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A Model of Startup Support by University: Focusing on the Case of Korea's H University

Chang-Ryong Ko *

Abstract This is a case study on a university's support for entrepreneurs preparing startups. Previous studies have focused on startups within universities, but this study differs in its focus on support for external entrepreneurs. First, university startup support worked in the form of open innovation for those preparing to start a business. In other words, performance varied depending on the degree to which entrepreneurs accepted the support. Second, this study showed that, unlike previous studies, the process of preparing to start a business is nonlinear. Third, startups are largely divided into small and medium-sized businesses and innovative businesses, and a new hybrid business type was identified through university support. This study shows that university support for startups is not limited to the In-Out model, which uses university knowledge and technology, but an Out-In model is also possible. Additionally, startup support can be added as one of the entrepreneurial university's activities.

Keywords Entrepreneurial university, Open innovation, Innopolis Campus Project, Startup support model, Business model

I. Introduction

The Korea Innovation Foundation initiated the Innopolis Campus Project, entrusting it to H University in 2012. This project aimed to verify the business feasibility of startup ideas and promote a vibrant venture ecosystem within Innopolis, a significant R&D cluster in South Korea. H University went beyond its initial mandate, mobilizing its resources and expertise to actively support the success of these ventures.

Between 2012 and 2023, H University evaluated around 1,000 startup items, leading to the creation of about 120 companies. The university achieved notable outcomes, including IPOs and successful mergers and acquisitions. Out of 47

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* Associate professor, Department of Economics, Hannam University, Daejeon, Korea; bluecore@hnu.kr

technology startups over the past two years, 31 generated sales, received investment offers or established overseas operations, demonstrating the effectiveness of the university's support mechanisms.

We address this case by placing greater emphasis on deriving the theoretical and practical implications for startup support. This 12-year activity offers theoretical and practical insights in several ways. First, startup support functions as a form of open innovation from the perspective of startup preparers. Second, the startup process is nonlinear, contrasting with existing theories that suggest a linear progression from idea to business model to execution. Third, it demonstrates that university support for all startup preparers, both internal and external, can be a significant activity for an entrepreneurial university.

This study analyzes the cases of entrepreneurship support that have been carried out at this university for 12 years. To this end, Chapter 2 examines the attempts of H University by including them in the discussion of entrepreneurial universities. Chapter 3 examines related theories by focusing on the entrepreneurship support process to derive the framework of this study. Chapter 4 presents an analysis framework to support the argument of this study. Chapter 5 presents the results of the analysis, and Chapter 6 summarizes and examines the theoretical and policy implications of the results of the analysis.

II. Entrepreneurial Universities and Startup Support

1. Entrepreneurial University

The concept of entrepreneurial universities, sometimes referred to as university capitalism, has gained significant attention since the 1990s. Scholars such as Slaughter and Leslie (1997), Etzkowitz et al. (2000), and Rothaermel et al. (2006) have discussed the evolution of universities, which traditionally focused on education and research to include a third function: entrepreneurial activities.

In Korea, there has been a proactive shift in policies to transform the roles of universities. The government enacted the Industry-Academic Cooperation Promotion Act in 2003, expanding upon the existing Industrial Education Act. This legislation mandated universities to actively pursue industry-academic cooperation beyond their traditional roles of education and research. These policies are grounded in the Triple-Helix model proposed by Etzkowitz and Leydesdorff (1997), which emphasizes the interconnectedness of universities, industry, and government, as well as the innovation system theories of Freeman (1987), Bjórn and Lundvall (1992), and Nelson (1993) (Seol, 2012).

Korea's university-based startup policies are primarily driven by the Ministry of SMEs and Startups (MOSS), the Ministry of Education (MOE), and the Ministry of Science and ICT (MOS/ICT). Key initiatives include the Startup Leading University Program by MOSS initiated in 2011 and the LINC Project by MOE started in 2012. While the Startup Leading University Program focuses directly on fostering startups, the LINC Project emphasizes startup education and student activities. Additionally, the MOS/ICT launched the Innopolis Campus Project in 2012 to stimulate entrepreneurship using technologies developed within R&D clusters like Daedeok Science Park (Ko & An, 2019).

In the past, the primary activities of entrepreneurial universities typically involved the transfer of technology and knowledge from the university to businesses. However, the OECD (2012, 2022) identifies seven basic factors that an entrepreneurial university must possess, and Eizaguirre et al. (2020) further expand on the activities of entrepreneurial universities, dividing them into 14 different activities and highlighting external consulting as one of them. We propose adding a new activity for entrepreneurial universities: startup support, regardless of whether the startup idea and knowledge originate from within or outside the university. Startups originating from outside the university that begin business with its support are referred to as Outside-In startups, and those that utilize the university's own knowledge and resources are termed Inside-Out startups.

2. H University and Innopolis Campus Project

H University, a private institution located in Daejeon, South Korea, is situated near the Daedeok Science Park. Since its establishment in 1978, Daedeok Science Park has grown to include 46 research institutes, 57 non-research institutions, and 2,371 companies (Korea Innovation Foundation, 2024).

In 2012, the MOS/ICT selected two universities, including H University, to implement the Innopolis Campus Project, aiming to promote technology commercialization within Daedeok Science Park. The project was deemed successful and subsequently expanded to 32 universities and institutions across Korea's R&D clusters.

Since 2016, H University has placed a strong emphasis on entrepreneurship education and activities. This commitment is reflected in its University Entrepreneurship Index rankings, where it was 15th in 2018 and has consistently ranked within the top four from 2019 to 2021. Currently, the university is engaged in the Startup-Oriented University Project designated by MOSS.

The Innopolis Campus Project at H University initially focused on assessing the feasibility of startup plans utilizing technologies developed in the Science Park. In 2015, the project introduced a business model (BM) workshop for early-

stage startups seeking investment. Just before the introduction of the accelerator system in Korea in 2016, the Innopolis Campus Project began playing a similar role.

The business model innovation workshop (hereinafter referred to as the workshop) supports entrepreneurs facing growth stagnation by mobilizing experts to assist in modifying their business models. This initiative received positive feedback and was expanded in 2019 to include prospective entrepreneurs. In 2017, Korea's startup policies underwent changes with MOSS taking the lead, prompting MOS/ICT to shift its focus to prospective entrepreneurs in the Science Park. By 2021, the workshops had become more systematic and tailored to each prospective entrepreneur's needs.

The project has been led by three professors up until 2023, all experts in technology commercialization and startups. The author holds approximately 60 patents, with two-thirds being business model patents, most of which have been externally licensed.

In summary, this case relates to entrepreneurial education and consulting by universities. If the university's entrepreneurial candidate is an inside-out type in that it uses the university's knowledge and technology, we call it an outside-in activity in that the university supports the external ideas and knowledge to start a business.

III. Theoretical Considerations for Entrepreneurship

In order to derive the analytical framework of this study, existing studies on related concepts are reviewed here. These are the startup process, start-up intention and preparation capability, open innovation, and business performance. The reason for dealing with open innovation is that startup support is open innovation for startup preparers on the other side.

1. Startup Process

Research on the entrepreneurial process often focuses on stages such as idea generation, business concept development, business plan creation, and growth (Moroz & Hindle, 2012). However, the terminology and emphasis of each stage can vary based on the researcher's perspective (Fishbein & Ajzen, 1975; Kazanjian, 1988; Bhave, 1994; Ucbasaran et al., 2001; Polishchuk, 2023). Paschen (2017) categorizes this process into pre-startup, startup, and growth stages.

Fishbein and Ajzen (1975) divided the entrepreneurial process into a creation stage and an activation stage, incorporating the theory of planned behavior,

which includes intention, behavior, and outcome at each stage. In the creation stage, a startup is formed through entrepreneurial intention, opportunity recognition, and resource acquisition actions. In the activation stage, startup success is achieved through strategic intention, entrepreneurial strategy, and management actions (Kim, 2012).

During the preparation stage, entrepreneurial intention, opportunity recognition, business model (BM) concept, and resource acquisition are separately reviewed. The first step, entrepreneurial intention, explains the relationship between entrepreneurial intention and behavior through the theory of planned behavior (Ka, 2021). The second step, opportunity recognition, is widely discussed by many researchers (Fishbein & Ajzen, 1975; Bhave, 1994; Ucbasaran et al., 2001). Opportunities refer to creating market opportunities from new technologies or recognizing and approaching specific market phenomena (Cho & Kim, 2023). Differences in opportunity recognition arise from variations in knowledge, information, cognition, and behavior, which are influenced by previous experiences and new information (Ucbasaran et al., 2001). The third step involves transforming recognized opportunities into business ideas, which entails identifying and validating potentially successful business ideas (Brockner et al., 2004; Lee & Ahn, 2018). This step also includes presenting a business concept that combines value creation and delivery to customers (Kazanjian, 1988; Bhave, 1994; Bang et al., 2014; Lee & Ahn, 2018).

The fourth step, technology development and resource acquisition, presents varying perspectives among researchers. Kazanjian (1988) includes both resource acquisition and technology development in the preparation stage, while Paschen (2017) considers these necessary from the preparation to the startup stage. Bhave (1994) views them as activities during the startup phase. Additionally, Brockner et al. (2004) emphasize the importance of raising capital from investors.

2. Entrepreneurial Intention and Preparation Capabilities

In entrepreneurship, attitude is defined as a favorable or unfavorable reaction to entrepreneurship (Kim & Lim, 2019), while subjective norms refer to the social and cultural pressures from social support groups or reference groups on the behavior of prospective entrepreneurs (Hong & Kim, 2023). These studies often focus on the personal, psychological, and entrepreneurial characteristics of individuals in addition to their intention to start a business.

Entrepreneurial orientation refers to the tendency of individuals or organizational members to identify innovative opportunities in the market, take risks, and act enterprisingly. Miller (1983) first proposed the concept of entrepreneurial behavior based on tendencies of innovativeness, risk-taking, and

proactiveness (Kim, 2024; Mahmood & Hanafi, 2013). Covin and Slevin (1989) introduced the concept of entrepreneurial posture, and Lumpkin and Dess (1996) expanded it to include autonomy and competitive aggressiveness, thereby defining entrepreneurial orientation (Yoon, 2015; Kim et al., 2017).

Table 1. Previous research on startup preparation capabilities

Process	Researchers
Intention	Fishbein and Ajzem, 1975; Lee and Ahn, 2018; Kim and Kim, 2020
Opportunity recognition	Fishbein and Ajzem, 1975; Bhave, 1994; Ucbasaran et al. 2001; Brockner et al., 2004; Kim et al., 2017; Kim and Kim, 2020
Preparing startup items	Hong and Kim, 2022; Park and Ahn, 2016
BM derivation	Bhave, 1994; Bang et al., 2014; Kim et al., 2017; Lee and Ahn, 2018; Shim and Seol, 2022
Business Plan	Ucbasaran et al., 2001; Brockner et al., 2004; Lee and Ahn, 2018; Shim and Seol, 2022
Securing resources	Fishbein and Ajzem, 1975; Kazanjian, 1988; Bhave, 1994; Ucbasaran et al. 2001; Brockner et al., 2004; Kim et al., 2017
Digital competency	Kang, 2020; Kim, 2021; Kim, 2022; 2024

Competence is an individual's internal characteristic that leads to effective and excellent performance in a specific situation or job (Spencer & Spencer, 1993). Applied to entrepreneurship, entrepreneurial competence is defined as the knowledge, skills, and attitudes that influence entrepreneurs (Lee, 2024). Numerous studies argue that the competence of entrepreneurs and startup companies is a critical factor in determining startup performance (Kim & Kim, 2020). However, the relationship between entrepreneurs' competence and performance remains unclear (Kim & Shin, 2022). Specifically, research on the startup preparation capabilities required during the business establishment process is still insufficient (Park & Ahn, 2016).

Hackathons and startup camps are representative examples of entrepreneurship education that enhance startup competence. Prospective entrepreneurs seize startup opportunities through such education, which is expected to improve their startup preparation competence (Kim & Kim, 2020). However, the startup preparation competence of prospective entrepreneurs can be categorized into three types: lack of overall preparation, neglect of education for competency strengthening, and comprehensive preparation of capabilities (Hong & Kim, 2023).

From an entrepreneurial process perspective, as shown in Table 1, startup preparation capabilities include entrepreneurial intention, opportunity recognition, preparation of startup items, derivation of a business model (BM), the establishment of a business plan, securing technical capabilities, BM

verification through prototypes, and resource acquisition. Resource acquisition is further subdivided into initial capital, forming a startup team, and building a network (Shim & Seol, 2022; Hong & Kim, 2023; Park & Kim, 2019).

Recent studies also highlight digital competency as essential for startup preparation (Kim, 2024). In the era of digital transformation, digital capabilities influence the recognition of technological startup opportunities (Kang, 2020; Kim, 2022, 2024) and opportunity evaluation (Kim, 2022), thereby enhancing management performance and improving survival rates (Kim, 2021).

3. Open Innovation

Despite processes and investments to explore new ideas and technologies, companies often struggle to innovate their business models (Chesbrough, 2010) due to the challenges of managing the innovation process for new products and services (Chesbrough, 2003).

Startup open innovation involves developing technology commercialization by exchanging information with the market (Salimi et al., 2023). Positive outcomes are achieved by combining both the founder's ideas and external ideas (Chesbrough, 2003; Kim & Lee, 2019), which helps explore new opportunities and apply novel problem-solving methods to products, services, and processes (Dess & Lumpkin, 2005; Choi, 2015).

Open innovation is crucial for startups to compensate for or overcome the lack of resources and capabilities needed for growth. It functions as a network to address resource deficiencies (Mirghaderi et al., 2023), create new markets, secure competitive advantages through technological competitiveness (Salimi et al., 2023), and improve corporate performance (Seo & Yoon, 2021; Mirghaderi et al., 2023).

Open innovation in startups can be divided into participatory capacity and absorptive capacity (Salimi et al., 2023). Participatory capacity refers to the ability to acquire necessary resources and capabilities through active networking. Absorptive capacity is split into potential absorptive capacity (acquiring and understanding necessary technology and knowledge) and actual absorptive capacity (transforming it into new technology or knowledge and utilizing it effectively) (Seo & Yoon, 2021; Kim & Nam, 2023). This study defines actual absorptive capacity as utilization capacity.

Research on open innovation in university startups is limited. Cooperation with external startup experts positively impacts business model (BM) establishment during the startup preparation of university personnel (Ahn & Kwon, 2021). Business consulting by external experts also benefits prospective student entrepreneurs (An & Lee, 2022). These studies highlight outside-in

innovation activities, demonstrating that universities often lack entrepreneurial capabilities.

4. Business Performance of Early Startups

The approach to measuring startup business performance has evolved over time. In the 1980s and 1990s, performance was evaluated based on R&D and new product development processes from a technological innovation perspective. Since the 1990s, financial indicators have been predominantly used (Jung et al., 2020).

However, early startups often lack extensive business records (Kim, 2021), making it difficult to rely solely on objective financial performance indicators (Kim, 2021; Kim & Geum, 2023). Therefore, a combination of objective and subjective indicators is recommended (Seo & Yoon, 2021; Kim & Nam, 2023). Some scholars advocate using only subjective indicators (Mahmood & Hanafi, 2013; Ahn et al., 2019; Kim, 2021).

For financial performance, sales revenue is a common metric (Park & Ahn, 2016; Kim & Nam, 2023). Non-financial indicators can be categorized into technical characteristics, market characteristics, and organizational characteristics. Technical characteristics include technology development (Kim, 2019; Kim & Lee, 2019; Kim & Hwang, 2022; Kim, 2021) and intellectual property rights, including patents (Choi, 2015; Kim, 2019; Jung et al., 2020). Market characteristics cover market development (Kim & Lee, 2019) and market share (Kim & Nam, 2023). Organizational characteristics include the number of employees (Park & Ahn, 2016; Kim & Nam, 2023).

Subjective indicators encompass founder, employee, and customer satisfaction (Kim & Nam, 2023), goal and vision planning, growth potential (Kim & Hwang, 2022), perceptions from peers (Ahn et al., 2019), and positive evaluations from investors and competitors (Jung et al., 2020).

IV. Research Methods and Hypotheses

1. Data

Participants in H University's start-up support program are recruited through general announcements. Applicants are selected through a startup readiness assessment. If they are accepted, they receive startup education. Upon completion of entrepreneurship training, they undergo an evaluation and participate in a business model workshop.

As shown in Table 2, there were a total of 32 workshop participants from 2019 to 2023. Of these, 4 participated after starting a business and 28 participated in the preparation process. Eighteen participants completed the workshop while 14 discontinued midway. The primary reasons for discontinuation were an inability to absorb the innovation model knowledge provided in the workshop and a lack of time due to employment commitments.

This study analyzes 12 of the 18 participants who completed the workshop, excluding 5 entrepreneurs who closed their businesses and 1 who participated after starting a business. The five business closures were due to family conflicts (2 cases), poor technological development, and lack of funds (2 cases), and student-related issues (1 case).

Table 2. BM workshop participation and start-up status

Participation		Not started	Started			Total
			Operation	Shut down	Subtotal	
2019		2		2	2	4
2020		2	3	4	7	9
2021		3	5		5	8
2022			6		6	6
2023		2	3		3	5
	Complete	-	**13**	5	18	18
	Stop	8	4	2	6	14
	Total	8	17	7	24	32
%		25.0	53.2	21.8	75.0	100.0

2. Research method

This study is basically a case study explained by Tellis (1997) and others. However, almost all of the data used in this study are descriptions or evaluations written in the form of documents. Therefore, this study converts these into data and analyzes them using Likert's 5-point scale. The scale for each item for conversion is detailed in <Appendix 1>, so it is briefly explained here.

To analyze the cases, this study followed a systematic approach, starting with a literature review to establish an analytical framework. Subsequently, documents related to program participants were classified and organized according to this framework.

The research sequence can be summarized as follows:

1. Derivation of an analytical framework and setting hypotheses through a literature review.

2. Review of documents from each prospective entrepreneur:
   1) Business plans submitted at the time of participation and after the workshop.
   2) Evaluation documents by experts at the time of participation and after the workshop.
   3) Interviews with entrepreneurs to address missing factors.
   4) Business performance reports for 2023.
3. Measuring each factor of the framework on a 5-point scale based on the Appendix.
4. Analysis

The documents submitted by prospective entrepreneurs included business plans and performance reports submitted post-startup. Evaluations were conducted multiple times at each milestone by about 5 experts in a descriptive manner. This study utilized only the initial and final evaluations. The initial evaluation assessed startup readiness for those who completed competency training, while the final evaluation measured improvements through mentoring or the workshop. Additional factors not sufficiently covered by documents were measured through interviews with the founders.

3. Research Model

This study aimed to examine the impact of university startup support on individuals preparing to start a business. To achieve this, we first establish the startup process for this study through a theoretical discussion. Additionally, we present a model to assess the open innovation capabilities and startup preparation capabilities of these prospective entrepreneurs and introduce an analytical framework to evaluate startup performance.

First, as shown in Table 3, this study categorizes the startup process into startup intention, business model (BM) design, and startup implementation as suggested by Lee and Ahn (2018). The first stage, intention confirmation, includes the detailed factors of innovation, risk-taking, and proactiveness as suggested by Miller (1983). The second stage, BM design, adds digital capabilities to factors like opportunity recognition, BM concept, and business plan establishment, reflecting recent Korean research that emphasizes the importance of digital capabilities. The third stage, startup implementation, consists of technology/productization capabilities, startup team, network, and marketing/sales channels, drawing heavily from recent entrepreneurship research in Korea (Choi & Cho, 2012; Lee & Kim, 2017; Lee & Ahn, 2018; Polishchuk, 2023; Kim & Geum, 2023; Kim & Jeong, 2020).

Second, as for open innovation capabilities, this study divided it into participation capabilities, absorptive capabilities, and utilization capabilities,

followed by Salimi et al. (2023), Seo & Yoon (2021), and Kim & Nam (2023). In particular, we examine this competency by dividing those preparing to start a business into an office worker group, an experienced group, and a student group.

Third, following previous studies, business performance is measured using a mix of financial and non-financial indicators. Non-financial characteristics include numerical information such as the number of patents and employees, as well as technology readiness, business group evaluation, and external evaluation.

Table 3. Analytical framework and variable measurement

Process & details		Main Content
Intention	Innovativeness	Level of innovativeness of business idea
	Risk-taking	Propensity during stages
	Proactiveness	Specificity of goals and level of immersion
BM design	Digital competency	Level of understanding and use of digital technology
	Opportunity recognition	Types of opportunity recognition in entrepreneurship
	BM concept	BM characteristics and presentation level
	Business plan	Ability to write, and level of systematic description
Implementation	Technology / productization	product or service and how to implement it
	Resource - Startup team	Level of key personnel in each domain
	Resource - Network	Size and quality level by network field
	Marketing	Level of marketing knowledge and development

To measure business performance, sales revenues were scaled based on annual sales in 2023: no sales, ~230K, ~380K, ~770K, and $770K US dollars or more[1]. For companies founded less than one year, sales revenue during that period was annualized.

Non-financial performance indicators such as patents were measured by the number of applications, and employment was scaled from no employees to four or more. Government subsidies were measured on a scale of 1 to 5, ranging from no support to over $230K US dollars. Investments were scaled from no investment to offer received, contract, seed investment, and Series A investment.

Fourth, Startup readiness levels were categorized into R&D planning, R&D prototype development, commercialization, and launch based on the interview

[1] US$ 1 ≒ KRW 1,300, K= 000.

timing. Internal evaluation was classified into business item change, BM pivot, BM supplement, excellent, and best. External evaluation in entrepreneurship-related contests was categorized into no awards, participant, excellence, grand prize, and national grand prize.

The hypothesis of this study, which diverges from existing studies, posits that all stages and open innovation influence each other and that the characteristics of each stage affect business performance. Previous studies generally assume that open innovation can exist at each stage of the startup process, impacting business performance. This study hypothesizes a more interconnected influence, as depicted in Figure 1.

Table 4. Performance measurement

Category			Levels
Financial	Sales revenue		Annual sales in 2023
Non-financial	Numbers	Patent	Number of applications
		Employees	Number of employees
		Gov't subsidies	Government support amount
		Investment	Investment intention and offer
	Evaluation	Readiness	Startup readiness level of products
		Internal	Evaluation by internal experts
		External	Winning of contests and government subsidies

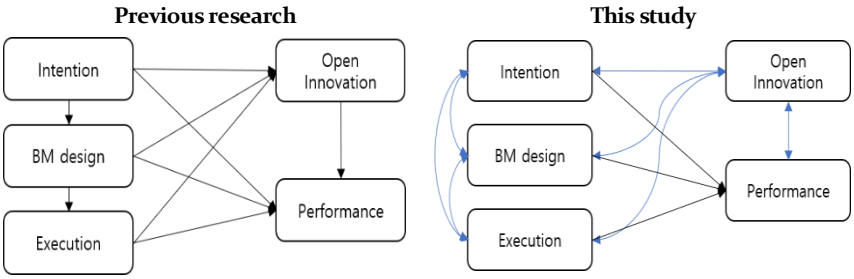

Figure 1. Hypothesis: Open innovation and Startup process

V. Analysis Results

The demographic characteristics of the analysis subjects are as follows. There are 10 males (83.3%) and 2 females (16.7%). In terms of age, there are 4 in their 20s (33.3%), 4 in their 30s (33.3%), and 2 each in their 40s and 50s (16.7%). Regarding educational background, 4 individuals (33.3%) are currently enrolled in or have graduated from university, while 2 each (16.7%) have a high school diploma or hold a master's/doctoral degree. Their majors are as follows: 6 in science and engineering (50.0%), 2 in the humanities (16.7%), 2 high school graduates (16.7%), and 1 in physical education (8.3%). These preparers are distributed among the student group, the working professional group, and experience group.

1. Open Innovation

This study examines open innovation through three key dimensions: workshop participation, knowledge absorption, and utilization, as illustrated in Table 5. Overall participation levels are notably high, averaging 3.8, with employees showing the highest engagement at 4.3. Their proactive involvement stemmed from recognizing the workshop's potential to enhance startup preparation skills and business model (BM) value.

Table 5. Open innovation capability

Capability	Student group	Employee group	Experience group	Average
Participation	3.5	4.3	3.5	3.8
Absorption	3.0	3.8	3.0	3.2
Utilization	2.0	3.0	3.5	2.8
Average	2.8	3.7	3.3	3.3

Note: Student group means student participants; Employee group refers current employees; Experience group is those with business or R&D experience.

Average absorptive capacity, measured at 3.2, reflects participants' ability to develop a BM. While some participants demonstrated high levels of commercialization (4.0) or effective integration of technology and business (5.0), others lagged at 2.0, primarily due to inadequate digital capabilities. Previous experience occasionally hindered innovation in the experienced group, with employees facing challenges such as reduced focus during weekday workshops, diverse educational backgrounds, and a tendency to adhere rigidly to initial BMs.

Utilization capability, averaging 2.8, indicates the extent to which participants were willing to learn and apply external knowledge. While some were at a basic

learning stage (2.0), others, particularly in the experienced group, achieved partial utilization levels of 4.0.

Interestingly, absorptive capacity (3.2) generally lags behind participation (3.8), with utilization (2.8) being even lower. However, there were exceptions. One employee selected for an in-house venture program of a public enterprise faced organizational barriers to innovation post-workshop but overcame these to resign and launch an international product within a year. Similarly, a student significantly increased their entrepreneurial drive (+3.0) after developing a BM in the workshop, leading to the establishment and subsequent sales of a separate company.

2. Impact of Startup Preparation Capabilities

At the time of participation, preparation competency was notably low, averaging 1.9 across all groups, as shown in Table 6. The experience group exhibited the highest readiness at 2.4, while the employee group and student group showed similar levels at 1.8 and 1.6, respectively.

Within the experience group, intentions (2.6) and implementation (3.0) were relatively stronger despite challenges in business model (BM) design (1.6). Conversely, the employee group faced significant difficulties in both BM design (1.8) and implementation (1.6). The student group displayed low readiness across intentions (1.7), BM design (1.7), and implementation (1.4).

Across stages, intention levels varied, with the student group exhibiting the lowest at 1.7, followed by the employee group at 2.2, and the experience group at 2.6. Specifically, innovativeness (2.0), risk-taking (2.1), and proactiveness (2.3) were all below 2 for the student group, indicating a limited entrepreneurial inclination consistent with findings by Marullo et al. (2018) on the influence of background and personality on entrepreneurial processes.

In the BM design stage, all groups displayed similarly low levels of preparedness: student group (1.7), employee group (1.8), and experience group (1.6). Digital abilities (1.5) were particularly lacking, impacting BM concept (1.7), business plan development (1.7), and opportunity recognition (1.9). This underscores the challenge faced by most prospective entrepreneurs in identifying and capitalizing on startup opportunities without sufficient experiential knowledge.

Preparation for startup implementation varied significantly, with the experience group notably higher at 3.0 compared to the employee group (1.6) and student group (1.4). Specifically, network competency (2.6), technology/productization skills (1.9), marketing proficiency (1.9), and team organization (1.6) were ranked in descending order of readiness.

Table 6. Changes in capabilities by open innovation

Process		Student group		Employee group		Experience group		Average	
		1st	After	1st	After	1st	After	1st	After
Intention	Innovativeness	1.5	4.0	2.3	3.6	2.3	**4.8**	2.0	**4.1**
	Risk-taking	1.8	1.8	2.0	2.8	2.5	**3.0**	2.1	2.8
	Proactiveness	1.8	2.8	2.3	3.3	3.0	**3.5**	2.3	**3.1**
	Average	**1.7**	3.1	**2.2**	**3.2**	**2.6**	3.8	**2.1**	3.3
BM design	Digital ability	2.0	2.3	1.3	1.6	1.3	**1.8**	1.5	**1.8**
	Opportunity recognition	1.8	**4.1**	1.7	**5.0**	2.2	5.0	1.9	**4.7**
	BM concept	1.8	5.0	1.7	**5.0**	1.5	5.0	1.7	**5.0**
	Business plan	1.3	**4.1**	2.2	**5.0**	1.5	5.0	1.7	**4.7**
	Average	**1.7**	2.1	**1.8**	**4.2**	**1.6**	4.2	**1.7**	4.1
Implementation	Technology/ productization	2.0	-	1.8	3.1	2.0	**3.0**	**1.9**	**2.7**
	Startup team	1.3	3.3	1.0	1.8	2.5	**2.8**	1.6	**2.3**
	Network	1.5	1.8	2.3	2.8	4.0	**4.0**	2.6	**2.9**
	Marketing	1.0	-	1.3	1.6	3.5	**3.5**	1.9	**2.0**
	Average	**1.4**	1.7	**1.6**	**2.4**	**3.0**	3.3	**2.0**	2.4
Overall average		**1.6**	**2.9**	1.8	3.2	2.4	3.7	1.9	3.2

After the workshop overall competency levels increased by 1.3 points to 3.2. Across groups, the employee group showed an increase of 1.4 points to 3.2, the student group increased by 1.3 points to 2.9, and the experienced group rose by 1.3 points to 3.7. Despite these gains, the student group's readiness remained relatively low at 2.9. The workshop had a significant impact on each stage in the following order: BM design increased to 4.1 (+2.4), intention to start a business rose to 3.3 (+1.2), and execution improved to 2.4 (+0.4). While the workshop did not notably affect startup intentions or implementation, it clearly heightened awareness among entrepreneurs regarding necessary actions.

Participation in the workshop boosted business model (BM) intention scores by 1.2 points to approximately 3.3, coinciding with a substantial 2.4-point increase in BM design. This underscores the workshop's strong positive influence on entrepreneurial intentions through open innovation in BMs.

In the BM design stage, notable improvements were observed: BM concept derivation increased to 5.0 (+3.3), business plan development to 4.7 (+3.0), and opportunity recognition to 4.7 (+2.8). These scores approached perfection, highlighting the workshop's significant impact on BM planning. However,

digital capabilities only saw a slight 0.3-point improvement to 1.8, suggesting a need for separate learning efforts, a critical factor for ventures targeting existing or niche markets.

In the implementation stage, advancements included securing commercialization technology at 2.7 (+0.8), organizing startup teams at 2.3 (+0.7), networking at 2.9 (+0.3), and developing marketing/sales channels at 2.0 (+0.1). The BM became more robust, with technology/productization and key personnel in the startup team showing short-term improvement potential. However, networking and marketing require ongoing capability accumulation, posing challenges for short-term supplementation.

The impact varied by group. Both the experienced and employee groups were significantly influenced by BM improvements, achieving near-perfect scores. Even the student group, though least affected, surpassed 4 points. Meanwhile, implementation capacity was the least influenced stage: the experienced group rose to 3.3. In contrast, the employee and student groups scored 2.4 and 1.7, respectively, indicating room for improvement.

3. Business Model Pivoting

In cases targeting weak business sustainability in existing or niche markets, business model (BM) pivots incorporating digital technology were attempted. This change allows us to add a new type of startup to Aulet and Murray's (2013) concept of small and medium-sized enterprises (SMEs) and innovation-driven enterprises, termed hybrid enterprises. By adopting new BMs supported by digital tech, startups can explore new markets.

Examining specifics in Table 7, all workshop participants achieved revenue generation but were encouraged to explore digital transformation. Stages included R&D, prototyping, commercialization, and launch. Some companies founded in 2023 launched digital services by the first half of 2024, while those founded in 2021 remain in the prototype phase.

Table 7. Hybrid enterprise by open innovation

Establishment	Sales revenue	Digital Transformation Readiness			
		R&D	Prototype	Commercialization	Launch
2021	2		1	1	
2022	5	2	1	2	
2023	5	2	2		1
Sum	12	4	4	3	1

4. Performance Impact

This study differentiated between evaluations conducted by internal experts involved in the program and external evaluations based on awards from startup contests or government subsidies for promising startups.

Internal evaluations finally scored the experience group significantly higher, from 3.0 to 4.8, compared to the employee group (from 2.3 to 4.1) and the student group (from 2.0 to 3.8).

Five awards were given to four companies out of 12. The level of awards averaged 1.1 at the time of participation, with a slight increase to 1.5 (+0.4) post-workshop. Additionally, five companies received government subsidies eight times, and the average level increased from 1.1 to 1.5. Five companies received investment offers within one year after the workshop, two of which refused the offer because they wanted more mature investment opportunities.

Table 8. Open innovation result – evaluation

Evaluation	Student group		Employee group		Experience group		Average	
	1st	After	1st	After	1st	After	1st	After
Internal	2.0	3.8	2.3	**4.1**	3.0	4.8	2.4	**4.2**
External	1.0	-	1.3	**2.1**	1.0	1.5	1.1	**1.5**

5. Business Performance

Performance was assessed by distinguishing between financial and non-financial outcomes. Financial performance focused solely on initial sales generated after launching the business. The average score was 2.4, reflecting annual sales ranging between $230K and $380K US dollars.

Table 9. Open innovation result - indicators

Category		Student group	Employee group	Experience group	Average
Financial	Revenue	**1.8**	1.8	3.8	2.4
Non-financial	IT readiness	**2.3**	3.0	3.0	2.8
	Patent	**1.5**	2.0	**4.3**	2.6
	Number of employees	**3.0**	2.5	3.0	2.8
	Government subsidies	**1.3**	1.5	2.5	1.8
	Attracting investment	**1.5**	1.3	1.5	1.4

Among the groups, the experience group achieved the highest score at 3.8, generating between $380K and $770K US dollars. In contrast, both the student and employee groups scored 1.8, indicating sales below $230K US dollars.

Non-financial achievements included the application for a total of 23 patents facilitated through the workshop. These patents resulted from individual or collaborative inventions between participants and universities, securing intellectual property rights crucial for implementing innovative business models.

The average employment rate was 2.8, with both the experience and student groups hiring an average of 3.0 employees within a year post-workshop. In contrast, the employee group hired approximately 1 to 2 employees, averaging 2.5.

Additionally, several participants benefited from government subsidies aimed at supporting promising startups, scoring an average of 1.8, the average amount of $77K US dollars. The experience group received a higher subsidy score of 2.5, indicating support exceeding $154K US dollars.

Investment offers were also received from investors, a process typically requiring time and often conditional for early-stage startups. Within one year after the post-workshop, the average score was 1.4, reflecting the stage of receiving conditional investment offers.

VI. Conclusion

1. Discussion

This is a case study of the processes and outcomes of university support for entrepreneurs. From the perspective of these entrepreneurs, university support functions as open innovation, influencing how entrepreneurial capabilities evolve and what outcomes are achieved. While previous research has primarily focused on supporting the commercialization of technologies and knowledge within universities, this study distinguishes itself by examining how universities have supported the entrepreneurial efforts of external entrepreneurs.

The findings of the study are as follows:

First, university support for entrepreneurship operated as a form of open innovation from the perspective of aspiring entrepreneurs. The influence of open innovation was evident, as the outcomes varied depending on the extent to which aspiring entrepreneurs embraced the support, reflecting their open innovation capability in entrepreneurship.

Second, the hypothesis that the entrepreneurial preparation process follows a non-linear model was validated. Instead of a simple linear progression from intention to business model conceptualization and then to startup execution, the

study found that when open innovation is involved, the process becomes nonlinear. In this model, entrepreneurial intent, business planning, and execution interact and influence each other dynamically through pivots.

Third, while entrepreneurial types are generally classified into SME (small and medium-sized enterprise) and innovative enterprise types (Aulet & Murray, 2013), this study identified a hybrid enterprise type that transcends these two categories due to the university's support for entrepreneurship.

This study offers the following new perspectives:

First, it demonstrates that beyond the Inside-Out model, which utilizes only the university's technology and knowledge, an Outside-In model is also feasible. In this model, aspiring entrepreneurs are brought into the university to share its knowledge and experience, facilitating their startups (Ko and Seol, 2022). This startup support model, developed over 12 years, has established an entrepreneurial activity within universities in Korea aimed at regional community development. Its success has been recognized, making it a fundamental initiative in major innovation clusters in Korea.

Second, this type of startup-supporting university has not been previously addressed in theoretical discussions related to entrepreneurial universities. The various types of entrepreneurial activities identified by Eizaguirre et al. (2020), who classified entrepreneurial university activities into 18 types—including incubators/technological parks, technology/academic/student spin-offs, contracts/collaborations/major research projects, funding/grants, joint ventures/testing/consulting, knowledge dissemination/networking, entrepreneurial education, commercial activities, and student output—could be expanded to include this new type. While accelerators and other specialized entrepreneurial institutions offer various business model mentoring services, they typically target selected entrepreneurs with promising startup ideas. In contrast, universities have the advantage of providing comprehensive support, ranging from basic entrepreneurial education to business model innovation, and even facilitating investment through university networks.

2. Implications and future research

Practical implications indicate that prior assessment of startup preparation capabilities could enhance startup survival rates. Among the 32 participants studied, 8 ceased operations largely due to market misalignment or insufficient business readiness.

Moreover, workshops prove pivotal for BM pivots during startup preparation and market entry. While prospective entrepreneurs initially resist pivots based on self-confidence or biased data, trust-building with workshop experts fosters openness to external advice (An and Lee, 2022).

Policy implications urge adjustments in university startup support policies. While Korea's policies encompass diverse university roles—from startup education hubs to campus-based startup ecosystems—customized entrepreneurship education proves particularly effective and should be expanded (An and Lee, 2022). This study empirically supports such claims through University H's tailored workshop approach.

Furthermore, policies must actively respond to digital transformations by integrating digital education with startup initiatives. This study illustrates how such integration fosters hybrid business models from traditional SMEs, thereby enhancing market penetration and survival rates through BM innovation.

Despite these contributions, study limitations are evident. Firstly, the study is confined to the context of University H, necessitating broader case studies for generalizability. Secondly, variations in university capacities and internal expertise were not fully examined, potentially impacting startup performance. Lastly, the study's focus on short-term post-startup performance precludes insights into long-term survival and financial outcomes. Future research should track these outcomes over extended periods and explore hybrid business models in depth.

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Appendix 1. Workshop activities for Likert Scale

	Participation	Absorption	Running
1	No	Resistance	No
2	Passive	Lack of ability	Future
3	Active	Understanding of BM	Now
4	Interactive	Understand technology	Business unit
5	Highly interactive	+ Business	Company-wide

Appendix 2. Evaluation of Likert Scale - Stages

Confirmation of intention

	Innovativeness	Risk sensitivity	Proactiveness
1	Imitation	Aversion	Lack
2	Simple ideas	Conditional	Present-focused
3	Improvement	Management	Future-focused
4	Innovation	Preferred	Goal-driven
5	Reorganization	Immersion	Immersion

Business model

	Digital competence	Opportunity awareness	BM concept	Business plan
1	Simple	Lifestyle-based	No	Simple
2	Understanding system	Experience-based	Traditional	Include market
3	Understanding flow-chart	Market attraction	Knowledge as a Service	+ Technology
4	Architecture Design	Tech attraction	Manufacturing & service	+ Resources
5	Project utilization	New convergence	Converged	+ Growth strategy

Startup implementation

	Technology	Starting team	Network	Marketing
1	Outsourcing	1 person (Founder)	Family-focused	Lack
2	Planning ability	Tech or market	Minority-focused	Knowledge
3	Design ability	Tech and market	Organization-focused	Sales experience
4	R&D ability	+ Production	Specific area	Marketing ability
5	Production capacity	+ Marketing	A variety of fields	Majoring & ability

Appendix 3. Business performance to Likert Scale

		1	2	3	4	5
Financial	Revenue(year)	None	~230K	~ 380K	~ 770K	770K~
Non-Financial	Investment	None	Willingness	Contact	Seed	Series A
	Gov. grants	None	~ 77K	~ 154K	~ 230K	230K~
	Employees	None	1	2	3	3~
	Readiness	R&D Plan	R&D	Prototypes	Productization	Launching
	Patent	None	1	2	3	3~
Recognition	Internal	Idea changing	Pivoting	Ready	Excellent	Best
	External	No	Honorable mention	Excellence	Prize	National prize

Note: US$ 1 ÷ KRW 1,300, K = 000

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