of the 8,467 enterprises in the incubator system in 2010 submitted proposals for funding (about 12%). On average,

1) Source: OECD (2013), "OECD Studies on SMEs and Entrepreneurship, Mexico: Key Issues and Policies," Chapter 4, pp. 93-104.

about 45% of proposals are approved.

The seed capital program has been successful in increasing the reach of bank finance regarding an important market that the banking system has not served well in the past. There are nonetheless two significant opportunities to increase the benefits obtained from the program.

- First, there is scope to increase the penetration of the program to incubator managers and enterprises as well as prior coaching to incubated enterprises to assist them in making higher-quality business proposals.
- Secondly, seed capital programs in other countries often supply not just loans, but also equity capital for growth-oriented start-ups. This is the approach taken in Brazil and Chile, for example, whereas the Mexican program confines itself to an offer of subsidized credit and lacks any growth capital elements. In the case of high-tech incubators, there is an opportunity to introduce such a funding element through equity capital in addition to loans.

Finally, it should be noted that in the case of defaulting loans, the program's interest rate skyrockets to 24%, twice the regular rate. While it is important to set a significant disincentive for late repayments, an interest rate premium of this degree is too much of a handicap for a start-up company that is already likely to be experiencing cash-flow issues.

2. SME Productive Projects

The aim of this program is to promote the establishment of small enterprises in disadvantaged regions of the country, particularly rural areas, by providing loans to entrepreneurial projects that cannot obtain adequate financing through commercial banks.

- The loan can be used for financing equipment, infrastructure, and up to 50% of working capital to a maximum of MXN 2 million (USD 81,000) per project.
- The interest rate is 12% for a term of 48 months with a reduction of 6% if the client makes monthly payments on time.
- To be eligible, the enterprise must be registered and at least one year old and the client firm must contribute 30% of the value of the investment project.

The program is administered through the Public Trust Fund for Capitalization and Investment Financing for the Rural Sector (FOCIR), which channels the funding through at least one NBFI partner in each state. The NBFI performs the project assessments and takes responsibility for recovering collateral in the case of defaults.

- From 2007 to 2011, the SME fund invested an average of MXN 540 million (USD 21.9 million) per year in the program, funding 4,593 projects.
- The losses on these loans are reasonable, with an estimated default rate of between 10–20%, and there appears to be scope to increase the scale of the program.

3. Financing Franchise Activity

The national franchise program was launched by the government in 2007 with the aim of creating relatively large SMEs following good process models as part of a franchise.

- Entrepreneurs wishing to start a new business as a franchise can assess an interest-free loan from a partnering financial institution to cover up to 50% of the costs of the franchise fee (to a maximum of MXN 250,000 or USD 19,800), which must be repaid over a 36-month term.
- Existing Mexican enterprises that want to expand using the franchising model can also benefit if they have been in operation in at least two locations for at least two years.
- During the 2007-11 period, the program supported 1,627 franchising outlets, of which 638 were new enterprises.
- The businesses tend to be concentrated in food and beverages and retail, while there are also businesses in technology fields.
- Fourteen specialized consultants were accredited to provide services to the sector.

This program helps to exploit important opportunities for SME creation and improvement.

4. Angel Investor Clubs

Business angels are wealthy people, often former entrepreneurs, who are ready to invest "informal" equity into new or growing firms and give management advice. They can meet the equity needs of early-stage and growth-oriented enterprises that have less than attractive or feasible amounts of funding for formal venture capital companies and thus fill an obvious financing gap.

In Mexico, support is provided through investor clubs that foster networks among informal investors and entrepreneurs.

- In 2011, there were 13 government-supported angel investor clubs offering equity investments in the range of MXN 2 million to 20 million (USD 81,200 to 846,300).

The initiative uses consultants to evaluate entrepreneurial projects and present them to potential investors as well as facilitates the pooling of their investments. In this way, the club reduces operating costs for individual members, augments their investment capacity, and enables the diversification of their portfolios through facilitating the pooling of investments, increasing the finance supply to entrepreneurs.

A further feature of the club is a specific and tailored investment guarantee created in 2006 called PYME Option.

- It covers up to 70% of investments in early-stage SMEs engaged in innovative, high-value-added or export-oriented activities to a maximum of USD 500,000 over a three- to five-year period.

Beyond contributing to operational costs and equity guarantees, the Ministry of Economy invests in building capacity.

- For example, in 2010, MXN 1.05 million (USD 42,600) was channeled into the development of an angel investment handbook and helping high-potential SMEs to formulate business plans to seek angel investments.

This program is an innovative form of institution building that directly confronts the difficulties that investors face in identifying appropriate SME investment opportunities and places the Mexican government firmly at the forefront of international trends of the past decade to introduce such initiatives.

However, while this represents an international good practice, the problem lies in there being only 13 such clubs in the country. Generally, investor networks are local initiatives, because investors prefer to be in relatively close proximity to their investee firms, even though there are a growing number of online networks to link investors with entrepreneurs seeking early-stage equity capital.

- To meet the important latent demand for informal equity capital, steps should therefore be taken to introduce further incentives to stimulate private interests in informal equity investment and support the formation of new investor clubs based on the practices of the best-performing of the existing 13 clubs. The government might also consider other models for escalating the provision of risk capital.

5. Entrepreneurial Capital FoF

The Mexican government is investing in capacity-building for entrepreneurs, SMEs,

and investors to increase knowledge of both the supply and demand sides regarding the mechanisms and value of formal equity investment.

- In 2009, for example, the Ministry of Economy's SME Fund invested MXN 1.32 million (USD 53,600) in the development of venture capital courses in partnership with the Mexican Association of Venture Capital (AMEXCAP) and NAFIN.

At the beginning of 2011, the NAFIN public development bank created an FoF with support from the SME fund. This organization makes investments in other venture capital funds rather than investing in firms directly. Its objective is to increase the availability of private sector venture capital to early-stage innovative SMEs with high growth potential.

- The MXN 850 million (USD 34.5 million) government investment made during 2011-12 is expected to leverage MXN 6.5 billion (USD 514 million) of private venture capital investment in growth-oriented SMEs.
- There are nonetheless limits to the capacity of this fund, given that it is obligated to invest in venture capital funds that have already been in operation for at least 5 years and these funds in turn invest in growth-stage SMEs that have been in operation for 3 to 5 years.

The Ministry of Economy is therefore designing a new venture capital fund together with AMEXCAP with an investment focus on initial and early-stage SMEs (that have been in operation for 1 to 3 years).

6. Bond Markets for SMEs

In 2011, the Ministry of Economy allocated MXN 50 million (USD 4 million) to launch the Debt Program in alliance with the Mexican Stock Exchange and AMEXCAP. The Debt Program aims to enable companies to issue bonds that can be quoted on the Mexican Stock Exchange.

The program offers middle-sized SMEs funding to perform the necessary corporate governance process, introduce an appropriate software infrastructure, and obtain legal and advice services for listing.

- In the first call, some 124 companies registered and 10 were selected.
- A second call was closed in 2012 with an additional MXN 100 million (USD 8 million) of funding support, and the Under Ministry of SMEs is evaluating the schedule to launch a third call with an additional MXN 50 million (USD 4 million). This represents an important extension of financing into a new, niche area.

Appendix 2

〈Appendix Table 2-1〉 Guarantee Fees to Add

Category	Addition
1. Large-amount user - Over 100 million KRW - Over 200 million KRW	 +0.1% +0.2
2. Long-term user - Over 3 years - Over 4 years - Over 5 years	 +0.1% +0.1% +0.
3. Guarantee prohibited or limited company	+0.1% – +0.2%
4. Guarantee default company	+0.1% – +0.2%
5. Overlapping guarantee with KODIT or KOTEC	+0.1 %

〈Appendix Table 2-2〉 Guarantee Fees to Subtract

Category	Subtraction
1. Special guarantee for disasters	-0.5%
2. Network Loan Guarantee	-0.3%
3. Companies operated by handicapped people	-0.3%
4. Guarantees based on collateral	-0.3%
5. Guarantee for equipment	-0.1%
6. E-commerce Liabilities Guarantee	-0.2%

〈Appendix Table 2-3〉 Re-guarantee Restricted Businesses

* Bar businesses (except small bars for a living)
* Real estate businesses (except real estate management and real estate consultancies)
* Golf club operational businesses
* Dance halls (ballroom businesses)
* Sauna or betting businesses
* Cigarette brokerage businesses
* Antique and precious jewelry brokerage businesses
* Tobacco wholesale traders
* Fur product wholesale traders (except artificial fur wholesale traders)
* Financial businesses
* Insurance and pension businesses
* Financial and insurance-related service businesses (except underwriting businesses, insurance agencies, or brokerage businesses)
* Credit investigation and collection service businesses
* Pyramid sales businesses under Article 2, Paragraph 6 of the Act on Door-to-Door Sales, etc.
* Anti-culture and anti-health businesses
* Businesses that promote speculations

〈Appendix Table 2-4〉 The Change in Re-guarantee Fee Rate since 2004

* 2004-2006: 0.8% (Fixed fee rate)
* 2007-2008: 0.75-0.85%
* 2009-1010: 0.8%
* 2011: 0.75-0.85%
  - 1st group of 2 CGFs→0.75% / 2nd group of 3 CGFs→0.775%
  - 3rd group of 6 CGFs→0.8% / 4th group of 3 CGFs→0.825% / 5th group of 2 CGFs: 0.85%

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Chapter 3

The Strategy of Development & Operation for the Colima Techno-park

1. Introduction
2. Current Situations and Tasks of Colima State
3. Korean Experience
4. Building Strategy of the Innovative Ecosystem for Colima TP
5. Activation Strategy of Colima TP

The Strategy of Development & Operation for the Colima Techno-park

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Summary

Colima State plans to promote the development of science and technology with Techno-Park (TP), and to strengthen cooperation between industries and academia in order to revitalize the regional economy in the future. Colima State has been participating in the Knowledge Sharing Program (KSP) since 2014 with a deep interest in Korean industrial development experience, especially TP.

Despite the fact that Colima TP began development in 2008, it is still in its infancy, and there is little awareness among universities, businesses, and communities about science and technology policies and innovation. In addition, Colima University is building three laboratories in Colima TP, but there is still a weak Industry-Academia (I-A) network.

This study aims to offer advice for Colima TP's activation policies. In order to achieve this, we analyzed previous KSP projects, which were completed from 2014-2016. We will propose activation strategies for Colima TP based on the establishment of an innovative eco-system and the I-A cooperation requested by the preliminary demand survey of Colima State in early 2016. In other words, government, universities, business, and research institutes will devise an innovation eco-system centered on Colima TP for I-A cooperation. We also present strategies for attracting foreign direct investment, human-resource development, marketing, and international cooperation between Korean and Mexican research institutes for Colima TP.

This study consists of four sections, which are 1) The Status and Future Tasks of Colima State, 2) Korean Experience, 3) Building Strategy of an Innovative Ecosystem, and 4) Activation Strategy of Colima TP as follow.

Section 1 presents an industry structure analysis of Colima State, a spatial distribution analysis of Colimatitutes ima an analysis of human resources and science/technology resources, the current status of Colima TP's master plan, and an Foreign Direct Investment (FDI) analysis. The challenges will be explored from five perspectives: 1) Economy/Industry, 2) Manufacturing, 3) Innovation Eco-system, 4) I-A cooperation, and 5) Challenges to activate Colima TP.

Section 2 explores industry development policies, innovation cluster policies, I-A cooperation policies, and TP development policies over the past 50 years as a Korean experience review. The Korean industry development policy can be divided into five stages, and each feature and policy implication is presented. We introduce the background of the Korean cluster policy, the reorganization of relevant laws, the outline and development process of the innovation cluster project, and its relevant achievements. It outlines the present status, organization and function, major projects, history, model, success factors and trial and error of the Korean TP, and its implications for Colima TP.

In 2003, the Korean government enacted the "Act on the Promotion of Industrial Education and the Promotion of Cooperation between Industry and Academia." Based on this law, we present the goals, necessity, and form of I-A cooperation. In addition, we introduce examples of I-A cooperation taking place at Korea Polytechnic University. Colima aims to increase I-A cooperation and an ecosystem that fosters innovation by establishing an I-A network. Therefore, we suggest the policies to Colima based on experiences in Korea.

Section 3 consists of the building strategy for I-A cooperation and an innovative ecosystem for Colima TP. I-A cooperation involves receiving applications for a university-based cooperation project plan, selecting a target college after examining it, and executing it in a way that federal and state governments provide financial support. To this end, the university needs to reorganize itself to encourage I-A cooperation through activities such as professor evaluations and the bachelor's degree system, and carry out I-A cooperation and network-hub functions via the establishment of an I-A cooperation group. The establishment of a cooperation group includes the selection procedures for supporting universities, the size and fields of support, the implementation procedure, project implementation, and project management. The family company is a system in which the university establishes I-A cooperation agreements such as the sharing of the latest research equipment, joint research and development, and the exchange of technical personnel, in order to

foster organic I-A cooperation activities with other members of the group.

The purpose of technology transfer and commercialization is to acquire promising commercial technologies from companies, universities, research institutes, individuals, etc. and to transfer it to companies that hope to commercialize them. It is the process of applying technology to the production process, creating a prototype, testing it in the market, setting up the mass production of a product or initiating sales to research institutes, individuals, etc and transferring them to companies that desire to commercialize them, and to make prototypes by applying them to the production process.

Section 4 will explore the potential activation strategies for Colima TP. These strategies will include attracting investment from domestic and foreign companies, human-resource development, image building, self-promotion, promotion, and international cooperation between Korean and Mexican research institutes for Colima TP. The FDI attraction strategy suggests investment attraction activities such as image building, seeking investment opportunities, investor services, improvement of investment organization, securing network-based investments, investment promotion capacity and investment promotion systems, as well as follow-up management of investment companies. The human- resource development strategy also recommends the introduction of specialized departments in the university, start-up training at Colima TP, field practice for the university and businesses, and a capstone design program at university and TP. The image building strategy is an imaging process for actively informing investors about Colima TP and its investment environment. The promotion strategy is a program that utilizes a public relations strategy, incentives, institutional support of promotions to attract investment, and a strategy to attract enterprises to Colima TP. Those are the present marketing objectives, promotion goals/image/targets, advertising, sales promotion, personnel sales, and public relations for Colima TP. Finally, we will suggest an international cooperation strategy that aims to strengthen Colima TP's capacity for innovation by strengthening exchanges and cooperation with relevant research institutes in Korea, expanding exchanges, and cooperation with advanced research institutes to build a global network system.

This study does not aim to transfer Korean experience unilaterally, but to cooperate with local experts at Colima State based solely on our experience so as to enhance local participation and to draw appropriate policies for the local situation.

1. Introduction

1.1. Background and Goal

Colima State plans to promote the development of science and technology centered on a techno-park (TP), and to strengthen Industry-Academia (I-A) cooperation for revitalization of regional economy in the future. Colima State has been participating in the KSP project since 2014, reflecting its deep interest in Korean industrial development experience, especially in relation to TPs.

Colima State has actively sought to support start-ups and corporate innovation as part of its industrial policy. However, despite the fact that development of Colima TP having begun in 2008, it is still in its infancy, and there is a low awareness of universities, businesses, and communities about science and technology policies and innovation. In addition, Colima university is building three laboratories in Colima TP, but there are still weak I-A networks throughout the state.

This study aims to offer advice on the activation policies for Colima TP. In order to achieve this, we inherit the previous KSP projects, completed in 2014 and 2015/16. In addition, we will propose the activation strategy of Colima TP centering on the establishment of an innovation eco-system and the I-A cooperation requested by the preliminary demand survey of Colima State in early 2016. In other words, the government, universities, business, and research institutes will devise an innovation eco-system centered on Colima TP for I-A cooperation. We will also present strategies of foreign direct investment (FDI) attraction, human resource development, marketing, international cooperation between Korean and Mexican research institutes for Colima TP.

1.2. Contents and Configuration

The strategy of Development and Operation on Colima TP consists of four sections: 1) Status and Future Task of Colima State, 2) Korean Experience, 3) Building Strategy of Innovation Eco-system, 4) Activation Strategy of Colima TP.

Section 1 presents an industry structure analysis of Colima State, spatial distribution analysis of Colima's economy, analysis of human resources and science/technology resources, status of Colima TP by master plan, and FDI analysis. The challenges will be explored from five perspectives: economy/industry, manufacturing, innovation eco-system, I-A cooperation, and challenges to activating Colima TP.

Section 2 will explore industry development policy, innovation cluster policy, and TP development policy over the past 50 years in the Korean experience. Colima

aims to build an I-A cooperation system and innovation eco-system by forming a I-A network. Therefore, here is a suggestion of the policy implications based on Korean experiences.

Section 3 consists of building strategies of industry-academia-government (I-A-G) cooperation and the innovation eco-system for Colima TP. This focuses on how Colima TP organizes its I-A-G cooperation system and operates sustainably in the future. It will also cover operation of the partner company program, technology transfer, and commercialization for Colima TP.

Section 4 will explore the activation strategies of Colima TP. This will include attracting investment from domestic and foreign companies, human resource development, image building & promotion, and international cooperation between Korean and Mexican research institutes for Colima TP.

1.3. Methodology

This study seeks to conduct KSP consultation with Colima State, Mexico, to explore ways to activate Colima TP based on Korean Experience. This study will utilize their needs and ideas by collaborative research with local experts in Colima as well as convey Korean experience to Colima State.

This project was conducted by a Korean research team visiting Colima twice (Sep. 19-26 and Nov.27-Dec.4, 2016), and gathered information and consulted through field surveys and expert meetings. Colima's local experts also visited Korea (March 19-25, 2017) to learn about Korea's TP and related policies.

This study aimed not to transfer the Korean Experience unilaterally, but to cooperate with local experts in Colima State based solely on our experience so as to enhance local participation and to draw policy appropriate to the local situation.

We surveyed policies, economic and industry situation, and science & technology manpower through visiting Colima, invited local experts to Korea, and conducted a demand survey, combining the results of learning Korean cases.

- High Level Demand Survey & Pilot Study: State Government, Professors, Entrepreneurs, Economy Group Executives
- Additional Pilot Study: Government Policy & Organizations, Innovation Projects of Universities, Corporates Activity, etc.
- Interim Reporting & Policy Practitioncers' Workshop : Korean TPs, Local Governments, Universities, Corporates, Relevant Institutes, etc.

The Contents of review and analysis through local experts are as follow:

- Science & Technology Policy of Federal and State Government, Relevant Support
- State Policy of Science, Technology, and TP
- Status of I-A-G Cooperation, Start-up Supporting Policy

It is a very important task to analyze Korea's industrial development experience, especially concerning I-A-G cooperation and TP supporting policies for 15 years, and apply it to Mexico. We have identified the following policies as relevant to the analysis:

- Development Strategy of Korean TP
- Strategy Creation of Innovation Cluster & Ecosystem
- Human Resource Development Policy, FDI Attraction Strategy
- Advantage/Disadvantage Analysis of Korea Case, Comparison with Colima TP and Implication

〈Table 3-1〉 Research Activities for 2016/17 KSP with Colima State, Mexico

No.	Period	Venue	Major Works	Participants
1	2016. 9.19 - 26	Ministry of Foreign Affairs, Mexico	Kick-off Meeting for 2016/17 KSP	Federal & State Government Officials
		Colima State Government	Discussion for Co-work Review on TP Master Plan	Governor & State Government Officials
		Colima TP	Review on TP Development	Government Officials
2	2016. 11.28- 12.4	Colima State Government	Presentation Interim Report Hearing on 2015-2016 KSP	Government Officials
		Manzanillo port (APIM)	Infrastructure Review on Manzanillo seaport	APIM Officials
		University of Manzanillo	Review on innovation base in Manzanillo	Dean & Professors
		Ministry of Foreign Affairs, Mexico	Wrap-up Meeting for 2016/17 KSP	Federal & State Government Officials

〈Table 3-1〉 Continued

No.	Period	Venue	Major Works	Participants
3	2017. 3.19-25	KOTRA	Interim Reporting Workshop & Investment Seminar	Working Group of Colima & Korean Experts, Federal & State Government Officials
		BPA, KMOU	Maritime Ind. & System	
		GNTP, GGTP	Korean Technopark Program	
		KICOX , KPU	Univ.-Industry Cooperation	
		Auto. /IT Com.	Auto./IT Promotion Policy	
		Lotte Hotel	Korean Technopark Policy	
4	2017. 5.23-26.	Ministry of Foreign Affairs, Mexico	Senior Policy Dialogue with Colima State	Working Group of Colima & Korean Experts, Federal & State Government Officials
			Project Evaluation	
			Final Reporting Workshop	

2. Current Situations and Tasks of Colima State

2.1. Situation Analysis of Colima State

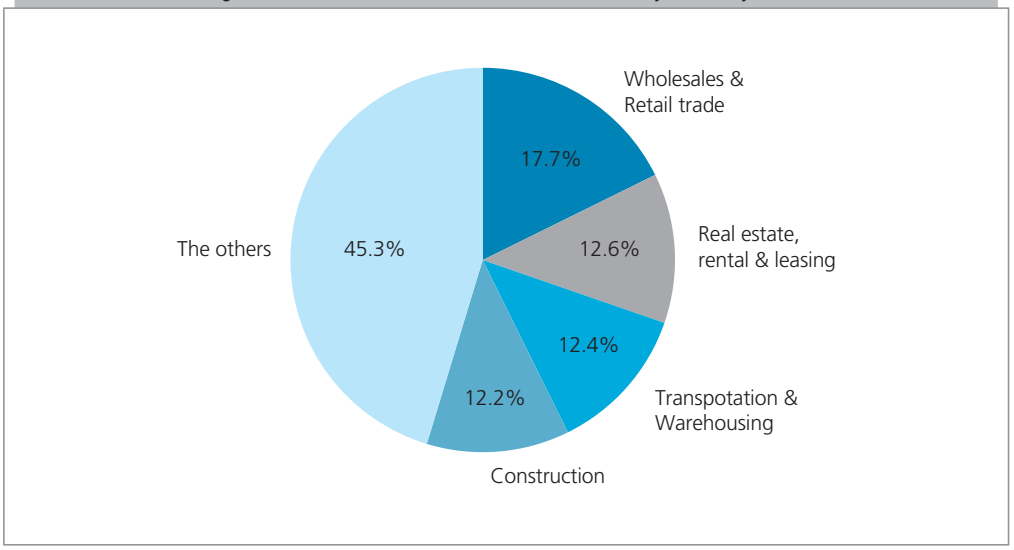
2.1.1. Introduction

Among the 32 states in Mexico, Colima is the 28th smallest (5,625km^2), and the smallest in terms of population (725,724 in 2014). However, the quality of life is very high, and the unemployment rate is the lowest in Mexico as the service industry and advanced agriculture are well developed. Colima is also a hub for shipping lines in Mexico, the southern United States, and central and southern America through the Manzanillo port on the pacific coast of central Mexico. It is also highly likely to develop in the future, given the desire for local development by governments, industries, and communities.

2.1.2. Industry Structure

Colima is dominated by four industries: 1) wholesale & retail (17.7%), 2) real estate & rental services (12.6%), 3) transport & warehousing (12.4%), and 4) construction (12.0%). As shown in [Figure 3-1], these four industries accounted for 54.7% of Colima's GRP (Total GRP at current price for 2014 is 98,110 million pesos).

[Figure 3-1] GDP Distribution of Colima State by Industry (2014)



Source: GDP Distribution of Colima State by Industry (2014).

Thus, Colima recommends that technologies related to these four industries should be developed in a TP. In addition, the businesses that are derived from these fields should be integrated with high-tech inputs and processes that can gain high added value through Colima TP (see Table 3-2).

As shown in [Figure 3-2], the manufacturing of Colima is only 6.4% of the whole industry (GDP basis), which is a weak point of Colima TP in the future. The main products in the manufacturing sector are beverage products, food, furniture, and building materials that cannot be considered high-tech industries.

〈Table 3-2〉 ICT Hardware in 14 Ministries

Industry	Main business	Technologies to be developed in CTP
Wholesale & retail trade	Shipping & packing	Logistics information technology
	Shop management	Information monitoring technology
Real estate & rental business	Urban development	Smart information technology
	Rental service	Web programming technology
Transportation & warehousing	Trucking business	Vehicle navigation technology
	Storage business	Warehouse monitoring technology
Construction business	Road construction	Geographic information technology
	Water & sewage system	Environment friendly technology

Source: Modified from "Ministry of Education of Colima State (2015)."

〈Table 3-3〉 Technology to be Developed in Colima TP for Manufacturing Sectors

Manufacturing Sector	Business Area	Technologies to be developed in Coloma TP
Beverages	Healthy beverage	Nutrition & medical technology
	Beverage logistics	Bottling & delivery technology
Food	Canned food	Natural preservative technology
	Food production	Soil & water purification technology
Furniture	Furniture design	Computer-aided design program
	Furniture materials	Environment friendly material technology
Construction materials	Construction materials	New material development technology
	Building materials	Environment friendly material technology

Source: Modified from Ministry of Education of Colima State (2015).

2.1.3. Status of Innovation Human Resource

In 2014, the proportion of professional services, including science and technology, was only 1.3% of Colima's total GDP. This is a very important factor for the development of Colima TP, but it is a very low proportion. The weight of employees in this field is similar to that of GDP. Thus, great effort should be made for the success of Colima TP in the future.

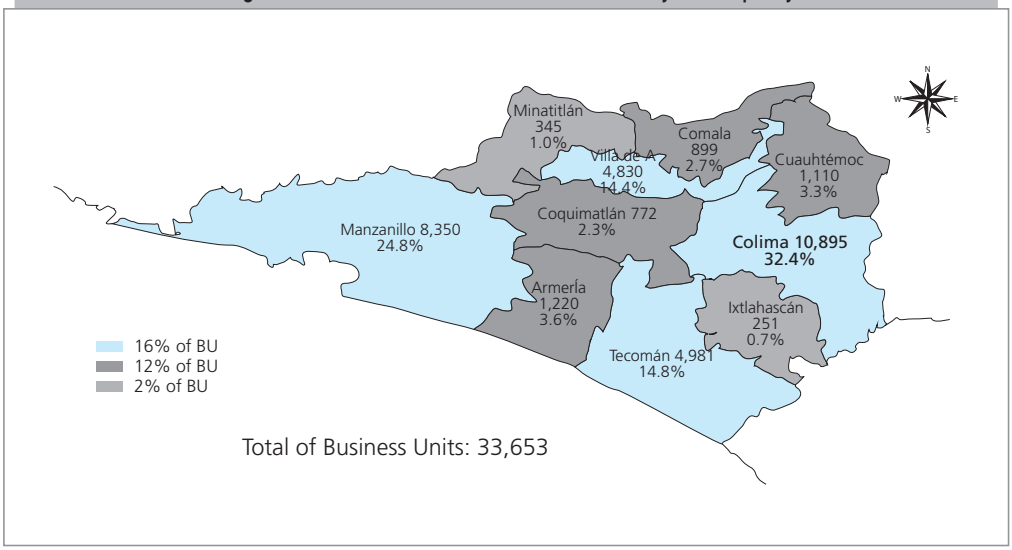
About 12% of Colima's population has received university-level education. As of 2013, there are 54 undergraduate and 11 graduate programs in 18 universities in Colima, with 22,274 students and 2,658 professors. Among them, about 60% of science and engineering students were concentrated in Colima University, Technological Institute of Colima, ITESM - Colima, and Autonomous Education Institute of Tecomán (IAETAC). This is an encouraging statistic for Colima TP, but only about 1,000 people have graduated from graduate school. The major sources of graduate students are Colima University and ITESM - Colima. Thus, the state should foster science and technology graduate schools for advanced research. Until recently, the traditional majors of these universities were architecture, management, and health, and they are gradually expanding into biology, computers, and mechatronics.

In addition to university-level research capabilities, there are 51 innovative research companies in the private sector that are still in early development stage. Colima operates six state-owned and university-run corporate incubator centers and one small-scale start-up facility. Colima TP is planning a technology management center at the "Triple Helix Building." This corporate incubator program will become a core group of the Colima innovation system.

2.1.4. Analysis of Spatial Distribution

The economic development of Colima is led by three growth axes: 1) Colima / Alvarez, 2) Manzanillo, and 3) Tecomán. Each axis includes expansion of production, employment, and related investments as well as new technologies and new industries in the logistics, mining, business support services, manufacturing, and agricultural business sectors.

[Figure 3-2] DP Distribution of Colima State by Municipality

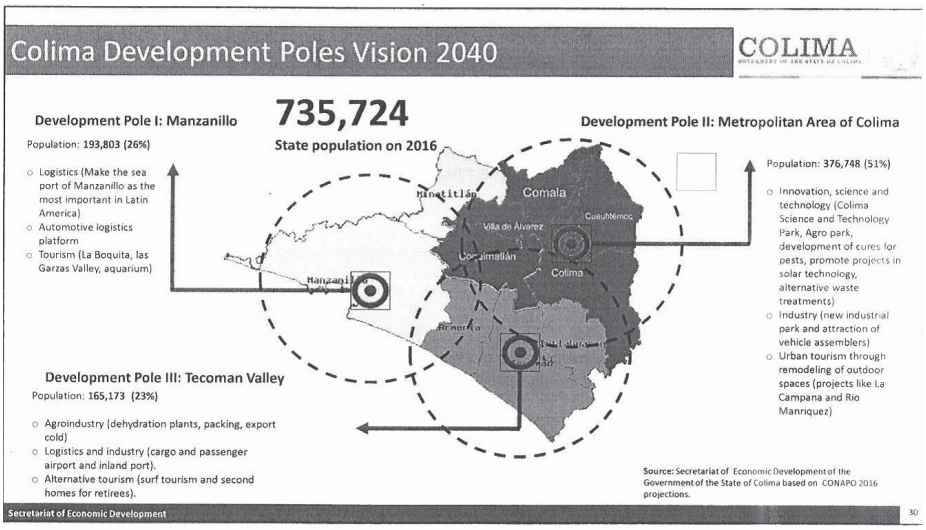


Source: SEFOME-Fuentes Flores, 2016.

Colima (32.4%), Manzanillo (24.8%), Tecomán (14.8%), and Alvarez (14.4%) are the most concentrated municipalities in terms of spatial distribution of Business units (Total business units, 33,653). The number of employees is similar, with Colima (36.3%), Manzanillo (30.0%), Tecomán (12.4%), and Alvarez (11.8%).

The most concentrated municipality of human resources is Colima. Economic activity in this region is related to Colima TP such as knowledge, innovation, science, technology, and SMEs. Unlike the agricultural valley of Tecomán, Manzanillo is a place where logistics and energy companies are concentrated. Therefore, it is reasonable to develop Colima TP in Colima City. In addition, Colima TP will be able to expand its scope with the logistics industry in Manzanillo and agricultural development in the Tecomán area.

[Figure 3-3] The Three Major Economic Growth Axes of Colima State



Source: Secretariat of Economic Development Colima State (2014).

2.1.5. Analysis of Foreign Direct Investment (FDI)

Colima's FDI is deeply related to logistics, energy, and agriculture. FDI in the logistics and energy sectors is distributed in Manzanillo, and agriculture in Tecomán. Colima City is an ideal location for FDI in high-tech industries because of its high level of education and labor force.

The Colima government is trying to create a competitive business environment for FDI attraction. Colima is a suitable investment destination for North American and Pacific markets. Based on this geographical strategic superiority, the quality of life is very high, and business promotion programs are becoming more attractive.

One of the best examples is the company Yazaki, which produces Japanese automobile parts. The Yazaki is utilizing the high quality workforce of Colima City, which is adjacent to the highway across the state government complex. This factory has the lowest defect rate among Yazaki's factories around the world. Thus, Yazaki added a new production line to the Tecomán area. This advantage has become a key point for attracting FDI to Colima's.

2.2. Tasks of Colima State

2.2.1. Industrial Economic Perspective

As we have seen above, the share of manufacturing in Colima's GDP weight is very small, and the manufacturing of high value added, high-tech, quality products remains poor. Therefore, it is very important to attract domestic and foreign companies equipped with advanced technology as well as to improve technology level through technology development and commercialization centered on Colima TP. In addition, the Colima state, retail, and port logistics industries are the backbone of the local economy. In response to the development of transportation, communication, and IT technologies in the future, it is urgently required to advance distribution and logistics management using IT and other advanced technologies. Moreover, the well-developed agro-fisheries industry should increase value-added through development of processing technology and distribution management.

2.2.2. Manufacturing Industry Perspective

Since the manufacturing industry in Colima is composed of SMEs with low skill level, attracting leading companies with technological capabilities is a very important task. However, there are various limitations on how to improve this by relying on diversification and start-up of companies in the region within a short period of time. Therefore, the most important task is to attract domestic and overseas manufacturing leaders by establishing bold investment attraction strategies at the state level. In addition, R&D and technology introduction should be combined with advanced technology, and productivity should be increased through manufacturing

2.2.3. Innovation Ecosystem Perspective

In recent years, Colima has begun to pay attention to innovation in industrial technology, but it is still the case that there is insufficient social and economic awareness of innovation. Therefore it is a task that should encourage the interest of innovation in industrial technology as well as the government, universities, corporations, and society as a whole, and share the awareness of innovation. In addition, the government and universities should foster organizations that will be responsible for innovation in industrial technology. Moreover, when TP starts to operate in earnest, the state government, universities, innovation organizations, and corporations should establish innovative ecosystems and operate clusters by industry. On the other hand, the state and federal governments should also lead innovation of industrial technology by securing and supporting innovation related budget.

2.2.4. I-A-Government (I-A-G) Cooperation Perspective

Colima has also begun to recognize the importance of I-A-G cooperation, but neither companies nor universities regard it as high-priority, and there are few experiences to draw on. Therefore, companies, universities, government, and research institutes need to increase their participation by sharing their perceptions and related information on the necessity and effects of I-A-G cooperation and how to promote them. In addition, after establishing an I-A-G cooperation council, it is necessary to select and cultivate control towers to lead the I-A-G cooperation and coordinate business in the future.

2.2.5. Tasks of Colima TP

The Colima TP began to become the 8th TP in Mexico in 2008 and is still under construction. Supporting facilities are being built, some research facilities have been moved, but there are no production companies. Due to various political and economic circumstances, the construction is delayed compared to the original plan, but it is expected to be completed soon as it is one of the main projects of the state government.

The biggest weakness of Colima TP is that it has no operation experience of TPs, and it is urgent to attract research institutes and supporting organizations and companies. Therefore it will be necessary to prepare future operating programs, secure operating personnel, and expand operating budgets. The success of the TP is supported by the state government, but independence from political influence is needed in view of the specificity of this project. In addition, we need to raise awareness of the necessity and importance of community through image-building regarding the TP.

3. Korean Experience

3.1. Regional Innovation Policy

Korea developed industrial infrastructures to promote industrialization in the 1960s and 1970s. In other words, since the early 1960s, Korea has been developing a number of industrial complexes in specific areas along with export promotion for economic growth. The target industries were labor-intensive, such as textiles and shoes in the 1960s, and heavy chemical industry, such as steel, shipbuilding, and petrochemicals in the 1970s. The characteristic of the industrial policy at that time was that it was the development of a large national industrial complex by the central government, and led by the FDI, and which were linked from Seoul to the east-southern coast geographically.

Since the 1980s, because the regional imbalance in the process of development over the preceding 20 years had intensified, Korea began to establish local dispersion policies. In other words, the policy direction was to correct the regional imbalance that deepened in the process of rapid economic growth. The main policy measures were to develop industrial complexes in small and medium cities of local areas. The target industries in that period were steel, shipbuilding, chemical, machinery, electronics, non-ferrous metals, parts, and materials industries. That period was characterized by the development of national industrial complexes in underdeveloped areas centered on the west coast, and the development of small and medium industrial complexes in local areas.

In the 1990s, the Korean government laid the foundation for fostering local industries. Specifically, the policy direction has laid the foundation for fostering high-tech industry and compiled a law for fostering local industry. The target industries in this period were automobiles, semiconductors, machinery, electronics, parts industry, and non-ferrous metals. The characteristics of the 1990s can be summarized as the integration of industrial location law, the transfer of the authority to develop industrial parks, and the development of seven high-tech industrial parks and six TPs in the non-metropolitan area.

Up to the mid-2000s, local industrial policy was introduced in Korea in earnest. The main policy direction was to respond to the emergence of a knowledge-based economy, to mitigate regional imbalances, and to promote endogenous development to enhance regional innovation capabilities. The target industries were high-tech industries such as IT, BT, mining industry, medical equipment, aerospace, automobile, and parts industry. The characteristics of the policy at the time were the enhancement of the role of local government in industrial policy, the selection and development of strategic industries (2-3 each) in 13 provinces, and the introduction of innovation cluster policy and regional innovation system.

From the mid-2000s, local industrial policy was greatly expanded. In other words, the main policy direction was to implement regional industrial policies in the local economy to enhance international competitiveness of regional industries. The target industries were IT, BT, renewable energy, cultural contents, knowledge-based service industry, and convergence industry. The characteristics of this period can be summarized as expanding participation of local governments in regional industrial policy, fostering leading industries in the metropolitan economy, and supplementing and expanding innovation clusters.

3.2. Cluster Policy

3.2.1 Back ground

Since the early 2000s, Korea has been attempting to transform its economic paradigm from a factor-driven economy to an innovation-led economy in response to the emergence of the knowledge - based economy. In other words, Roh's government (2003-2008) established an innovation-led economic development plan that includes cluster policy and innovation system as the top priority of economic policy. As a result, the importance of innovation clusters for raising the competitiveness of local industries has been raised by local governments, universities, research institutes and companies, as well as the central government.

3.2.2. Reorganization of Related Laws and Structures

To implement the innovation cluster policy, the government enacted the following related laws and carried out the reorganization of the policy structure to implement them.

- Establishment of foundation of innovation cluster by reorganization of related laws
  - Establishment of special law for balanced national development (2004)
  - Amendment of Act on Industrial Cluster Activation and Factory Establishment (2006)

- Reorganization for development of innovation cluster
  - Presidential Commission on Balanced Regional Development: (Senior level) policy cooperation
  - Ministry of Commerce, Industry, and Energy : Budget support
  - Korea Industrial Complex Corporation (KICOX): Project management & monitoring
  - Innovation Cluster Promotion Team: Promotion of cluster business by each industrial complex

3.2.3. Innovation Cluster

Since 2005, clusters have been promoted mainly in national industrial complexes as follows.

- Innovative cluster business of national industrial complex
  - Purpose: Conversion of industrial complex to innovation cluster by complementing R&D function

- Subject: Seven national industrial complexes in 2005, 12 national industrial complexes in 2008, 193 industrial complexes in 2010 (including general industrial complexes)
- Budget: $ 450 million (2005-2012) put into government budget
- Contents of business: 1) Enterprises, universities, and research institutes specialized in each industrial complex with a mini cluster 2) Supporting R&D, technology transfer & commercialization, HRD, investment attraction, marketing for companies

- Innovative clusters in national industrial complexes: mini-clusters by industries
  - Overview: Small-scale network (cooperation group) of enterprises, universities, and research institutes of similar technology & business
  - Management process: Find the problems faced by enterprises through seminars and workshops, solve problems by collaborative R&D, cooperation, etc.
  - Improvement: 70 mini-clusters have solved the problem through activities since 2005.
  - New direction: "theme clusters" were introduced in 2012, and 19 are in operation

- In the national industrial complex, the company's family doctor business is promoted.
  - Purpose: To support the growth of SMEs with high potential.
  - Subject: Selected from four national industrial complexes (Banwol, Sihwa, Gwangju, Changwon, Gumi) since 2011
  - Budget: $ 1.5 million per year (supported by government budget)
  - Business contents: 1) Task force team composed of more than 10 experts, 2) Provide technical, management, and financial consulting services for SMEs in national industrial complexes.

- Industry–University Convergence District project in national industrial complex
  - Purpose: To foster skilled engineers in cooperation with local universities and companies
  - Subject: Starting from 2011, five national industrial complexes (Banwol, Sihwa, Gumi, Gunsan, Daebul, and Osong)
  - Budget: Government supports $ 26 million per year
  - Business contents: Consortium of local universities to provide education and training services to companies. Establish corporate research institutes & university campuses in industrial complex

3.2.4. Performance

Over the past 12 years, the Korean innovation cluster has had many successes. Not only has experience and trust in cooperation among innovation actors been increased, but also industry-university and inter-enterprise cooperation have increased significantly (see Table 3-4). There are 73 mini-clusters and cooperative networks, in which a total of 1,594 R&D projects have been conducted (R&D cooperation project).

〈Table 3-4〉 Performance of Korean Cluster

Year	Number of I–A–G cooperations (per company)	Number of inter-company cooperations (per company)
2004	2.9	2.3
2010	4.9	3.2

Source: Korea Industrial Complex Corporation (2012), Internal Material.

In 2005-2012, companies participating in the cluster business showed a 6-fold increase in production, 3.8-fold in exports, and 2.3-fold in the number of employees compared with those who did not participate in the cluster.

〈Table 3-5〉 Performance Satisfaction of Cluster Participants

Rank	Level	Ratio(%)	Rank	Major Performance	Five Scale
1	Very satisfied	48.2	1	Enhance R&D capability	4.34
2	Satisfied	43.8	2	Increased I-A-G cooperation	4.16
3	Just Then	7.6	3	Increase in human / physical network	4.15
4	Unsatisfied	0.4	4	Increase new business opportunities	4.03
5	Very unsatisfied	0.0	5	Improve productivity	3.97
Total	100.0		6	Improve marketing ability	3.84

Source: Korea Industrial Complex Corporation (2012), Internal Material.

3.3. Korean TP

A TP is an industrial technology park that integrates human, material and technological resources that are dispersed among enterprises, universities, research

institutes, and governments to foster local knowledge-based industries and create new industries. It also refers to the collection of land, buildings, and facilities in which enterprises, universities, research institutes, and local government or central government participate.

In the early stage, TPs were focused on building the technology infrastructure needed for enterprise support. After that, they established a network with local enterprises, universities, research institutes, and local governments to identify and develop small-but-strong enterprises.

In 2007, the Strategic Industry Planning Agency and the Specialization Center were integrated with TPs to play a central role in strengthening strategies and policy functions to foster local industries and fostering regional industries. As of 2016, 18 TPs have become the basis for revitalization of the regional economy in 17 cities and provinces. In other words, we have established an organic cooperation network with related institutions, including industry, academia, and related associations, for policy planning to establish mid- and long-term regional industry development strategies and policies that fits regional conditions and industrial characteristics, and enables efficient local industry development activities. In addition to establishing networks and infrastructures to strengthen inter-agency exchanges and cooperation, we are also fostering technology-based companies by creating a business environment and fostering a variety of support programs.

For the past 20 years, TPs have contributed greatly to the growth and development of the Korean economy centered on the region. For the sustainable growth and development of the nation, the local economy must find ways to create new industries and foster knowledge-based industries. Organic cooperation among local governments, enterprises, universities, and research institutes in the region is important for this.

3.3.1. Status of TPs

TPs, which are the foundation of regional industrial development and regional innovation, include 18 complexes in 17 provinces, focusing on fostering specialized industries that are the main driving force of regional development (see < Table 3-6 >).

3.3.2. Organization and Functions

The TPs scattered throughout the country are systematic and standardized in functions and roles. Employees are also focused on local development, specializing in the characteristics of each region.

3.3.2.1. Standard organization

Each TP's organization consist of a board of directors that is the highest decision body (led by governor of the state), a policy planning agency that supervises the regional industrial policy planning, and the administrative support office, which is in charge of administrative affairs.

〈Table 3-6〉 Status of Korean TP (2016)

Name	Founded on	Budget (billion KRW)	Site area(㎡)	Building floor (㎡)	Persons
Seoul	2004.12	17.3	83,906	30,916	36
Busan	1999.12	77.1	295,621	89,246	200
Daegu	1998.12	72.6	57,087	101,533	177
Incheon	1998.06	431.0	452,895	112,345	70
Gwangju	1998.12	56.0	99,174	40,892	85
Daejeon	2005.01	54.0	53,019	35,697	155
Ulsan	2003.03	44.0	167.604	63,067	144
Gyounggi	1998.09	18.0	178,476	40,685	56
Gyounggi Daejin	2008.03	66.7	105,453	56,602	19
Gangwon	2003.12	44.0	222,492	39,074	94
Chungbuk	2003.12	55.2	302,965	42,635	140
Chungnam	1998.12	58.6	252,933	88,004	129
Jeonbuk	2003.12	29.0	510,587	19,236	81
Jeonnam	2003.12	91.7	153,862	49,200	113
Gyoungbuk	1998.08	46.1	152,727	21,478	84
Gyoungnam	2000.06	103.9	164,736	64,019	104
Jeju	2010.08	44.0	116,502	37,551	127
Pohang	2000.01	18.5	180,856	34,452	36

Note: Specialized in: Seoul (IT, IT convergence, BT), Busan (Marine, Machinery parts, Material, Video·IT, High-tec future), Daegu (Nano, Bio, Oriental medicine, Mobile, Green energy), Incheon (Auto parts, Bio, Mechatronics, Electronics Information, Digital design & processing, Nano), Gwangju (LED/LD, Optical communication, Information appliance parts, Auto parts), Daejeon (IT, Bio, Mechatronics, High-tec parts & materials) Ulsan (Auto, Shipbuilding, Marine, Precision Chemical, Environment), Gyounggi (IT, Electronics, Auto parts, Bio, Robot), Gyounggi Daejin (New & recyclable bio energy, Video media culture, Contents, Fabric Material, Furniture Design, LED display, Eco-friendly bio material), Gangwon (Bio, Medical instrument, New material, Fire protection, Plasma, Maritime bio), Chungbuk (Bio, Semi-conductor, Electronic/Electric convergence parts, Next-generation fuel cell), Chungnam (Electronics/information device, High-tec culture, Auto parts, Agricultural/livestock bio), Jeonbuk (Auto, Machinery, Bio, New recyclable energy, RFT, Culture, Tourism, Video), Jeonnam (New material, Shipbuilding, Bio, Logistics & cultural tourism), Gyoungbuk (Nano, Bio, Oriental Medicine, Mobile, IT convergence, Green energy), Gyoungnam (Aero-space, Mechatronics, Precision devices, Shipbuilding, Robot, IT convergence, Bio), Jeju (Health, Beauty, Bio, Digital contents, Water, MICE), Pohang (Nano electronics material, New metal material, Bio medical material, Energy material).

Source: Korea Techno-park Association (2016).

3.3.2.2. Functions and Roles

TPs serve as bases for fostering local industries by establishing strategies and plans that are geared to local environment and characteristics, and by establishing an organic cooperative network composed of local industry, academia, and research institutes. The main functions of TPs are as follows.

- **Strategy and policy planning to foster knowledge-based and local industry:** Long-term development strategy building for fostering local industry in accordance with local situation and characteristics, planning and evaluation of local business for performance enhancement, and planning and evaluation of management strategy of TP itself.
- **Strengthen cooperation with related organizations:** Operation of an I-A cooperation network, regional innovation system, and global network for fostering regional industry
- **Enterprises support:** Assist with the provision and support of advanced equipment, test production, certification space, technology and management consulting, marketing, FDI, human resource development, etc.
- **Fostering of small-but-strong enterprise:** Excavation companies with technological capabilities, supporting start-ups and commercialization, attraction of high-tech companies
- **Technology innovation:** Promotion of technology innovation, activation of technology transfer, education and training in new technology through R&D through I–A cooperation and innovation
- **Local industry fostering:** Fostering of small-but-strong enterprises through innovation, start-up, and support

3.3.3. Major Business

TPs conduct the projects of the local government and central governments, such as the Ministry of Trade and Industry and Ministry of Future Creation Sciences. In particular, in order to promote the regional innovation system, local industry promotion, and local science and technology development for the regional specialization development, the local industry support project is being undertaken with the support of the wide area development account of the Ministry of Trade and Industry.

3.3.3.1. Fostering of Regional Strategic Industry

The Regional Strategic Industry is aimed at raising the competitiveness of regional industry centered on strategic industries that reflect regional characteristics and at fostering them as the basis of regional innovation.

- Establishment of regional industrial base: technology development and commercialization through development of local strategic industrial complex or creation of innovation base, and joint use of equipment and facilities
- Core technology development of specialized and strategic industry by region, pursuing balanced regional development
- Enterprise support service project: Provide technical guidance, consulting, marketing, and knowledge services by utilizing local infrastructure
- Local strategic industrial planning agency operation: Through establishment of the industrial cluster planning organization, and efficient promotion of the regional strategic industry
- Fostering of regional innovation Base: Based on a TP that has already been established, to reinforce the function of regional innovation and to provide a comprehensive service for enterprise support

3.3.3.2. Fostering of Regional Specialized Industry

The Regional Specialized Industry project aims to build a regional innovation system that fits local specialized industries and to strengthen local innovation capacity.

- Local industry nurturing promotion project: In order to foster industries that meet characteristics and conditions of a given region, regional innovation actors such as industry, academia, and research institutes jointly participate in various I-A-G cooperation elements such as technology development, professional manpower training, marketing support, and networking.
- Regional Innovation Center (RIC) project: To conduct joint R&D by I-A-G cooperation, to install and operate technology diffusion and commercialization
- Establishment of a local research institute: To foster establishment of hub research institutes to lead R&D in order to foster local strong points and local-based industry

3.3.4. History

TP, which was created mainly for the establishment of enterprise support infrastructure in six regions for the first time in 1997, has been established as a base for fostering regional industries with the addition of local industrial strategy and

policy planning functions since 2007. The major events in the history of Korean TPs are as follows.

- 2013 Launching of new local industry development project, separation of the regional evaluation center
- 2012 Completed local innovation base project
- 2009 Globalization of TPs in Korea (Overseas expansion of enterprises, FDI)
- 2008 Raising the Foundation for Regional Innovation (Investment Expansion of technological enterprise)
- 2007 Integration of Strategic Industrial Planning Agency and Specialized Center (Function strengthening of local industry development and policy planning)
- 1998 Establishment of the Special Act on the Support of Industrial Technology Parks (Institutional support for TP development)
- 1997 Launched six TPs
- 1995 Confirmation of the Korean TP project

3.3.5. Model

The Korean TP model has characteristics, such as rapid growth, stable governance, fostering strategic industry, and systematization, that are difficult to find in other advanced countries.

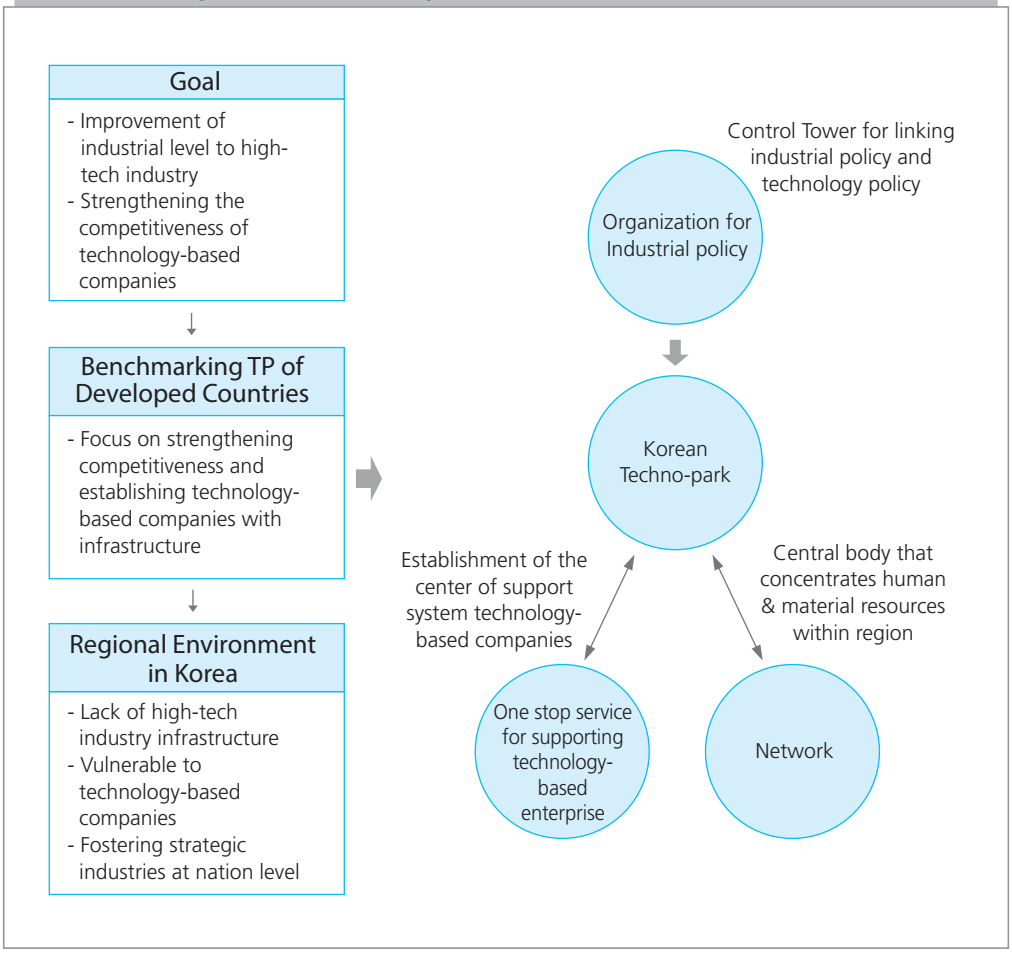
3.3.5.1. Background and Development

The TP policy emerged as part of the policy to nurture local industries in the mid-1990s. Composition of TPs started from the end of 1997, and now there are 18 complexes in 17 cities. The development of TPs in Korea can be roughly divided into three stages.

The first stage (1997-2007) focused on creating a space for corporate innovation. The second phase (2008-12) focused on the technology and organizational structure for fostering strategic industries. This period was the time to establish an organization for supporting the innovation of technology-based companies and to promote the linkage and cooperation of technology and human resources. The third phase (2013-present) focuses on the formation of a network hub through the establishment of a corporate innovation ecosystem in order to foster strategic industries. It will be used as a comprehensive enterprise support center and RIC.

3.3.5.2. The Korean TP Model

[Figure 3-4] The Three Major Economic Growth Axes of Colima State

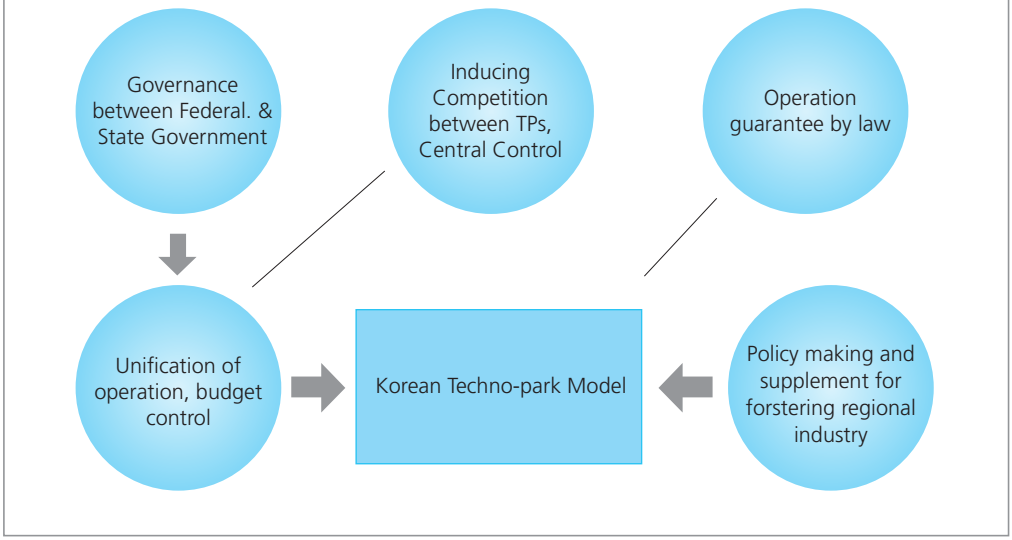


Source: Korea Techno-park Association (2016).

Unlike the developed countries, TPs in Korea play a larger role in establishing, supplementing, and managing industrial promotion policies in the region (see Figure 3-4).

On the other hand, the TP model of Korea includes the governance between the central government and the local government, and it is characterized by the establishment, supplementation, and operation of the local industrial development plan according to the law (see Figure 3-5).

[Figure 3-5] Characteristics of the Korean TP



Source: Korea Techno-park Association (2016).

3.3.6. Success / Trial & Error Factor of the Korean TP[1)]

3.3.6.1. Success Factors

The success factors of Korean TP are 1) Strong and continuous support by central government on R&D, cluster, and innovation, 2) Fostering strategic industries based on regional industry capability analysis, 3) Operation of think-tank in TP: strategic industry planning agency for local government, 4) Strong I–A Cooperation policy, closely linking government departments.

3.3.6.2. Trial & Error Factors

The trial & error factors of Korean TP are 1) Quantitative/qualitative limit of companies in strategic industries, 2) Lack of graduates and researchers in new technology fields, 3) Lack of local government policy for supporting strategic industries.

1) Modified from Kim, Hakmin, Linking Strategy of Academy, Business and Government for the Innovation Ecosystem in Colima Science & Techno-park(2016), KDI., and Lim, Chongin (2012), "Korean Techno-park; The fusion of technology, industry, and region," Journal of industrial location, KICOX.

3.3.6.3. Implications for Colima TP

Based on the case study of Korean TPs, the implications for the Colima TP are as follows. 1) Strong and continuous support by federal government on R&D, cluster, and I-A-C, 2) Fostering strategic industries: Agro-biotech, IT, Logistic IT, and Renewable energy, 3) Establishment of a think-tank in Colima TP ⇒ Colima strategic industry planning agency, 4) Linkage activation between universities, research institutes, and FDI companies in Colima TP, 5) Detailed analysis of business competence by state government for fostering Colima TP, 6) Engineering program development on key industries in Colima TP, 7) Policy Development for attraction of FDI to Colima TP.

〈Tips〉 Characteristics of Developed Countries TP

Unlike industrial complexes, which are production bases, TPs have a common point of emphasizing the transfer of high-tech research results and new technology start-ups and childcare to universities and research institutes.

There are differences in scale and function according to the industrial structure and technological innovation system of each country.

- The United Kingdom and the United States: TPs have been formed mainly in universities, and the start-up of high-technology venture companies has been prominent.
- Germany: Emphasis on new technology development and technology diffusion of R&D results that is centered on technological innovation centers established in consideration of regional industrial structure and technological environment.
- Japan: emphasizing the role of the university in the mix of British and German models, the development of large-scale techno-polis, the development of innovative technologies, and the transfer to industries (though effectiveness is still insufficient).
- China, Taiwan, and Singapore have established large-scale TPs in the form of industrial complexes based on science and technology.
- TPs in developed countries restrict the movement of production activities, but late-developing countries are developing into multiple complexes in which R&D, start-up, and production activities of high-tech products coexist.
- Their major supporting programs for TPs are

  - Special amortization system for high technology facilities
  - Income tax, building/land tax exemption for tenants
  - Subsidiary for installation of special facilities
  - R&D funding for tenant companies
  - Supporting incubation facilities for cultivating high-tech preliminary founders
  - Financial support for construction of special facilities such as R&D facilities

Source: Lim, Chongin (2012), "Korean Techno-park; The fusion of technology, industry, and region," Journal of industrial location, vol.48, Korea Industrial Complex Corporation.

3.4. I-A Cooperation Policy

3.4.1. Goals

The Korean government has the following three goals in the "Act on the Promotion of Industry Education and the Promotion of Cooperation between Industry, University and Education" enacted in 2003 in order to facilitate cooperation among industries. The first is the training of human resources in order to meet the demands of the industry and future industrial development. The second is R&D for the creation and diffusion of new technical knowledge. The third is the technology transfer to the industry and the activation of engineers.

3.4.2. Necessity

Today, industry is placing more emphasis on intangible assets, such as knowledge, technology, or intellectual property, than on tangible assets. As a result, the paradigm of science and technology has been transformed and demanded a wider range of I-A cooperation.

Therefore, the role of the university should be to not only provide education and research (as in the past), but also to contribute to the finances of the university through I-A-G cooperation that utilizes the research results in the industrial field. In addition, they should seek national growth engines to provide a foundation for sustainable economic development. Cooperation among industry, academia, and research institutes can be seen from the following three perspectives.

First, one of the key factors in enhancing national competitiveness is cooperation between industry and academia, which is used by advanced countries as a strategy to build a knowledge-based economic system.

Second, facing global competition, companies are choosing I-A-G cooperation to open up application technology at the same time as progress of basic science for continuous growth and rapid market adaptation.

Third, universities emphasize collaboration between industry, universities, and research institutes to improve human resources with global competitiveness and to provide stable and sustainable R&D and a virtuous circle of research in university.

3.4.3. Types

I-A-G cooperation can be divided into the following four types (see Table 3-7).

〈Table 3-7〉 Types of I-AG Cooperation

Classification	Categories
Cooperation relation among participants	- University-led - corporate-led - government-led(local government-led)
Contents	- Cooperation (consignment) R&D - Education & training / Knowledge & technology transfer - Technology consultation - Personnel & Information exchange - Equipment & facility sharing
Organization structure	- I-A-G cooperation by research institute integration based on regional economy - I-A-G cooperation by research-oriented university focused on basic research - I-A-G cooperation by consortium /I-A-G cooperation by business incubation - I-A-G cooperation by supporting spin-off companies
Type	- Collaboration (consignment) Research / Human resource exchange - Sharing of human resources and equipment - Exchange of knowledge and information

Source: The Ministry of Education, Science & Technology (2011), The fostering project of leading university in I-A Cooperation; Leaders in I-A Cooperation (LINC).

First, it is classified into university-led, enterprise-led, and government (local government)-led types according to the partnership relationship of participating parties.

Second, according to the cooperation contents, there are six categories of 1) joint (consignment) R&D, 2) education and training, 3) transfer of knowledge and technology, 4) business technology consultation, 5) human resources and information exchange, and 6) equipment and device sharing.

Third, there are five categories depending on the organizational structure; 1) I-A-G cooperation by research institute integration based on regional economy, 2) I-A-G cooperation by research-oriented university focused on basic research, 3) I-A-G cooperation by consortium, 4) I-A-G cooperation by business incubation, 5) I-A-G cooperation by supporting spin-off companies

Finally, according to the cooperation method, there are four forms: 1) joint commissioned research, 2) human resources exchange, 3) joint utilization of human resources and equipment, and 4) exchange of knowledge and information

3.4.4. Korea Poly-tech University Case

3.4.4.1. Background

As progress has been made in working towards a knowledge-based society, cooperation and human resources training have been emphasized for technological innovation and national creation among universities, companies, research institutes, and governments. Accordingly, the Korea Poly-tech University established an I-A cooperation foundation, the purpose of which was to promote I-A-G cooperation that matched the paradigm shift of science and technology innovation.

3.4.4.2. Goal

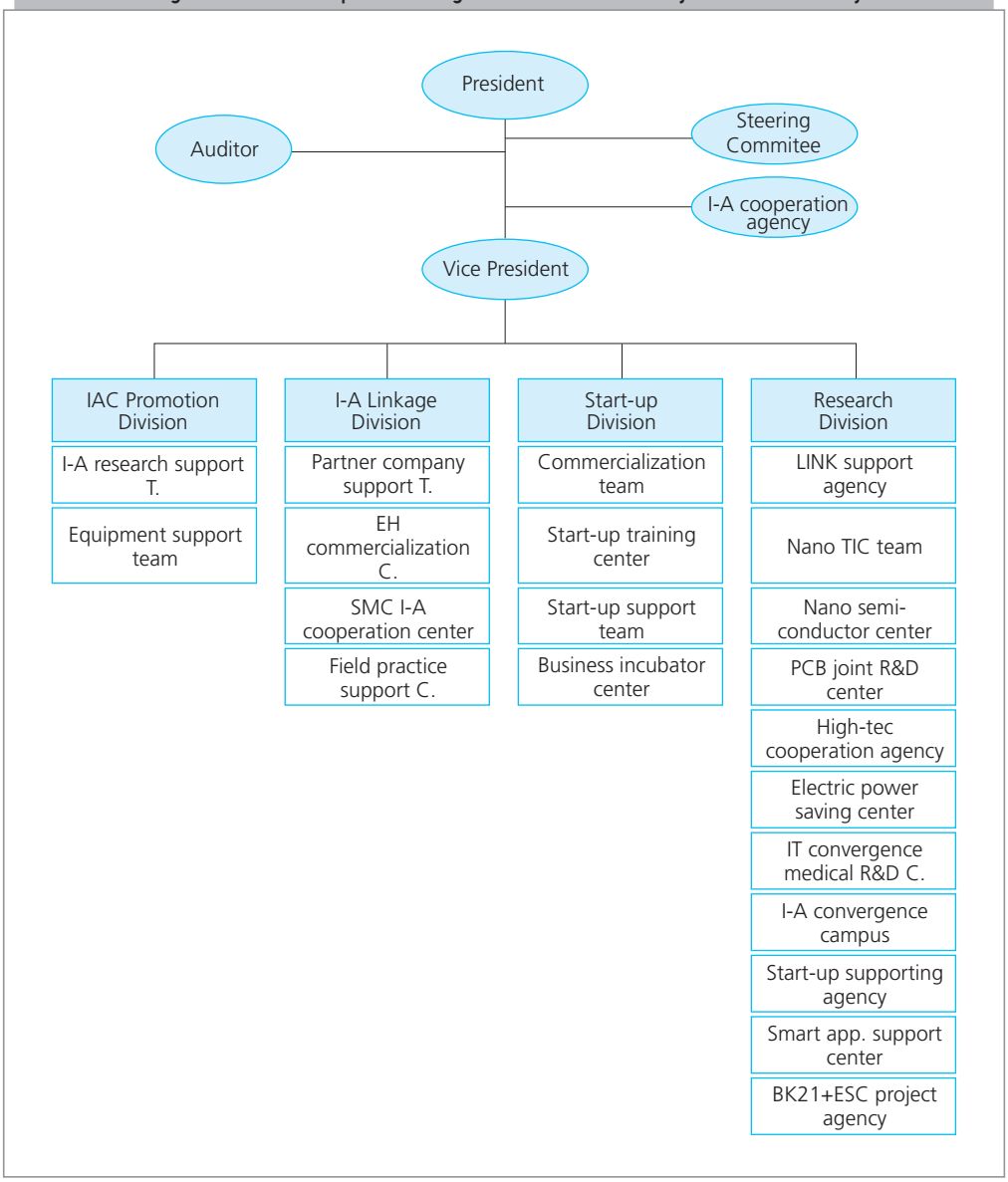
The promotion of I-A cooperation has emerged in the field of national innovation ability sufficiently to be adopted as a key index representing national innovation ability, and the relationship between I-A cooperation innovators has been established and the network has been emphasized. As technology changes rapidly, various technologies converge and an innovation system is established in which individual experts are interconnected. In order to enhance the competence of each sector participating in I-A cooperation and to strengthen the network, they established an I-A cooperation agency.

3.4.4.3. Organization Structure

The I-A cooperation agency of Korea Poly-tech Universities has the character of a university subsidiary and special corporation. It is a dedicated organization that manages and supports I-A cooperation projects, promoting regional industry development and improving the competitiveness of university.

The purpose of the establishment is to strengthen the support system for SMEs by linking education/research and business activities through industry-university cooperation. Step-by-step goals include 1) establishing an I-A cooperation support system, 2) establishing an I-A cooperation network, 3) establishing technology development and profitable business area, 4) contributing to university finance improvement and regional economic development. As the I-A cooperation program has increased, the organization has expanded.

[Figure 3-6] I–A Cooperation Organization of Korea Polytechnic University



Source: Korea Polytechnic University (2016).

3.4.4.4. Function & Task

The IAC Agency is responsible for planning support for I-A cooperation and cooperate with partner companies. It also acts as a cooperative organization for I-A-G cooperation and supports projects of SMEs. In addition, it is responsible for supporting equipment for SMEs, providing the necessary training and resources for companies, and managing the university's research expenses.

4. Building Strategy of the Innovative Ecosystem for Colima TP

4.1. Status of Colima TP

4.1.1. Introduction of Colima TP

According to the Colima TP master plan, it is an institute of the state government to boost the competitiveness of the strategic industries of the Colima state by creating and enabling appropriate space for the installation of technology- and science-based companies and institutions that provide supports for regional businesses. The industries to be developed at Colima TP are logistics, information technology, agro-industry, and clean energy.

The objectives of Colima TP are generation of business opportunities through the creation and application of knowledge and technology (knowledge and technology as source of wealth and social equity), promotion of business activity through incubation and acceleration of enterprises (growth of strategic sectors), generation of intensive jobs in the use, acquisition and generation of knowledge (employment), and promotion of the transfer and commercialization of scientific research result(productivity). As the underlying concept of Colima TP is that of a "City of Knowledge," It is equipped with all services, banking module, convenience store, stationary, restaurant, cafeteria, kindergarten, jogging track, outdoor gyms, an artificial lagoon.

Details of Colima TP are as follow:

- Total area of 42 hectares
- 28 lots (average surface area 1ha)
- Closed boundary with access control and independent security
- Telecommunications with fiber optics and wireless internet throughout the park
- Main building technical link center(under construction, with the business wing partially completed)
- Laboratory of agro-biotechnology
- Radio frequency research laboratory
- Classification of land-use type "industrial garden"
- Luminaires and 100% ecological urban furniture
- Total respect for the conservation of the park's natural resources

A total of 269 million pesos were invested to develop Colima TP during 2008-2016. <Table 3-8> shows the investment status by institutions, by projects.

〈Table 3-8〉 Investments by Institutions in Colima TP (2008–2016)

(Unit: 1,000 Mexican pesos)

Project	Federal Government		Colima State Government	University of Colima	Total Investment By Concept
	CONACYT	S. of Economy			
Agro-bio technology laboratory	48,249	-	18,502	6,799	73,550
R.F. laboratory (Canechoic Chamber)	41,667	-	10,000	1,000	52,667
Techno- complex/Tech link center	-	76,293	3,537	-	79,829
Land purchase	-	-	26,000	-	26,000
1st stage urbanization	-	-	25,000	-	25,000
1st stage construction of the perimeter fence in order to establish a closed reserve (comprising 2000 linear meters)	6,000	-	-	-	6,000
Deep portable water wall (185m & equi.)	-	-	5,000	-	5,000
Other instrument (taxes, connections, executive projects and security)	-	-	645	-	645
Total	95,916	76,293	88,683	7,799	268,692

Source: Government of Colima State (2016), Current state of CLQ TP.

〈Table 3-9〉 Economic Needs for Launching the Colima TP operations

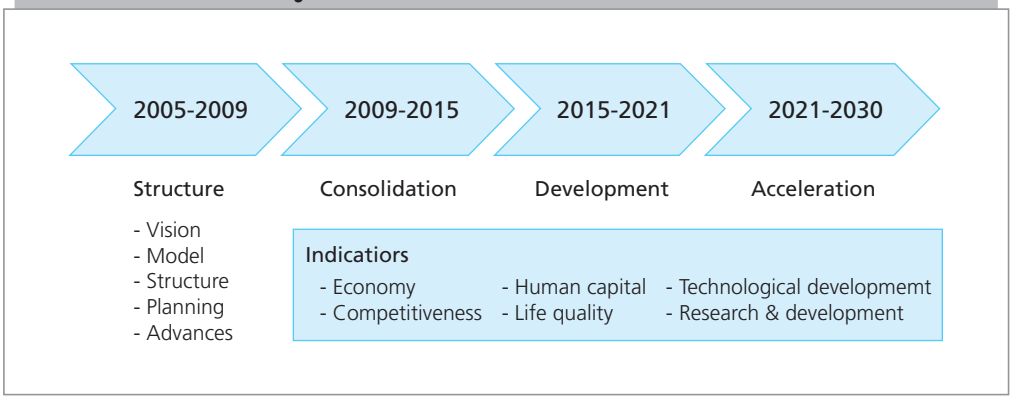
Concept	Amounts
Electrical substation with capacity of 15MVA that would allow to supply electricity the Colima TP at 100% of occupation	30,000 (urgent)
Internal communication network for the Colima TP(optic fiber and connection hotel for different carriers or communication service providers)	10,000 (urgent)
Conclusion of perimeter wall, guardhouse, and CCTV	10,000 (urgent)
2nd & last stage of urbanization, encapsulation of river (11remaining lots)	36,000
Completion of Technological Linking Center The central module, the academic wing, the government wing, the parking lot, the outer squares and metal parasols, the emergency stairs and gardens are missing the construction to be finished	104,282
Total	184,282

Source: Government of Colima State (2016), Current state of CLQ TP.

The budget for launching the Colima TP operations is shown in <Table 3-9>, and about 154 million pesos is needed in the future.

[Figure 3-7] shows the work schedule of Colima TP to 2030. It has four stages: Structure (2005-2009), Consolidation (2009-2015), Development (2015-2021), and Acceleration (2021-2030). Its indicators are Economy, Human capital, Technological development, Competitiveness, Life quality, and R&D.

[Figure 3-7] Work Schedule of Colima TP to 2030

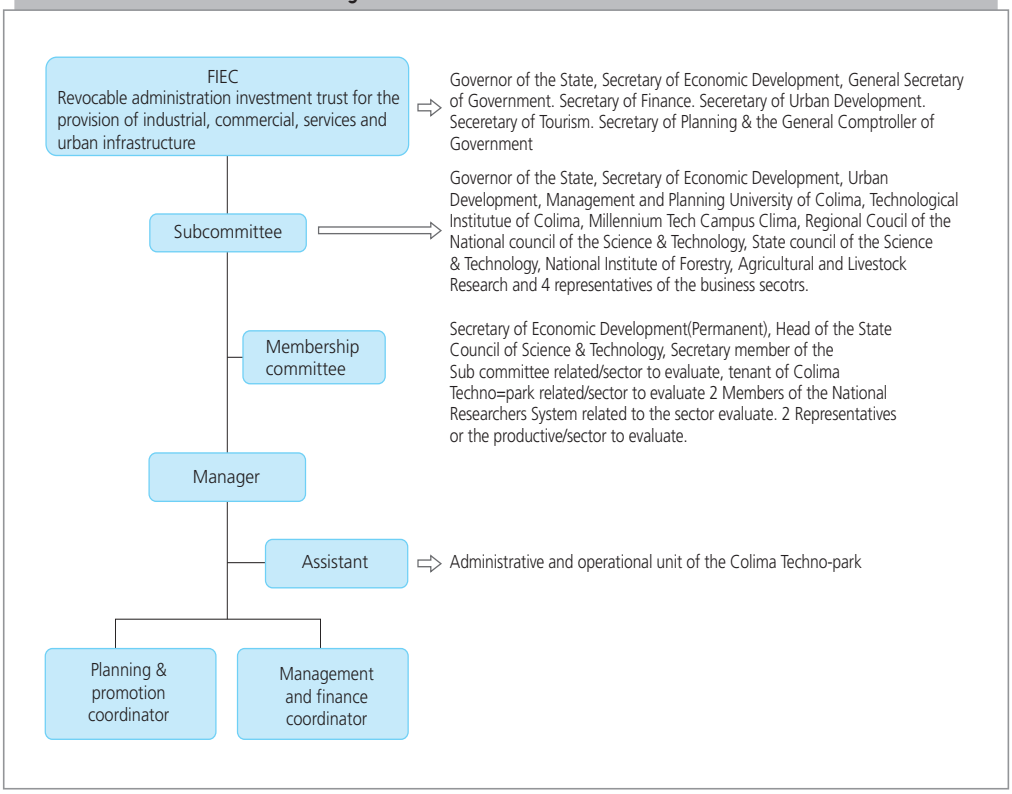


Source: Government of Colima State (2016), Current state of CLQ TP.

Colima TP focuses on the "triple helix model," in which the state government plays a key role in promoting I-A cooperation: the "triple helix building" (Figure 3-7) of Colima TP has three wings, symbolizing the spirit of fusion into one building. This is the first building of the Colima TP and is considered the most important of the Colima State. The building is located in front of the Colima TP complex, where the three wings represent state administration services, college research, and corporate production, respectively. The key facility in this building is the "Technical Coordination Center," which means an organic linkage or operation between industry and academia. Surrounding this building are the agricultural biotechnology, radio, automotive and electrical, and telecommunications laboratories supported by the Colima Research Institute, as well as the University of Colima.

In the "triple helix model," the operation of the wing represents the operation process of the Colima TP. Recently, the Colima State government has been trying to shift from a service-based economy to a knowledge-based economy. However, these three axes also compete with other states in Mexico as well as foreign countries. As shown in [Figure 3-8], the Colima TP should be operated in harmony with the three institutions equally and actively, acting as a team for regional economic development.

[Figure 3-8] Governance of Colima TP



Source: Kim, Hakmin (2016), Linking strategy of academy, business & government for the innovation ecosystem in Colima Science & technology park, KDI.

The government should take charge of promoting understanding and cooperation between universities and companies in order to implement budgetary allocation, policy development, and the purpose of establishing Colima TP for its development and operation. Universities are a key elements of this task. This is because we have to supply human and intellectual capital to cooperate with companies to innovate to improve products and services.

On the other hand, enterprises should make efforts to solve problems jointly with universities and state government by presenting needs for business success and further development of the regional economy.

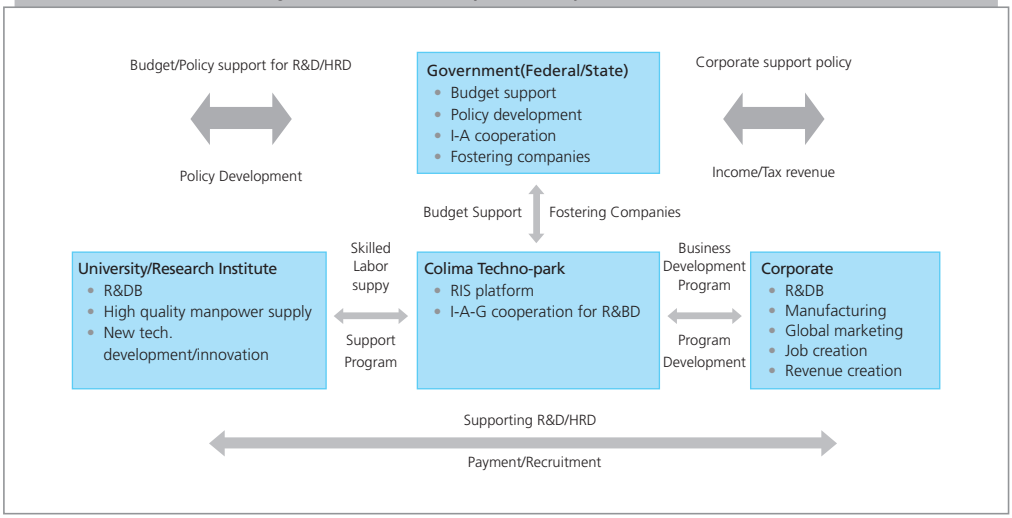
4.1.2. Task of Colima TP

The Colima TP began to be the 8th TP in Mexico in 2008, and it is still under construction. Support facilities are being built and some research facilities have been moved, but there are no production companies. Due to various political and economic circumstances, the construction is delayed compared to the original plan,

but it is expected to be completed soon as it is one of the main projects of the state government.

The biggest weakness of Colima TP is that it has no experience in running a TP, and it needs to attract research institutes, support organizations, and companies. Therefore, it will be necessary to prepare future operating programs, secure operating personnel, and expand operating budgets. The success of the TP is supported by the state government, but independence from political influence is needed in view of the specificity of the project. In addition, we need to raise awareness of the necessity and importance of community through image building regarding TP.

[Figure 3-9] I-A-G Cooperation System of Colima TP



Source: Kim, Hakmin (2016), Linking strategy of academy, business & government for the innovation ecosystem in Colima Science & technology park, KDI.

4.2. Building Strategy of Innovation Ecosystem (Technology Transfer, Commercialization)

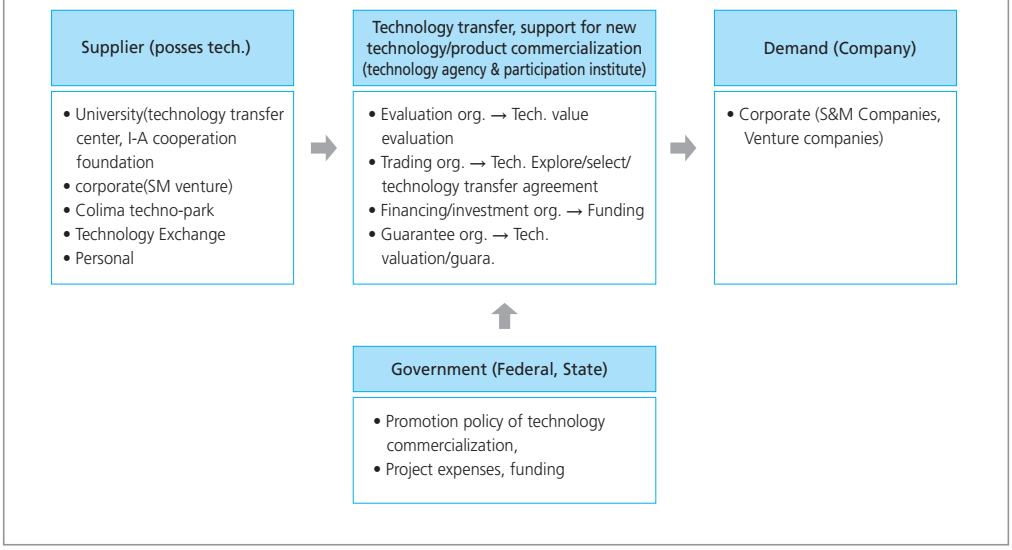
4.2.1. Introduction of Technology Transfer & Commercialization Project

This project seeks promising commercial technologies from companies, universities, research institutes, individuals, etc., to transfer it to companies that hope for commercialization. It concerns activity to apply technology to the production process, to make the prototype, to test it in the market, to set up the mass production of the product, or to start the sales, research institutes, individuals, etc.

and transfer them to companies that desire to commercialize them, and to make prototypes by applying them to the production process, or to start selling.

The economic development department, which is a project organizer, should establish a "technology business agency" to take on technology transfer and commercialization for Colima TP. Participating organizations of this agency would include technology trade & evaluation institutions, Colima TP, and technology transfer centers at each university.

[Figure 3-10] Model of Technology Transfer and Commercialization



Source: Lim, Chongin (2005), The operation model of innovative cluster, Korea Industrial Complex Corporation.

The target is a company that is located in Colima TP. It is a corporation that aims to commercialize technologies or new products introduced by the participating agencies. Support contents include technology transfer, new technology, commercialization of new products, mediation, and funding for commercialization, mediation, technology transfer, and commercialization. Financial support will be determined by the budget of the federal government and the state government.

On the other hand, the project period of technology transfer and commercialization of the step-by-step Colima TP is as follows.

〈Table 3-10〉 Period of Technology Transfer and Commercialization by Stages

Classification	Period	Period Main contents
Level 1 (Early stage)	1st year	- Support exchange of business between resident companies and technology-trading institutions - Supporting the exchange of business between venture companies and technology related institutions - Promoting brokerage linkage between related organizations and companies - Operated as an intermediary agency, sponsored by a promotional agency
Level 2 (Growing stage)	2nd and 3rd year	- Independent technology transfer, business support project for new products - Registered as a technology-trading institution (Certification: Technology Transfer Center) - Promotion of center-oriented technology transfer and new product commercialization support - Support for linkage through the creation and operation of commercialization investment funds
Level 3 (Mature stage)	After the fourth year	- Developed independent technology transfer model for prototype commercialization - Technology transfer, commercialization of new products and new technologies

Source: Lim, Chongin (2005), The operation model of innovative cluster, Korea Industrial Complex Corporation

4.2.2. Contents and Role Sharing

The contents of the project include the demand for technology transfer, the demand for technology introduction, the technology to be transferred, scope of commercialization support, and the technology commercialization feasibility analysis. In addition, there is also on-line and off-line technology promotion support that regularly introduces new technologies and new products supported through business support projects in cooperation with business magazines and various public relations media. The project also includes consulting on legal consultation on technology transfer contracts, technology introduction and commercialization strategy, search for and mediation of technology transfer, and recruiting manpower and funds (investment and financing) necessary for commercialization of introduced technology.

4.2.2.1. Role Sharing by Participating Institutes

<Table 3-11> shows the roles of the participating agencies.

〈Table 3-11〉 Role Sharing by Function of Participation

Division	Main Task	Remark
Technology agency	- Demand survey and analysis of resident enterprise technology transactions (consumer and supplier) - Demand for technology transfer & introduction, transfer-desired technology, commercialization support contents - Supports technical evaluation of technology owned by universities (I–A cooperation, technology transfer center), research institutes and resident companies, commercialization of technology or products developed	Subjectivity
Technology exchange	- Technical transaction, technology evaluation, technology transfer support, professional training, registration of trading company - Establishment and service of national technology transfer information system (NTB)	Cooperation
Government-designated technology trading, evaluation agency, and TP, technology transfer center of universities	- Evaluation of technology transfer, establishment of technology transfer strategy & technology marketing - Advise on technological difficulties of companies and support for transfer of excellent technology	Cooperation

Source: Lim, Chongin (2005), The operation model of innovative cluster, Korea Industrial Complex Corporation.

4.2.3. Operation Method

4.2.3.1. Preparation and Application

After selecting the specialized agencies in the relevant fields, the Technology Project Team concluded a "Business Agreement" and shared the technology transactions, possessed data-bases, and technology trading networks held by the participating organizations and investigated the experts and experienced professionals in the region. This is subsequently managed by personnel pools. In addition, employees who will be responsible for commercialization support will be selected based on the related field major or years' related business experience, so that they can acquire professional job knowledge through their own and entrusted education. Upon completion of such preparations, applicants will receive support in accordance with the annual commercialization supporting plan.

4.2.3.2. Evaluation of Commercialization Exploration

The project team shall establish a deliberation committee to evaluate and select the technology transfer, new technology, and new product commercialization support in order to fairly carry out the business. The committee shall consist of no more than 10 members. The members of the participating organization shall be appointed by the head of the business along with the recommendation of the head of the participating agency among those who have abundant knowledge and experience.

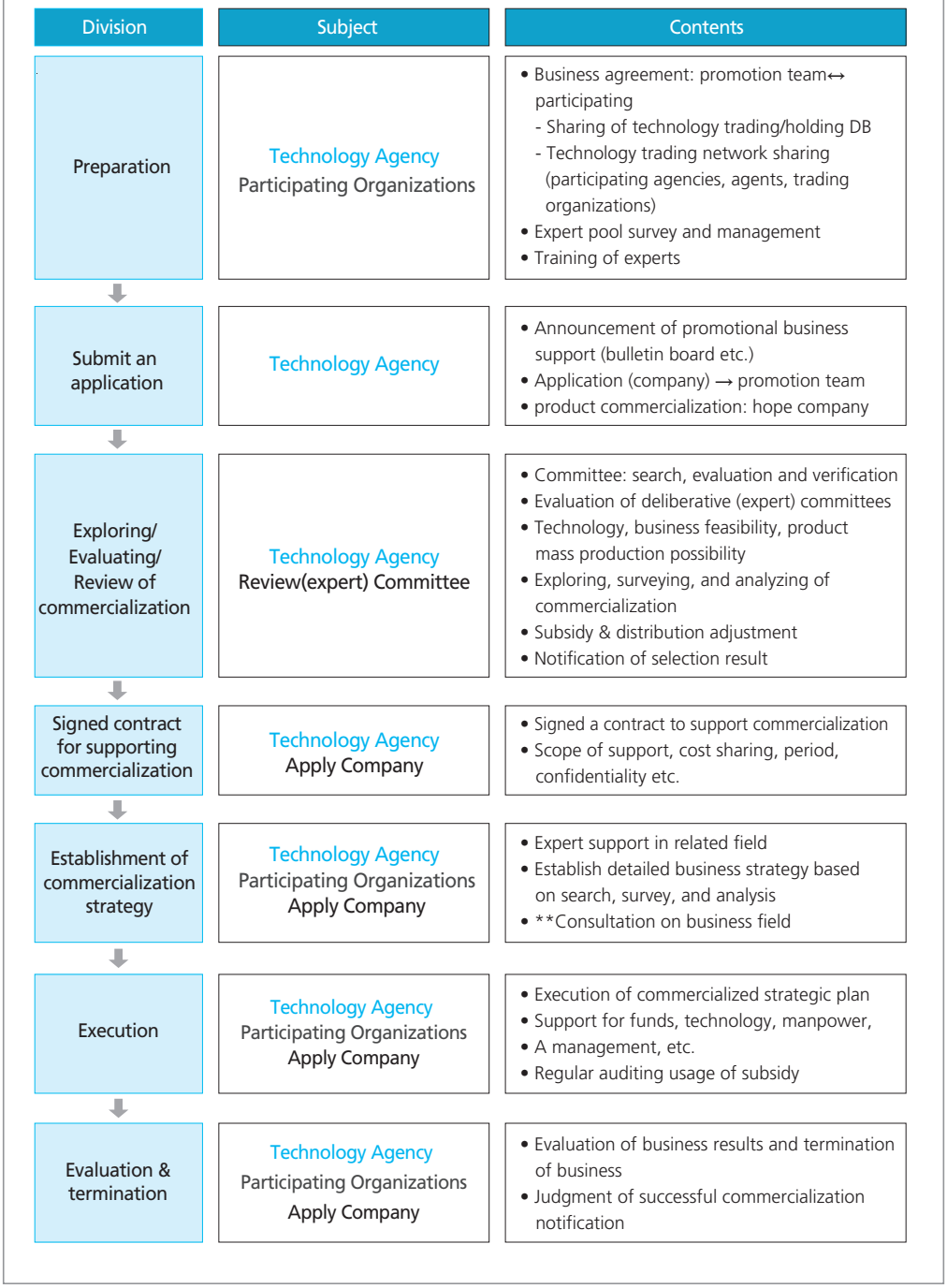
The deliberation committee shall have a special committee for professional examination and evaluation in relation to the commercialization of technology and products. The professional committee consists of up to 10 members. The committee members are recommended by the professional chairpersons, who are rich in knowledge and experience, such as entrepreneurs and experts.

Participating agencies take charge of technology transfer and introduction, commercialization support, funding, market research, feasibility analysis, etc., taking into account the characteristics of each organization.

The role of each participating organization is done through agreement with the project team and coordinated by the project team so that the cooperation between the participating organizations is smooth. The deliberation (expert) committee selects candidates for support based on the following points. It should be a product that can be mass-produced with creative technology, product technology, and business feasibility, technology/product with high technical and economic spillover effect, technology/product that contributes to related industry development and strengthening national competitiveness.

The technical committee evaluates the designation of the technology/product considering the technicality, business feasibility, and possibility of mass production of the project. The deliberation committee then reviews and decides whether to support it based on technical committee evaluation collectively.

[Figure 3-11] Technology Transfer & Commercialization Flow Chart



Source: Lim, Chongin (2005), The operation model of innovative cluster, Korea Industrial Complex Corporation.

4.2.3.3. Concordat Strategy Establishment

The project team and the applicant enter into business agreements related to commercialization support such as scope of support for commercialization, support and sharing of required expenses, duration of agreement, and maintenance of business secrets. In addition, the promotion committee, participating organizations, and applicants establish and implement detailed commercialization strategies based on the results of search, research, and analysis related to the field support (management, marketing, manpower, technology, etc.) for commercialization.

4.2.3.4. Commercialization Support

The support target is the technology that is to be commercialization or the new product that has completed verification of technological and business feasibility by the committee. In addition, the principle is to support 1 business to 1 company.

The subsidy shall be applied for within the scope of commercialization costs (including raw material cost, reagent fee, sample purchase cost, mold production cost, test equipment, equipment purchase cost, and purchase, installation, and operation cost of production facilities for the project), and the period of application is two years in principle. However, if it is deemed inevitable by the applicant's request and the nature of the technology or product, an extension may be granted within a period of six months.

4.2.3.5. Performance Evaluation and Termination

The termination of the project is when the term of the project support service contract expires or the project support project is judged to be successful after the evaluation process of the deliberation committee (even during the business agreement period). In the event of bankruptcy or the corporation being dissolved by the insolvency of the # applicant company and application not being possible, if the applicant company requests to abandon or cancel the business, or if it does not start commercialization for more than one month from the notification date of commercialization support without any special reason, or if commercialization is impossible due to other serious reasons, the agreement will be canceled.

4.2.3.6. Post Management

If the agreement is canceled due to the applicant’s fault, the applicant should immediately stop the application and return the grant already paid. In addition, the members of the Promotion Committee and the employees of the participating organizations should not disclose or leak information of any technology or company that know about this project.

4.3. Establishment of an I-A-G Cooperation System

4.3.1. I-A-G Cooperation

This is a project to receive an application for a university-based cooperation project plan, select a target college after examining it, and execute it in the way that federal and state governments provide financial support. To this end, the university needs to reorganize itself into an I-A cooperation-friendly system, such as by evaluation of professors and the bachelor's degree system, and carry out I-A cooperation and network–hub function through establishment of an I-A cooperation group.

4.3.1.1. Types of I-A-G Cooperation

I-A cooperation can be classified into technological innovation type and field-based type. It is desirable that the former is centered on the undergraduate and graduate school, and the latter is centered on the undergraduate. Both types can be divided into HR training and technology development.

〈Table 3-12〉 I–A–G Cooperation Type

Type	Goals		Target
	HR Training	Technology Development	
Technology Innovation Type	Practical innovation research personnel and creative talent training	Source & innovative technology development, technology transfer & commercialization	Undergraduate & Graduate School
Field-based Type	Cultivate creative talent and tailor-made human resources	Technology development that feels difficult in the field, technical guidance and consultation	Undergraduate School

Source: Ministry of Education (2016).

4.3.1.2. Selection Process and Method of Supporting Universities

The selection procedure and method of the supporting universities are shown in <Table 3-11>. In the first stage, the basic competency of the university and the I–A cooperation capacity are evaluated by the formula index and set to double the number of the selected universities. Next, in the second stage, we examine the business plan that evaluates the ability and plan of creating an I–A cooperation model, and the questionnaire surveys the degree of cooperation between the

university and the industry and the satisfaction of the I–A cooperation. Here, the evaluation results of the business plan and the industry survey results are weighted at 70% and 30%, respectively. In addition, the indicator values for the capacity to characterize I–A cooperation conducted in the 1st stage are verified. In this result, if there are any information errors (false, mistakes, etc.), they have to be subject to a penalty according to the degree of error. The last (3rd) stage is the final selection of the university to be supported by the project management committee based on the results of the previous evaluation.

〈Table 3-13〉 Stage of Evaluation Procedure and Method

Stage	Evaluation Method	Evaluation Contents	Notes
1	Formula index evaluation	- Evaluation of the formula index on university basic competency and on characterization competency of I-A cooperation	Double the number of selected universities
2	Business plan review & industry questionnaire survey	- Business plan review : Capacity and plan to create I-A cooperation model - Questionnaire survey to industry : Degree of cooperation &satisfaction about I-A cooperation - Verification : Verification about the competence indicator value of I-A cooperation in the 1st stage	After Step 1 verifying the formula indicator value, universities with information errors are subject to sanctions
3	Project management committee (selection of support university)	- Selected as a support universities by region	Final Selection of support universities by region

Source: Ministry of Education (2016).

〈Table 3-14〉 1st Stage Quantitative Index

Classification			Contents
Fundamental Capability	Education / Research performance		- Employment rate, number of patent (registration) per professor
	Education / Research Condition		- Full-time professor retention rate, education cost per student
I–A cooperation Characterization ability	System	Institutions and Infrastructure	- Reflecting industry-university cooperation performance when promoting and upgrading of professors, Operational revenues of joint use equipment
		Manpower and budget	- Full-time faculty members who have an industry career, operation of I-A cooperation center
	Contents	HRD & employment	- Field practice and capstone design operation, start-up support
		Technology development & transfer	- Joint research with industry, technology transfer revenue

Source: Ministry of Education (2016).

4.3.1.3. Support Size & Scope

The size of the support is determined according to the budgetary situation of the state government, and the ratio of 6:4 between innovative type and field-based type is appropriate. It is desirable to differentiate support by university based on evaluation results.

The field of support is basically those focusing on reorganizing the constitution of the university into an I-A cooperation-friendly type. It is desirable to consider the competence of the university and state government's conditions, and the ability to cooperate with industry in the priority areas such as regional strategic industries, to specialize the operation of specialty majors as essential.

4.3.1.4. Procedure

First, the university should establish a plan that autonomously suggests current conditions, future goals, implementation plans, and performance indicators. Based on this, the Ministry of Economic Development would select eligible universities through quantitative evaluation, evaluation of business plans, and surveys of industry. The agreement between the selected universities and the state government should be concluded to ensure that the I-A cooperation is carried out efficiently.

And the selected university will promote the I-A cooperation projects strategically and autonomously. The autonomous performance indicators proposed by the university and the project implementation and management will then be evaluated comprehensively.

〈Table 3-15〉 2nd stage Evaluation Factors of Business Plan Review (example)

Area	Evaluation Factor	Contents
Creating Capability of I-A-C Leading Model	System	Status of I-A cooperation system and infrastructure construction
	Organization	Status of training programs and human resources training through I-A cooperation
	Linkage	Status of student employment, start-ups by student, and technology development &transfer through I-A cooperation
Creating Plan of I-A-C Leading Model	Vision	Goal to create leading model for I-A cooperation (sustainability, diversity)
	System	The creation plan of leading model about I-A cooperation system and infrastructure
	Configuration	The creation plan of a leading model about specialized curriculum operation and human resource development
	Linkage	The creation plan of leading model about specialized employment / start-up supporting, technology development & transfer

Source: Ministry of Education (2016).

〈Table 3-16〉 2nd Stage Industry Survey (example)

Degree of I–A–G Linkage	Contents of Questionnaire
Closeness degree	- Acquisition of expertise for university-affiliated I-A cooperation - Establishment and operation of cooperation plan for strengthening - I–A cooperation (facility / maintenance)
Cooperation degree	- Accomplishment of I-A cooperation program - Suitable for local conditions - Status of administrative process (period, procedure, etc.) for I-A cooperation
Satisfaction degree	- The extent to which the participating program meets the needs of the demander - Satisfaction of the personnel trained through I-A cooperation

Source: Ministry of Education (2016).

4.3.1.5. Project Conduct

It is a principle that the project executes the budget autonomously according to the business plan. However, regarding the evaluation of professors, new recruitment of professors, strengthening the role and position of I-A cooperation agency, operation of specialized majors, field practice and capstone design, and operation of the I-A cooperation council should be implemented and supervised. On the other hand, the autonomous project promotion to reinforce I-A cooperation system, specialization of I-A cooperation contents, and linkage of I-A cooperation can be specialized for each university and differentiate the business according to technological innovation type and field type. <Table 3-15> shows examples of program execution by university.

〈Table 3-17〉 Program Execution by University (example)

	Area		Technology Innovation Type	Field Oriented Type
SYSTEM	Reorganization of University System	• University constitution reforming for I-A cooperation friendly		
		N	- Expansion of reflection of I-A cooperation when assessing and promoting professors. Expansion of the recruitment professor of with industry-academia cooperation, and industry experience	
		S	- Introduction of I-A cooperation professor system - professor's temporary sabbatical system to promote I-A cooperation - Bachelor's and Master's course integration ·Activation of fusion/ compounded major	- Introduction of a dedicated professor for I-A-C - Support for field professors - Introduction of a customized department and a contract department - Activation of connecting major
	Strengthening of I-A cooperation	• Establishment of industry-academia cooperation center as a hub of I-A cooperation resources & network		
		N	- Linking/integrating of I-A-C project and common equipment in the university - Hiring and operating a coordinator(expert) for industry-academia cooperation	
		S	- Recruitment of specialist personnel: patent attorney etc. - Support for technology transfer and commercialization - Incubator center, technology transfer center	Recruitment of specialists: career counselors - Employment and career guidance - Employment support center, corporate support center
	Expansion of I-A cooperation Infra.	• Expansion of technological development infrastructure/personnel training for strengthening I-A-C		
		S	- Laboratory for I-A-C - Equipped common equipment for technology development - Collaborative laboratory and equipment	- Facilities for industrial employees training - Establishment of common equipment for enterprise support - Collaborative training equipment

〈Table 3-17〉 Continued

	Area		Technology Innovation Type	Field Oriented Type
COMPONENT	Operation & reorganization of Curriculum	• Reorganization and operation of curriculum to meet local industry (leading, strategy) demand		
		N	- Establishment and operation of specialized curriculum. field practice and capstone design	
		S	- Operation of laboratory linked curriculum - Subject establishment of technology transfer and patent - Development of problem solving teaching method - Opening undergraduate research program	- Conducting joint project of employment-linked type - Establishment of career guidance and aptitude courses - Support to Field-based teaching and learning - Curriculum reorganization of tailor-made for corporate
	HRD, Employment, Start-up support	• Support for specialized employment and start-up based on local industry and I-A cooperation type		
		S	- Joint thesis guidance of I-A-C- linked - Industrial and research interns - Patent and IP rights education - Leadership / entrepreneurship education - Mini MBA education	- Conducted a joint project with I-A-C linked - Industrial interns - Lecture and club management for start-ups - Leadership / entrepreneurship education - Management & accounting literacy education
	Expansion of I-A cooperation Infra	• Expansion of technological development infrastructure and personnel training for strengthening I-A cooperation		
		S	- Laboratory for I-A cooperation - Equipped common equipment for technology development - Collaborative laboratory & equipment	- Educational facilities for industrial employees - Establishment of public equipment for enterprise support - Collaborative practice equipment
LINK	Strengthen of corporate linkage	• Strengthen corporate support to meet local and corporate demand		
		N	- Organization and operation of industry-academia cooperation council (family company, etc.)	
		S	- Supporting leading technology development - Technology export and commercialization (holding company) - start-ups in laboratories and laboratories - Management support and consulting - Operation of know-how program	- Technological guidance & support for difficult technologies in field - Establishment and operation of school company - Support for student co-start - Market demand research and consulting - Education for Industrial Employees

Note: N: Necessity, S: Specialized, I-A-C: Industry–Academia Cooperation.
Source: Ministry of Education (2016).

4.3.1.6. Project Management

A project is managed by consulting, evaluation, and continuous diffusion of models. First of all, it should be advised about business promotion and difficulties through consulting from the beginning of the business. In addition, annual and phase evaluations (two years after the start of the project) should be conducted to check the progress and performance of the project plan originally proposed. It is desirable to continuously disseminate the I-A cooperation model by constantly disclosing business plans and evaluation results on the homepage of universities and state government, and holding workshops and symposia for the spread and sustainability of results.

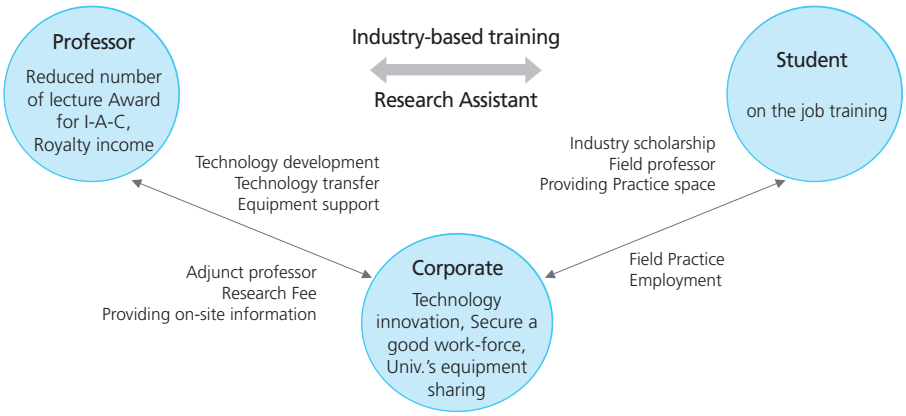
4.3.2. Partner Company

The family company is a system in which the university establishes I–A cooperation agreements, such as sharing of the latest research equipment, joint research and development, and exchange of technical personnel, in order to carry out the organic I–A cooperation activities with related companies. Through this, they do joint research and development, joint use of research equipment, on-the-job training, job training, university scholarship, subsidies, student employment, etc.

The purpose of operating a family company is to establish a close I-A cooperation relationship between companies and universities, to develop mutual-benefit and a cooperative culture, thereby fostering and supplying innovative talents and improving technological competitiveness of enterprises.

The operating system of the family company is shown in [Figure 3-11]. The company uses the technical personnel and the laboratory common equipment possessed by the university for research and development. In addition, the university uses the field technician and the production facility for the company on-site training, teacher training, professor training, etc., to educate skilled workers who are adaptable to the field through tailor-made education that reflects the demands of the industrial field, and to improve technology by supplying those workers to enterprises.

[Figure 3-12] Tax Revenue by Tax Types



Source: Korea Polytechnic University (2017).

[Figure 3-13] Benefit of Partner Company



Enterprise	University
Expanding R&D capabilities through joint R&D, technology transfer with universities, and securing necessary human resource early	Provide partners with research staff, facilities & equipment, and recognize partner/demand-based courses link graduates to work in partner company

Source: Ministry of Education (2016).

On the other hand, the expected effect of the family company is divided into the enterprise side and the university side as follows.

4.3.2.1. Enterprise

- Utilization of R&D such as technical personnel of universities
- Provides highly skilled workforce who have high adaptability in the field with customized training in the field
- Improvement of technology through faculty's technical guidance and consultation (factory doctor)
- Opportunity to interact with the same/different types of industry
- Utilization of university research equipment and common equipment
- Joint participation in various government support projects
- Priority support for university-academia cooperation programs
- Support for incumbent training programs
- Provide priority job opportunities for graduates
- Participation in various I-A cooperation events

4.3.2.2. University

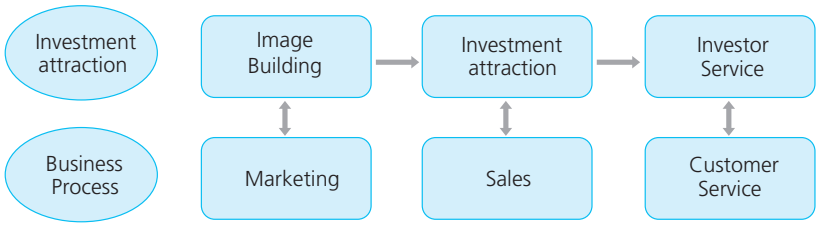
- Improving the performances of I-A cooperation research projects, and securing research funds
- Improving technical guidance and advisory performance
- Improvement of performance of technology transfer & commercialization
- I-A cooperation development fund & scholarship attraction
- Improving employment rate through on-the-job training and capstone design
- Information exchange through various council configurations
- Utilizing adjunct professors from industrial field specialists
- Expansion of research equipment operating income
- Expansion of educational incomes of industrial incumbents

5. Activation Strategy of Colima TP

5.1. Investment Attraction Strategy

In order to activate Colima TP, investment from foreign companies is urgently needed along with investment in Mexico. Given the weakness of the technology-based manufacturing in Colima, attracting FDI is an urgent task.

[Figure 3-14] FDI & Business Process



5.1.1. Investment Attraction Process

Before attracting FDI investment, it is necessary to have an investment attraction system, as shown in [Figure 3-14]. Such a system consists of value chains like image building, investment execution activity, and post management, which are sorts of a business processes.

5.1.1.1. Image building

Image building is a preparatory process for informing foreign investors about the TP's investment environment of information and making them actively informed. The key is to reduce the gap between the current perception of TP and the areas to be recognized in the future, and pursue change with the image that this is the best place for foreign investors' business activities. To this end, we need to develop marketing themes.

This offers not just a list of incentives, but also a unique selling point, which is necessary for foreign companies (i.e., efficient management, profit increase, and customer satisfaction). In other words, there is a limit to providing customized incentives to meet corporate needs by operating a support system focusing on tax cuts. It is therefore necessary to consider the use of effective and resilient subsidies as well as tax exemptions. For example, in accordance with the state laws, after the deliberation of the Foreign Investment Promotion Committee, the state can provide incentives like a state subsidies, employment subsidies, education subsidies, special subsidies for large-scale investment companies, and transfer subsidies.

In addition, incentives like above are also referred to as foreign investment, and should be given flexibly only when certain requirements are met, rather than unconditionally applied. Specifically, it should be applied differently depending on investment scale, R&D investment ratio, employment creation effect, front and back industry effect, and contribution of regional economic development.

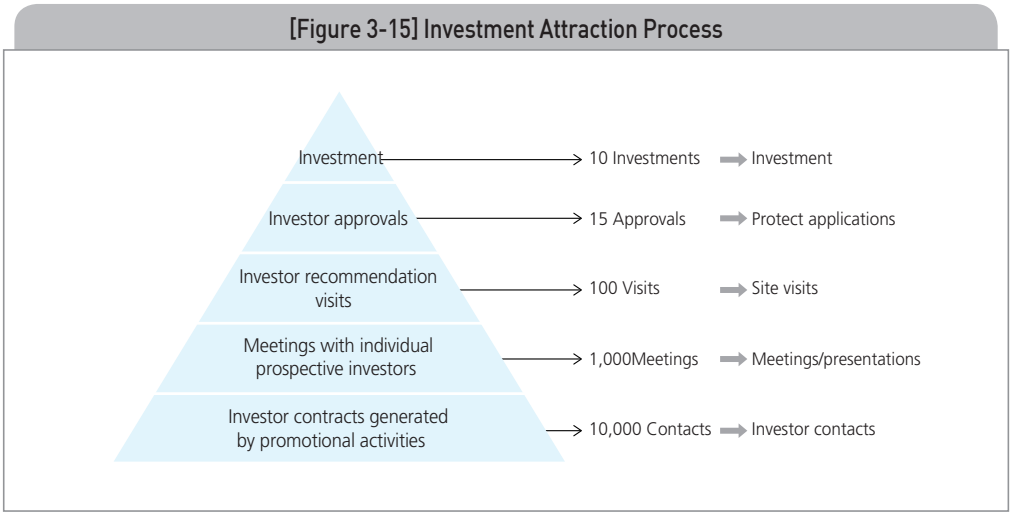
On the other hand, the marketing message that embodies this can focus on the strengths in a specific industry field or can be put into a combination of various advantages (package). Specific promotional techniques like these include creating brochures, preparing competitiveness reports for major local industries, providing various economic indicators, providing information such as newsletters, the Internet, and videos, advertising, publicizing in the press, and participating in seminars and exhibitions.

5.1.1.2. Investment Attraction

Investment attraction is the process of inducing investment through practical contact with preliminary marketing. First of all, it is targeted to potential investors. In order to do this, it is necessary to make and continuously update the DB of the target company. Once the DB is created and the investigation of investment decision makers is completed, full-fledged investment activities should be carried out. This process continues to mailing, e-mailing, phone contact, presentation, site invitation visit, post-visit management and negotiation, investment decision, and follow-up management.

As shown in [Figure 3-15], if we look at the process of attracting investment, about 10% of 10,000 target companies can make face-to-face contact or presentations, and only 10% of them visit the site. In addition, only about 15% of those companies make investment decisions, and after implementing the investment declaration procedure, they invest only 2/3 of them.

[Figure 3-15] Investment Attraction Process



Source: Lee, Seongbong (2008), FDI attraction strategy of knowledge economy free zone, Daegu/Kyungbuk Research Institute.

5.1.1.3. Service for Investor

This process is effectively initiated from site visits where investors seriously consider investments. Therefore, it is necessary to thoroughly prepare and provide enough information that is not provided during face-to-face contact or presentations. Particularly, in this process, it is important to remember that competition candidates should be identified and prepared in advance. If similar evaluations are made, it should be remembered that the investment is determined according to the investor service level. Therefore, when investors visit the site, a dedicated manager should be appointed to create a checklist that meets the needs of their company and can provide individual services. For example, it is necessary to provide professional guidance, such as meeting with potential human resources, R&D-related institutions like universities and research institutes, and the supplier and sales locations in Colima State. On the other hand, the most important things in the investment service are first to follow up, second to follow up, and third to follow up. To this end, incentives that can be provided by the Colima government should be determined and presented, and the Governor and the Mayor should also participate directly.

5.1.2. Improvement of Investment Attraction Organization

The investment promotion organization is placed in the secretariat of economic development, but it is desirable that independence is guaranteed. The effect of the investment attraction activity is determined depending on the method by which it is brought. The investment promotion organization should not be for the organization or its employees but for the economic personnel of the private sector to participate in the decision-making process.

This organization should have real authority to handle all licenses related to attracting investment. Thus, it can be a true one-stop service. The organization should be composed so that it can perform functions such as investment promotion (mainly image-building), investment attraction (introduction of PM system mainly responsible for investment attraction), license, incentive, and administrative support.

In addition, the composition of the staff can be considered as a mixture of civil servants and civilians, as well as utilizing private agency dispatch staff. In this case, civilian people need to differentiate from the public servant salary system in order to secure investment manpower with expertise in international management consulting and marketing. Finally, the organization should be able to support investment attraction activities by having IT, DB management, and information tracking abilities.

5.1.3. Network-based Investment Attraction

The investment of Colima TP should be made through the networking and utilization of related agencies and personnel as well as the independent promotion and attraction of the state government. In network-based investment attraction activities, cooperation is needed in three areas: development of investment attraction products (development of Colima TP), investment marketing activities, and various service activities for investors.

The targets of the network are the Federal government, State government, Colima TP, TP developers, public relations agencies, universities, SME support organizations, financial institutions, and major domestic enterprises by attracting industry. In this process, it is important that investment co-operation accompanied by a financial relationship must clearly state and agree on the contents and conditions in advance.

5.1.4. Introduction of Investment Promotion Capacity & Investment Promotion System

The person in charge of attracting foreign investment should have knowledge and ability to work. However, it is unreasonable to expect all the officials to cultivate these qualities and abilities. Therefore, after selecting a small number of elite candidates, they should be entrusted for education and training to professional organizations to nurture them as leading experts in the foreign investment attraction field.

On the other hand, it is necessary to expand the merit award system to motivate investment attraction. Colima should also provide a reward system to attract foreign investment. If the investment in the same business is made on an annual basis, the investment amount should be based on the annual investment amount, provided that the application for reward payment is made within three years from the completion date of the investment. In this case, it is preferable to apply the differentiation according to the contribution of the regional economy by reflecting both the type of industry and the number of employees, rather than evaluating only the investment amount.

5.1.5. Enhance Follow-up Management of Investment Companies

Until now, most of the investment promotion policies have focused on attracting companies and have tended to neglect support for companies that have already invested. However, it is important to follow-up on existing investments as well as pursuing new investments. To this end, it is necessary to create a company-specific

management card for investment companies and regularly visit them for systematic follow-up management.

In addition, it is desirable that the Governor invite investor companies or related organizations to provide information and administrative support after the investment such as holding a conference, awarding an appreciation plaque, and designating a dedicated public official.

5.2. Strategy of Human Resources Development

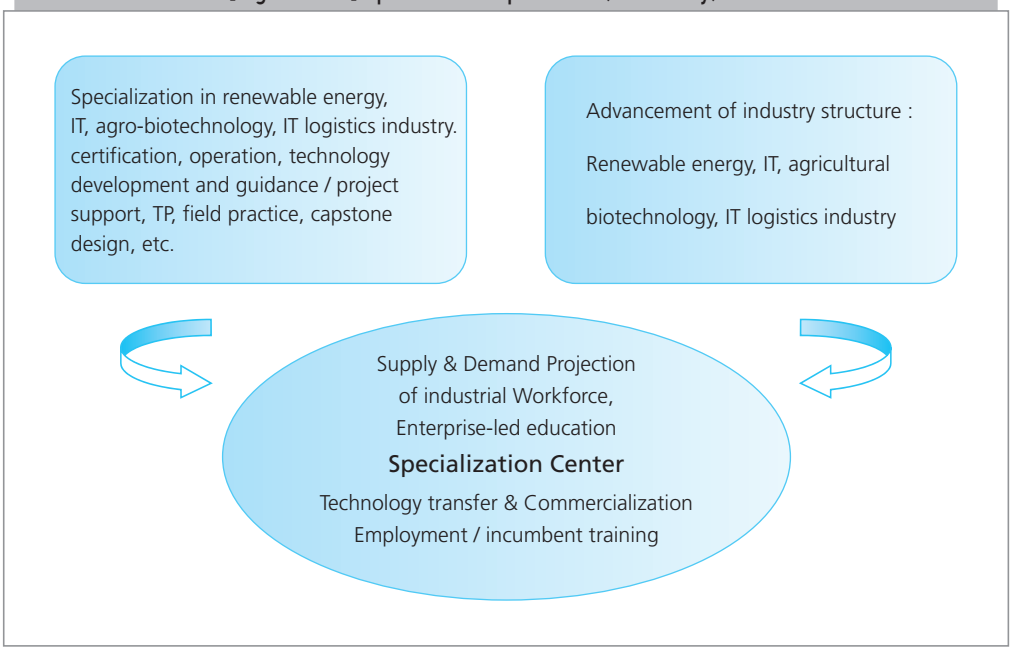
5.2.1. Specialized Department (University)

This project will select the specialization industries that focus on the fields that meet the demands of Colima TP, to support the advancement of regional industry structure by resolving the technical difficulties of companies engaged in these industries, and to concentrate on specialized talent production. The specialized industries for Colima TP are agricultural biotechnology, IT, logistics IT, and renewable energy.

This program aims to contribute to the securing and development of human resources through the operation of various university autonomous programs along with the specialized track (curriculum) and the support of the purpose-oriented enterprise. To cope with the changes in the industrial environment, it is necessary to first select the fields closely related to the main industries of Colima State as specialized industries and concentrate resources on them. It is also necessary to intensively cultivate the specialized field through a variety of I-A cooperation-friendly manpower training programs. In addition, it is necessary to focus on technology development and technical guidance in the specialized field through discovery of the demand-oriented approach.

The support by the university side includes education and training of human resources in specialized fields, securing equipment and laboratory, field practice and capstone design operation, education through development of teaching materials and curriculum by specialized field, which can improve the quality.

[Figure 3-16] Specialized Department (University) Model



Source: Ministry of Education (2016).

5.2.2. Start-up Training (Colima TP)

〈Table 3-18〉 Start-up Training & Support Program

Stage	Contents
Inspiration to start-up mindset, infrastructure building	- Establishment of start-up education center - Idea bank - Capstone design - Operation of start-up training center - Support for start-up club
Support for preliminary start-ups	- Support for start-up funds - Support for start-up space & infrastructure - Support for open TP - Support for Management and technology consulting
Start-up & post support	- Development of difficult technology for start-up track - Linkage support for tenants in the TP

Note: Examples of start-up-based lectures include entrepreneurship, new business development, new business development methodologies, business model and business plan preparation, market research and start-up business, entrepreneurship, and venture business internships.

The Start-up Training & Support Program is a project to support various entrepreneurial curriculum gatherings to spread the entrepreneurial culture throughout the region by supporting entrepreneurs and local residents to establish entrepreneurial mindsets and support entrepreneurship education so that entrepreneurship can be considered as one of the future career paths.

The purpose of this project is to expand the start-up companies by utilizing the infrastructure and network of Colima TP, to create entrepreneurship based on creative technology to establish the start-up support system in stages, and to activate the start-up business by operating the program.

5.2.3. Field Practice (University / Business)

A field-based credit system to develop students' adaptability to the industrial field is a representative field-centered curriculum that is taught at a production site of a company that has a university-academia cooperation agreement. It has the advantage of the participant being able to acquire credits and prepare for employment at the same time by practicing in the industrial field during vacations or semesters, and thereby acquiring credit in the major course. This enables systematic comprehensive support service through matching of companies and students, smooth supply of manpower to corporations, and training of manpower necessary for university.

The university can practice education diversification through on-the-job training, supporting the start-up business, systemizing the on-the-job training support through the certification of excellent companies, implementing the integrated support service through the on-site training support center, and establishing a one-stop service by mobile operating system based on smart phone.

5.2.4. Capstone Design (University / TP)

The goal of capstone design is to find out and solve the problems in the industrial field. It can be classified into enterprise-linked type, entrepreneur-linked type, majors convergence type, and creative work type, and contributing to the cultivation of creative and practical engineers with commercialization technology and entrepreneurial spirit.

The enterprise-based capstone design is used to commercialize the results of the graduation research projects selected jointly with the companies. Start-up-linked capstone design is for students who want to start a business, to find an entrepreneurial item, and to provide an opportunity to commercialize the product. Fusion capstone design cultivates practical skill related to fusion technology by

selecting and supporting interdisciplinary fusion capstone design. The creative work type capstone design cultivates creative engineering talents by selecting and supporting creativity-oriented capstone designs.

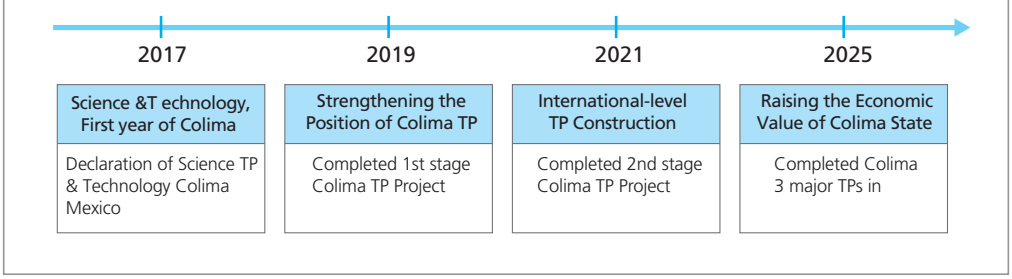
Examples of support include the Capstone Design Competition, which evaluates and rewards the final results of all of the knowledge and experience learned at the university. Students will also be able to contribute to student-led collaborative learning programs that will lead to a team of undergraduate and graduate students, to run labs for capstone design to realize ideas and dreams, and to operate programs to acquire artistic literacy along with engineering skills and knowledge.

5.3. Image Building and Promotion Strategy

Image building is an imaging process to actively inform about the information and investment environment of Colima TP. The key is to reduce the gap between the current perception of the Colima TP and the areas to be recognized in the future, and to pursue an image of a desirable place for investors to do business. To do this, we need to develop a marketing theme, which is not merely to list the merits or incentives of Colima TP, but also to provide a unique proposal of Colima TP, (a Unique Selling Point should be included).

Promotion is the strategic transmission of information both inside and outside the company to enhance image and awareness. In other words, it is a measure or program such as public relations strategy, incentive, institutional support to attract investment through the promotion and enterprise attraction strategy of Colima TP. Colima TP's step-by-step promotion strategy is shown in [Figure 3-17]. 2017 was declared as the first year of science and technology in Colima. In 2019, the first phase of Colima TP will be completed and the international status will be strengthened. In 2021, the second phase will be completed; by completing the Colima TP in 2025, it will become the top three TPs in Mexico and serve as a catalyst to boost the economic value of Colima.

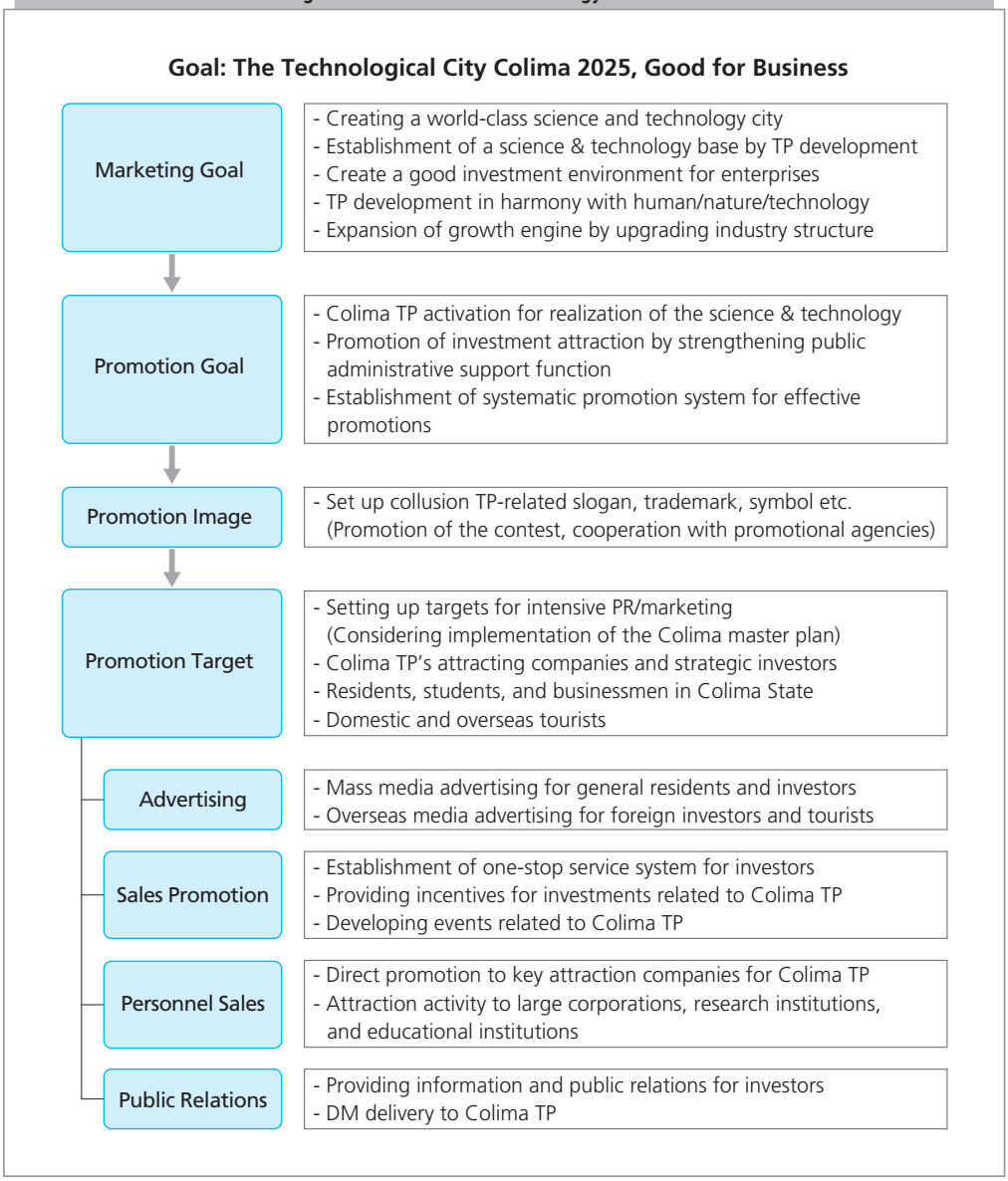
[Figure 3-17] Goal of Colima TP's Promotion Strategy by Stage



5.3.1. Promotion Strategy

The promotional strategy scheme of Colima TP is shown in [Figure 3-17]. First of all, the marketing goal is to create a world-class science and technology city, to build a science and technology base through TP, to create a good investment environment for enterprises, to harmonize the human, nature, and technology, and the expansion of the growth engine by upgrading the industrial structure. The promotion goal is the activation program of Colima TP for the realization of the science and technology

[Figure 3-18] Promotion Strategy of Colima TP



city, to promote investment attraction through strengthening public administrative support function, and to establish a systematic system for enabling effective promotion activities.

Promotional images set up the Colima TP-related slogan, trademark, symbol, etc. (cooperating with a promotion agency, by contest). The promotion target is for intensive promotion and marketing to implement the Colima TP's master plan. Promotional targets include attracting companies and strategic investors in Colima TP, general residents, students, businessmen, and domestic and overseas tourists.

5.3.2. Promotion Activity of Colima TP

The 4P activities for promoting Colima TP consist of advertising, sales promotion, human sales, and PR activities.

First, advertisement is divided into mass media for general residents and investors, and overseas media for foreign investors and tourists.

Sales promotion should be established a one-stop service system to promote sales, to provide incentives for investment related to Colima TP, and to develop events related to Colima TP for investors.

Personnel sales include direct publicity to key attraction companies of Colima TP, and strategic investor attraction activities to large corporations, research institutes, and educational institutions.

Finally, PR and promotion consist of providing information and promoting activity to investors, and sending DMs about Colima TP. Use of advertising by media is shown in <Table 3-19>.

〈Table 3-19〉 Advertising by Media

Types of Media	Contents
Broadcasting	- Airwave broadcasting, CATV, radio, etc.
Newspaper	- Continue to advertise Colima TP in the central and provincial areas
Journal	- Economic weekly magazines, related magazines, airline magazines, etc.
Internet	- Famous portal sites banner ads, etc.
Wall	- Railway, bus, etc.
Propulsion tower	- The main propulsion tower in the area
Pedestal	- Highway, main branch overpass
Display board	- Traffic facilities such as roads, railways, airports, and harbors
Banner	- Main intersection
Promoting credit card cooperation	- Insert advertisement on card invoice, credit card banner link

Source: Lim, Hwan (2014), Media Promotion Strategy of Research Institutes.

5.4. Cooperation Strategy between Research Institutes in Korea and Mexico

5.4.1. Introduction

This project aims to strengthen the innovation capacity of Colima TP by strengthening exchanges and cooperation with relevant research institutes (universities) in Korea, expanding exchange and cooperation with advanced research institutes (universities) to build a network system.

The promotion subject is Colima TP; related institutions are the Portal for the National Council on Science and Technology (CONACYT), universities, and research institutes in Colima. The contents of the project are intended to strengthen international exchange and cooperation with related research institutes in Korea. This will be jointly held with technical research, technology exchange and cooperation, training of cluster and industrial promotion experts, human resource exchange (education and training), international symposiums and industrial policy seminars, industrial clusters and mutual visits, etc. In addition, we will focus on supporting the exploration and introduction of overseas excellent technical workers with expert knowledge of advanced technology field and strengthening technical competitiveness of SMEs by supporting overseas technology worker introduction.

5.4.2. Preparation of Global Networking

<Table 3-20> shows the preparations for global networking.

〈Table 3-20〉 Preparation for Global Networking

Classification	Detailed work promotion contents	Remarks (target cooperation organization)
Selection of MOU for the target organization (area)	- Identification of related research institutes by field , and priority review · Target: 2-3 institutions · Identify practitioners in overseas institutions	- Ministry of Foreign Affairs and Embassy
Review & finalize the MOU text	- MOU review and confirmation	- Mexican, English, etc.
MOU Plan establishment	- Establishment of MOU Basic Plan · Purpose, duration, participants, main activities plan, programs by schedule, budget, etc. · Visitor: based on 4-5 people - General status of visiting area and institution - Question and answering materials	- Preparations for MOU conclusion events should be made with the target organization (preparation of the venue) - Practical consultation with Ministry of Foreign Affairs and Embassy
Materials preparation	- PPT materials creation · Brochure and CD ROM preparation	- English materials

5.4.3. Contents

This project offers benchmarking of advanced successful cluster technique through strengthening the global network with Korean industrial clusters and related research institutes. In other words, it is focused on research institutes and business exchanges (MOUs) related to identifying advanced technology trends, improving quality and exchanging information on new product development, promoting advanced technologies such as joint technology development, and strengthening product competitiveness.

The implementation method will be coordinated by the CONACYT, the Economic Development Department of Colima, and Colima TP. It will establish a comprehensive plan and step by step. This will be done after receiving the recommendation from the Korean side, and they conclude the MOU with Korean institutes (see Table 3-21).

〈Table 3-21〉 Organizations Subject to International Exchange and Cooperation (Example)

Sector	MOU Contracting Organization (example)	Remark
Agro-Bio	National Institute of Agricultural Science (NAAS), Food Science Institute (NICS), Dongbu Farm Hannong Institute, Dongbang Agro Technology Research Institute, Gyeongnong Gyeongju Research Institute, Agricultural Gene Support Center, Jeonju Agricultural Research Institute, Seoul National University/ Cheju National University/Chonnam National University/ Science Research Institute	Business exchanges and mutual cooperation
IT	Korea Electronics and Telecommunications Research Institute (ETRI), Information and Communication Industry Promotion Agency (NIPA), Korea Internet Development Agency (KISA), Korea Information Science Promotion Agency (NIA)	
Renewable Energy	Korea Institute of Energy Research (KIER), Korea Renewable Energy Center (KNREC), New & Renewable Energy Korea	
Logistics IT	Korea Electronics and Telecommunications Research Institute (ETRI), Korea Transportation Research Institute (KOTI), Korea Maritime Fisheries Development Institute (KMI) (KAILP), Hanjin Logistics Research Institute (HLI), Korea Integrated Logistics Association (KAILA)	

After configuring a working council for business exchange and cooperation, we will first promote joint research, technology exchange, and cooperation. The exchange society of excellent industrial technology information meets once every year to cross-visit between research institutes including corporations and universities, and to cooperate with each other in the field of research (IT, agricultural biotechnology, logistics IT, and renewable energy). We will also collect data related to technology development such as joint use of research and development equipment, mutual exchange of research and development achievements and data, establishment of technology transfer and a technical guidance cooperation system, DB construction, and mutual utilization. In order to cultivate industry promotion specialists and to cooperate with training, one or two people should be selected every year. They will undergo training and exchange work for professional workers of about one year or more. The contents are to nurture cluster professionals (such as network brokers and coordinators). The expenses incurred therefrom shall be borne by the dispatching organization. In addition, it may be considered to co-host international symposiums and industrial policy seminars once a year to promote exchange and cooperation between the two countries and exchange information.

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