Science and Technology Entrepreneurship Initiative

- Supplemental Materials -

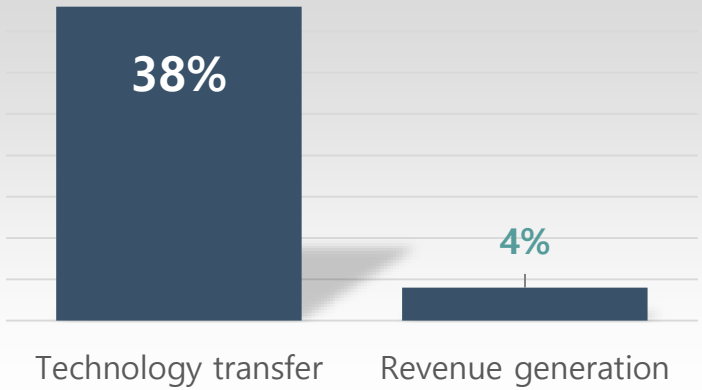
1. Innovation Summary

Why the innovation was developed, or the problem/opportunity being addressed

Government's drive to commercialize R&D results didn't create much economic achievements

As the government increases its investment continually, quantitative achievements such as papers and patents increase but economic utilization and spreading of public research results is somewhat insufficient.

Results of transferring government's R&D results and technology



Need to develop and operate Academic Research to Product/Market Opportunity Search Program

Before

Limitations of major policies for spreading public research results
Supporting simple technology transfer to industry
Lack of new product and service development

After

The leading model of Laboratory Start-up (technology start-up business) with excellent profit and job creation capabilities needs to be created and nurtured as a new growth engine at the national and regional level.

Key benefits of Laboratory Start-up (technology start-up business)

- Hires 9.5 employees on average/80% survives five years (general company: 2.85 employees/27%)
  (Source: 2012, Korea Institute of Startup & Entrepreneurship Development; 2017, National Assembly Research Service)
- The IPO (initial public offering) ratio of the USO (University Spin-Off) in the U.S. Is about 100 times of general start-ups.
  (Shane, SA, 2004).
- The return on investment of the USO in the U.S. (378%) far exceeds that of S&P 500 companies (201%) (2009-2014).

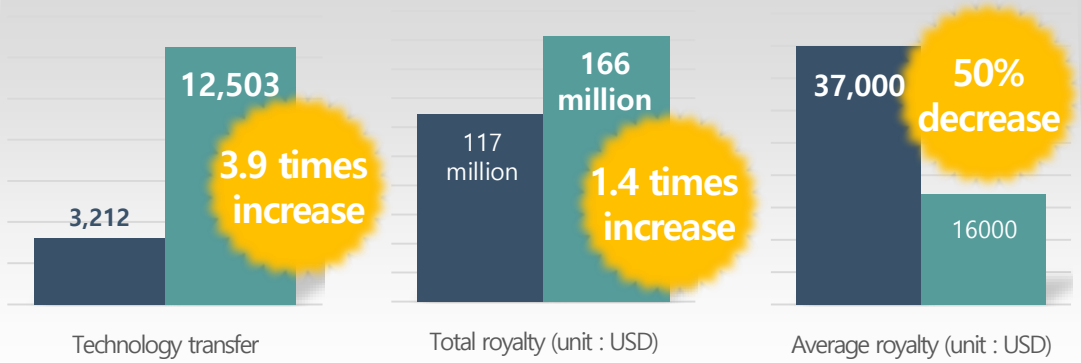
1. Innovation Summary

What the innovation is and who it benefitted

Efforts to spread public research results to industry

- The Korean government has implemented various technology commercialization support policies over the last 2 decades to spread public research results obtained from R&D investments to industry.
- Strengthened the capability of the organization dedicated to technology commercialization, such as college/government-funded research center, technology holding company, etc.
- Achieved remarkable quantitative results thanks to the government's continuous support for technology transfer and commercialization.
- However, qualitative performance (based on average royalty) was reduced by half compared to 10 years ago.

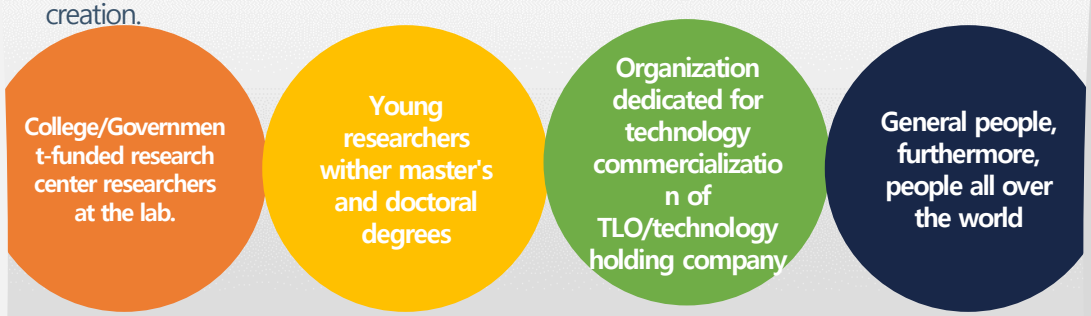
Status of technology transfer and commercialization support (2008 ~ 2017)



Source: Actual condition survey on technology transfer and commercialization by year

Switching to Laboratory Start-up nurturing policies that are directly linked to new product and service creation and even can create more high value-added new jobs.

The pertinent laboratory and related enterprises will be directly benefited from the Laboratory Start-upnurturing policy. The indirect benefit of contributing to the society also seems to be significant thanks to innovative products and services, and new job creation.



Job creation effect of Laboratory Start-up (technology start-up)

> Technology-based start-ups are more effective for job creation than general idea start-ups. Technology-based startups account for 60% of job growth in U.S. high-tech industry.

> U.S. technology-based start-ups create 1.2 million jobs in 2007, 1.1 million in 2011, and 1.5 million jobs in 2016. 25% increase in jobs over 10 years.
> (source: Korea International Trade Association, "Economic contributions and implications of technology-based start-ups in the U.S., 2018. 07.)

1. Innovation Summary

Why it is innovative

As most public research results are not mature in technology (under TRL 5), commercialization takes long compared to applied/developed technology.

- In addition, it is highly risky for a company to implement commercialization alone due to high market risks.
- The market failure area that is innovative but risky can be supplemented, which is avoided by existing enterprises when making investments, by nurturing Laboratory Start-up based on public research results.

Overcoming the limitations of start-ups based on public research results innovatively with Laboratory Start-up support programs.

1 Changes of perception and culture about start-up

Supporting programs that provide systematic information on start-up to eliminate concern about start-up failure, and verify the business model first to check competitiveness in the market before making an all-in effort for start-up, and perform rapid pivoting (fast-fail).

2 From technology first to Business Model and market first

Technology-based start-up that is mainly driven by college (graduate school) students in natural sciences and engineering, and researchers.
Switching the Laboratory Start-up paradigm with the business model immersed in techno centrism and market verification support.

3 Systematic support for the entire start-up cycle

Operating the system that supports trial and error systematically, which is experienced in various fields such as funds, human resources, R&D, and marketing.

Business model validation + pivoting by discovering customers and supporting experimental product production -> Consulting support for overall management such as incorporation of Laboratory Start-up (Lab-to-Market University Program) -> Inviting investment and supporting R&D relating to investment invitation (Private-investment based Public R&D Commercialization Program)

2. Innovation Description

What Makes Your Project Innovative

Supporting “lab-to-market” and “time-to-market” type Laboratory Start-up training.

Supporting diverse and effective customized training for “lab-to-market” and “time-to-market”.

2. Innovation Description

What Makes Your Project Innovative

Organizing a pre-startup team centered on the students of engineering college (undergraduate school). The pre-startup team should include at least one entrepreneurial leader, project manager, and principal investigator to maintain continuity until actual start-up.

Importance of teamwork

Source: Analysis report on "The Top 20 Reasons Startups Fail" (CB insights, a specialized venture capital research firm in the U.S., surveyed 101 failed start-ups in 2014.)

Composition of a pre-startup team

Entrepreneurial leader/Entrepreneurial member

Students in their school master/doctoral degree course (student on a leave of absence for start-up is allowed), post-Doc, researcher

> However, college students having capabilities related to Laboratory Start-up can also participate, in case of the entrepreneurial member (EM) and entrepreneurial leader (EL) of the female exploration team.

Project manager

Teachers or staff of the organization that can manage Laboratory Start-up business, such as start-up training center at the college belonging to the EL, industry-university collaboration team, technology commercialization center, and technology holding company.

Principal investigator

College professors who provided or want to provide laboratory technology and know-how to the Laboratory Start-up exploration team.

2. Innovation Description

What Makes Your Project Innovative

Providing actual start-up training at home and abroad, experimental product production, and customized training (e.g., commercialization consulting) with a focus on interviews with potential consumers (customer discovery).

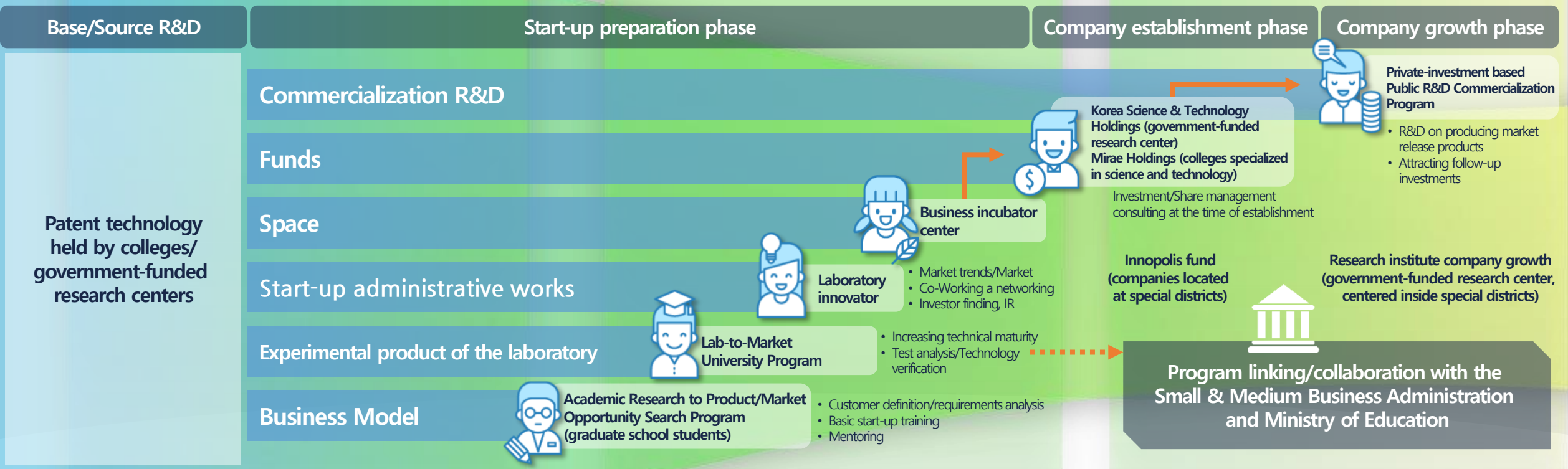
Plans to verify commercialization feasibility by implementing actual start-up training (3 weeks) with a focus on interviews with local potential consumers in the U.S. in cooperation with NSF in the U.S., and conducting and presenting more than 100 interviews for each team.

2. Innovation Description

What Makes Your Project Innovative

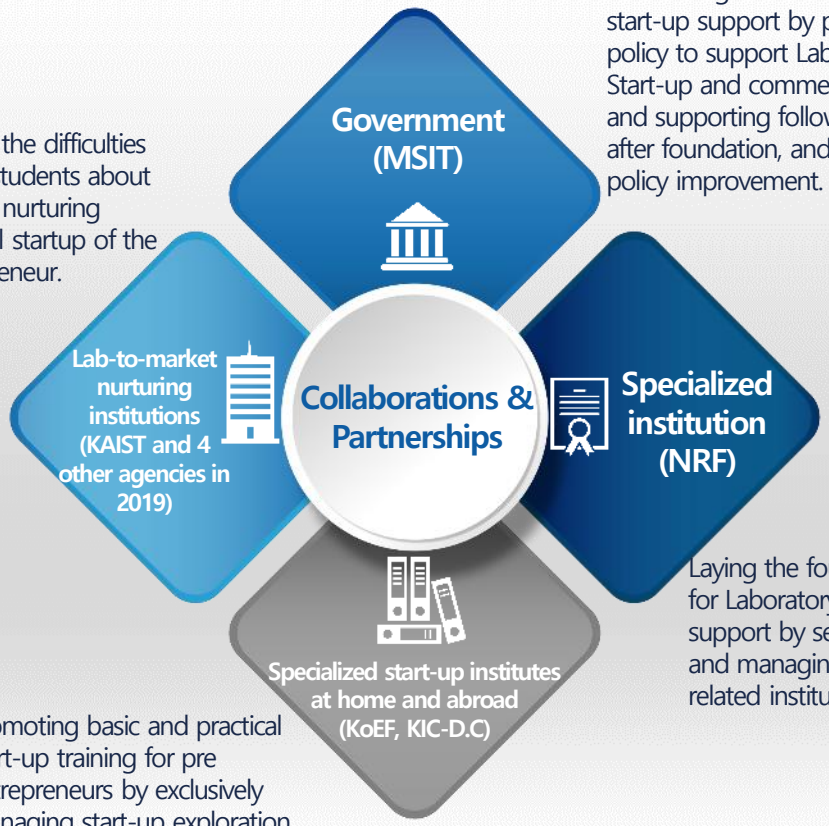
Systematic support for the entire start-up cycle:
Operating a system of supporting the entire start-up cycle, such as funds, human resources, R&D, and marketing, for Laboratory Start-up that actually establishes a company, through business model verification and pivoting

System of supporting the entire cycle of the Laboratory Start-up



3. Innovation Description

5-1. Collaborations & Partnerships



Establishing the foundation of start-up support by proposing a policy to support Laboratory Start-up and commercialization, and supporting follow-up R&D after foundation, and funds and policy improvement.

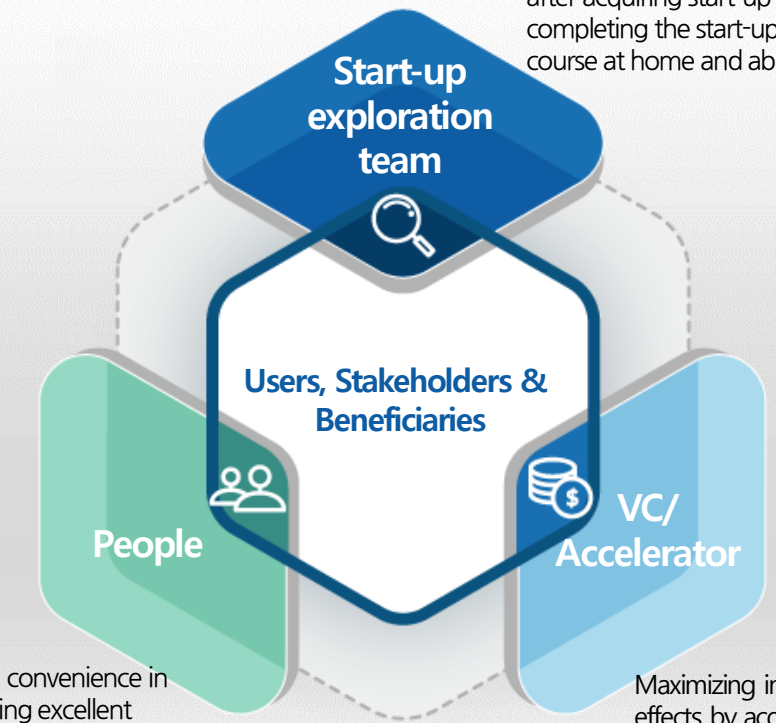
Eliminating the difficulties of college students about start-up by nurturing professional startup of the pre entrepreneur.

Laying the foundation for Laboratory Start-up support by selecting and managing start-up related institutions.

Promoting basic and practical start-up training for pre entrepreneurs by exclusively managing start-up exploration training at home and abroad.

5-2. Users, Stakeholders & Beneficiaries

Increasing achievements by start-up after acquiring start-up knowledge by completing the start-up training course at home and abroad.



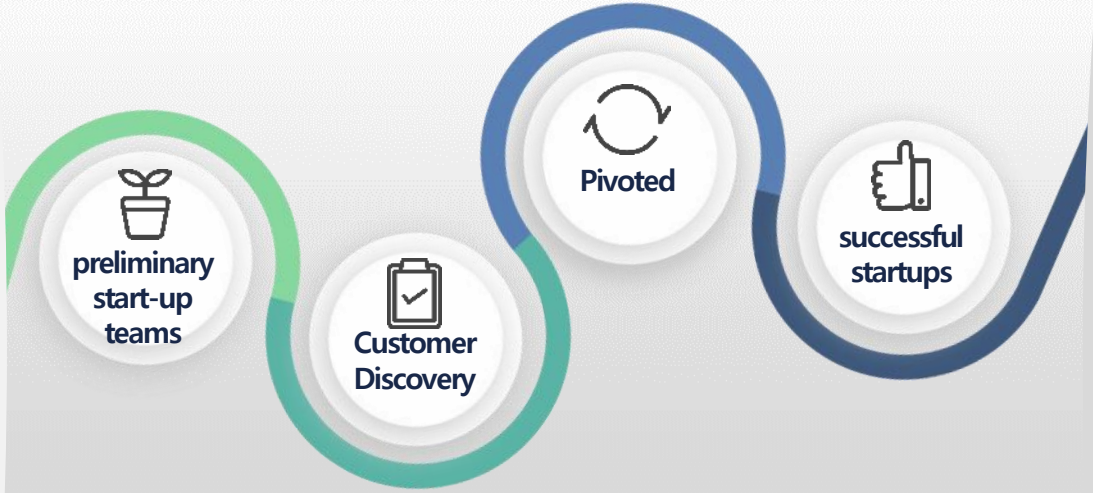
Increasing convenience in real life using excellent laboratory technology.
e.g.,) One-to-one personalized free App for child education

Maximizing investment effects by acquiring licenses for laboratory technology through investment in excellent start-up teams.

3. Innovation Description

Results, Outcomes & Impacts

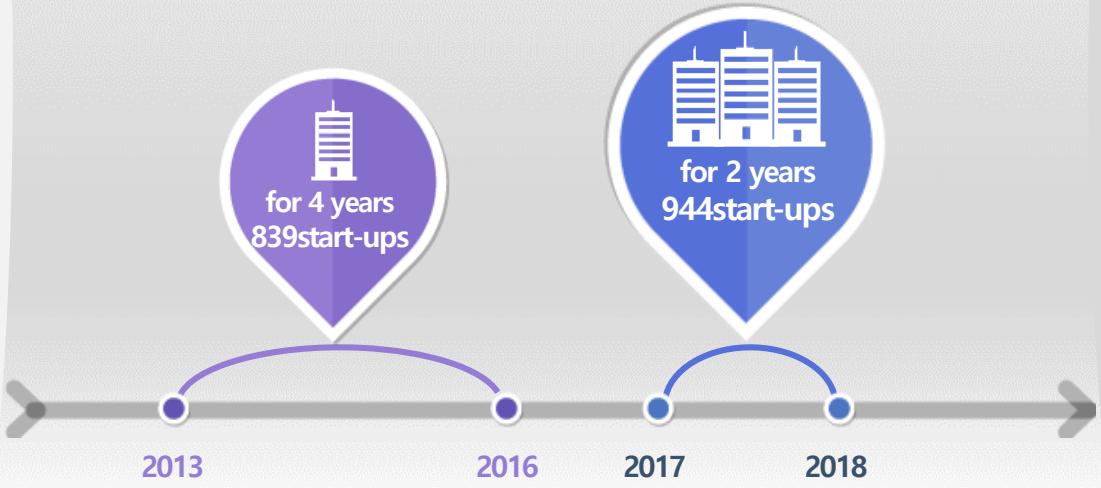
Business model verification and effective pivoting through the customer discovery process



- Numerous commercialization items of preliminary start-up teams based on public research results verified their business models through the customer discovery process and pivoted business models that are not suitable for the market.
- About 78% of successful startups in the U.S. started with the pivoted business model. (Source: CB Insights)

More than twice start-ups have been established as a result of policy support.

- A total of 442 start-ups were established in 2018, **creating 1,274 new jobs.**
- The number of new Laboratory Start-up, which are supported by the Ministry of Science and ICT, **has increased from 839 (for 4 years, 2013-2016) to 944 (for 2 years, 2017-2018).**



3. Innovation Description

Challenges and Failures

Main challenges found during the Laboratory Start-up support program process.

Uncooperative attitude of the principal investigator

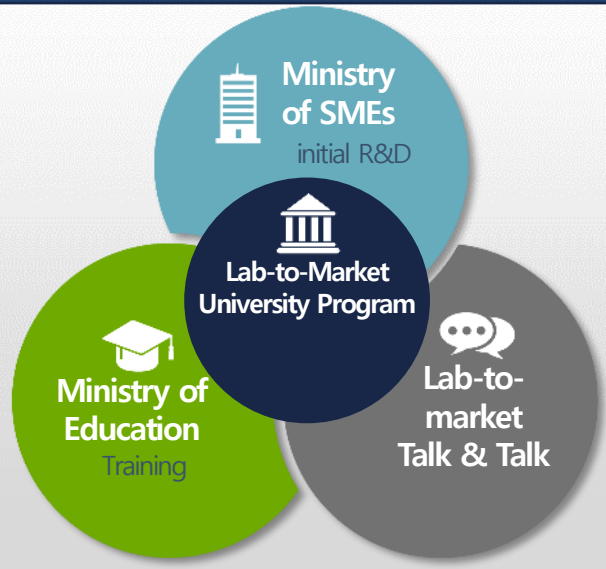
The principal investigator (technology guidance professor) formally participates in the program, or even worse, prevents the entrepreneurial leader and the entrepreneurial member from participating in the program, who are preparing start-up enthusiastically.

- This problem occurs because principal investigators think they are not directly benefited from the program.
- As securing research funds is important to most professors, they are negative about the preliminary start-up activities of master/doctoral course students who create project plans and conduct research for the program.
  ※ Most of the technology transfer contracts for the college/government-funded research center in Korea are based on the fixed amount (lump sum payment + advance payment), which is about 90% of the total technical fee.

Most researchers are more immersed in short-term results than high return in the future. It is partially caused by the attitude of the researchers, and concentration of research achievement evaluation index on short-term performance.

- Example : The entrepreneurial leader of the KAIST Startup Innovation Team with an "dementia prevention rehabilitation" item attended the program after taking sick leave, because his academic advisor did not allow his participation.

Supplementing Laboratory Start-up support programs to solve those challenges.



- The project of **Lab-to-Market University Program was newly created in 2018**, so that the entire college organization can be unified to support Laboratory Start-up. (Integrated support between government departments using a collaboration system that the Ministry of Education implements collage start-up training and the Ministry of SMEs and Startups conducts initial R&D on lab startup businesses.)
- In addition, the project promotes a Laboratory Start-up culture by **visiting the excellent Laboratory Start-up** of the college/government-funded research center and operating "Lab-to-market Talk & Talk" that **provides an opportunity of IR with investors in the field**.

3. Innovation Description

Conditions for Success

Support infrastructure, service policy, leadership, human and financial resources, personal value system and motivation

1

Will to start a business by the start-up exploration team

Increasing the start-up success rate by supporting the production of start-up experimental product after checking the will of college (graduate school) students to start a business by implementing strict basic/actual start-up exploration training at home and abroad for 5 months after selection.

2

Easing college's restrictions on start-up

Promoting local start-up in natural sciences and engineering by alleviating restrictions on the leave of faculty and college (graduate school) students for start-up, and eliminating the entry barrier to start-up promotion by lowering the standard.

3

Increasing local start-up experts

Promoting domestic start-up by reducing the material and personnel budget for overseas training, by implementing local Laboratory Start-up training by continuously recruiting local start-up experts and strengthening start-up training.