

LOOK OUT TO THE WORLD

ENTREPRENEURIAL UNIVERSITIES FOR SCIENCE AND TECHNOLOGY: CASES OF KAIST AND POSTECH

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Abstract:

The entrepreneurial university concept is a new challenge and opportunity for science and technology (S&T) universities in Korea. The traditional university functions of education, research, and community service are still highly relevant, but increasingly so are new types of collaboration for research outcomes and funding resources. Strategic university management is needed to handle socioeconomic contribution, involving the creation and maintenance of proactive relationships with firms, national and regional governments, and other regional entities. The emergence of the entrepreneurial university in Korea is similar to the socioeconomic changes observable in the history of university development in America and in many other developed countries. In this paper, we examine the emerging paradigm of entrepreneurial universities in Korea and discuss the interactions among universities, firms, and government strategy and policy by investigating and comparing two universities, POSTECH and KAIST, in their leadership, adaptation to changes in the environment, business strategies, organization, and cooperative network. We conclude with policy points that emphasize the fact that while entrepreneurial universities are an emerging concept, they can expand innovation and creativity in education and research in Korean universities in the mid-to-long term if university administration, policymakers and public administrators, and regional innovation actors take an interest in the need for a new organization and system where university research can contribute socioeconomically.

Keywords: *University entrepreneurship; Entrepreneurial research university; Technology innovation; Industry university cooperation; Regional innovation.*

1. Introduction

The sociological understanding of universities has undergone a major shift in recent years. While education and research remain key university roles,

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other major issues for universities have emerged such as innovation, competence, system restructuring, and strategic management. A close look into these issues brings to our attention a dual environment of optimism and pessimism in universities today.

At the government level, there persists a pessimistic mood regarding university performance and evaluation. Government R&D investment in research universities has continuously expanded over the last few decades but the effectiveness of research outputs remains questionable. At the institutional level, universities have struggled with issues related to research quality and impact, technology transfer, and industrialization. In addition, universities are concerned with student retention, the employment rate of graduates, and funding.

In a more optimistic perspective, the dynamics of social change are being formulated into a business ecosystem. The current Geun-hye Park administration (2013-2017) emphasizes the creativity of economic activities under a national vision called the “Creative Economy” and designates universities as a major driving force for nurturing human resources as well as creating new industries and small medium enterprises. In another important aspect under optimism, companies expand open innovation strategies to achieve technological innovation through university resources or augmenting in-house R&D. Consequently, a wide range of collaborative R&D activities are growing along with the commercialization of university-industry relations.

This mixed observation of optimism and pessimism about the university environment in Korea suggests that universities face critical issues in assuring sustainable development and core-competence, nurturing a new research culture, and establishing visionary agenda and strategic management. Accordingly, there is a need to expand the traditional roles of the university to consider their socioeconomic effects through technology transfer and commercialization spillover because the capacity of universities decides the future of the society it is part of by leading social and technological changes (*Duderstadt, 2000*).

In this situation, the concomitant rise of the “entrepreneurial research university” and the “several entrepreneurial characteristics in a university system” are observed in major Korean research universities specializing in S&T (*Rothaermel, Agung, & Jaing, 2007*)³. In this paper, research

³ Rothaermel et al.(2007) illustrates that “a conceptual framework containing four major research streams that have emerged over the last decade in the U.S. and developed countries: (i) entrepreneurial research university, (ii) productivity of technology transfer offices, (iii) new firm creation and (iv) environmental context including networks of innovation”.

university refers to either S&T specialized research university or S&T specialized university. Entrepreneurial university activities increasingly network externally with governments, firms, research institutions, and startups, building a business ecosystem in regional economic and social development (*Altbach & Salmi, 2011*). Such structural shifts in these entrepreneurial research universities serve two internal purposes: (i) to diffuse university research not only into the scientific community but also the regional and national socioeconomic system; and (ii) to respond to the growing needs of university-industry collaboration to achieve technology innovation.

What and why are entrepreneurial characteristics observed in Korean research universities specializing in S&T? What formulates the conception of university entrepreneurship in Korea? By providing a descriptive analysis, we intend to shed light on the relatively new phenomenon of university entrepreneurship in Korea and present a new fertile area for academic research. Economists note that the Korean economy is in decline, with weakening productivity and competitiveness in SMEs and high-tech startups stalling in their expansion. Kwok, Kim, Lee, Jeong, and Choi (2012) argue that society requires research universities to promote entrepreneurship towards finding important technical breakthroughs, creative and innovative human capital for new growth engines, and new industry development. Thus, entrepreneurial universities provide new opportunities for innovation with their extensive networks, achieving a virtuous circle of development within the regional business ecosystem.

Because Korean scholars rarely conduct research on university entrepreneurship, future research should remain focused on an in-depth discussion of the role of research universities and enhancing research quality. Through this paper, we aim to make the following contributions. First, we highlight the emergence of university entrepreneurship to better understand the current situation. Second, we present a case analysis of two Korean entrepreneurial universities, POSTECH and KAIST, which are also the two leading S&T specialized research universities in the country. Third, we show the opportunities and limitations of these two entrepreneurial universities. Lastly, we conclude our study with a brief reflection on the potential value of and future research for the concept of the entrepreneurial university.

2. The rise of entrepreneurial universities

We explain the emergence of entrepreneurship in Korea and its characteristics at two major S&T specialized research universities from the

perspectives of demand and response: the perspective of push in the shifting role of universities by social change and the perspective of pull in the efforts of universities.

2.1. The traditional university mission shift in socioeconomic environmental change

The paradigm of the traditional university is built on academic fulfillment, freedom of research, and government funding. Universities have three key missions: education, research, and social service, in other words nurturing human resources, promoting knowledge, and conducting further social responsibility (Hong, Lee, Shin, & Lee, 2002). However, universities have recently changed their missions and engaged with nontraditional activities in response to growing demands from industrial firms.

Smilor, Gibson, and Dietrich (1993) argue that the changing demand of enterprises led to the rise of the entrepreneurial university. Firms strategically search for talent and new technology from research universities as well as new products through technology transfers and joint ventures. Firms require new business opportunities and technology innovation in an “open system”. Subsequently, research universities have generally increased entrepreneurial activities in their systems (Ches-brough, 2003).

In Korea, a government push is observed in the publically funded mega project Leaders in Industry-University Cooperation (LINC). LINC aims to restructure the university system by assigning them a central role in university-industry collaboration activities (Korean Ministry of Education, S&T, 2012). The government assesses the effectiveness and productivity of universities using the employment rate of graduates and the quality and quantity of university-industry collaborative programs. Subsequently, government assessment affects student tuition loans as well as government research funding. Another government push is the Act on the Promotion of Industrial.

Education and Industry-University Cooperation enacted in 2004. This legislation aims to provide incentives to universities for establishing university industry foundation, industry training programs, and university- industry collaborations. In effect, the Korean government is formulating the concepts of university entrepreneurship and entrepreneurial activities through this law⁴.

⁴ Science and Technology specialized universities in Korea have significantly contributed to national economic development since the 1980s, but for the purposes of this paper we focus on systemic shifts and factors in order to define entrepreneurial universities.

University entrepreneurship and related activities are remarkable in the field of research as an entrepreneurial research university (*Rothaermel et al., 2007*). Although researchers by Korean universities specializing in S&T have rich resources towards technology development, the effectiveness of patent registration and technology transfers lag behind those of the US. Recent statistical analyses show that the simultaneous increase of registered patents and academic research papers in Korea strongly suggest that basic research and industry collaboration activities create opportunity for synergistic effects (*Kim, 2011*). Park, Shon, and Lee (*2012*) agree that enhancing collaboration between firms and universities does not decrease basic research and academic activities but generate opportunity for new research by complementing research and education.

Universities specializing in S&T have more entrepreneurship classes than ever. These classes provide mentoring and training opportunities to students for creating ideas, applying technology, and developing business plans. In the United States, entrepreneurship classes incubate student startups at a rate double the number of professor startups (*Astebro, Bazzazian, & Braguinsky, 2012*). For example, Silicon Valley and Stanford University have a close network and many collaborative activities including joint university courses as well as the creation of new initiatives and programs. Stanford University helps develop entrepreneurs and alumni for the fiscal stability of university and regional economic development (*Hong et al., 2002*). In Korea, it is noted that academic entrepreneurship is prevalent in the university community as well.

2.2. University-led efforts for change

Universities face great pressures to adapt. In spite of increased external R&D investment and the large number of research projects at Korean universities, the effectiveness of research regarding investment input is being questioned (*The National Research Foundation of Korea, 2012*). In terms of R&D investment and technology transfer income, the return on investment (R&D efficiency) was only 0.95% compared to 5.2% in American universities (*AUTM, 2010; NRF, 2010*).

In Korea, weak R&D efficiency puts greater pressure on long-term university sustainability and further government funding. Consequently, R&D efficiency leads to reduced public research funding (*Rothaermel & Thursby, 2005; NRF, 2010*). Concerns about the general operating revenue of universities explain the emergence of the entrepreneurial phenomenon. Industry-university cooperation foundations accounted for only 14% of

total operating revenue in 2007; consequently, the revenue inability compels universities to seek profit from technology transfer fees, equities, and royalties (Lee, 2010). Compared to Korean universities, the total operating revenue of Harvard.

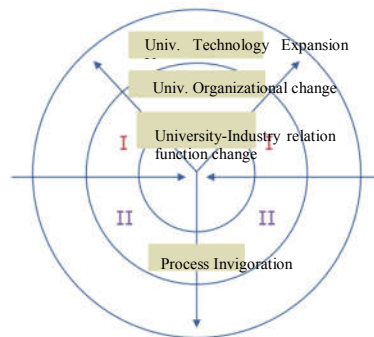
University was 86.4% from endowments and return on investments, and at Michigan State University almost 30% from return on investments and sales revenue in 2007 (Lee, 2010).

In the current socioeconomic situation, universities are asked to recognize the need for institutional change in order to enhance the efficiency and effectiveness of research through commercialization.

Organizational change has emerged as an important issue at the heart of these changes towards expanding entrepreneurial activities (Rothaermel, Agung, & Jiang, 2007). University entrepreneurship plays a key role in improving research effectiveness and facilitating technology diffusion through intermediaries (Rothaermel et al., 2007). Intermediary organizations are observed in the development of technology transfer organizations (TLO), industrial liaison offices (ILO), and incubating centers (Rothaermel & Thursby, 2005). Intermediary organizations play a significant role between professors and researchers outside of the university (AUTM, 2010).

The push-pull factors of university entrepreneurship and related activities explain the entrepreneurial phenomenon in Korean academia. It is possible to observe various factors of the emergence of the entrepreneurial university in two different dimensions simultaneously. First, the activity of entrepreneurial universities is externally networked with firms, research institutions, and technology-based startups within a business ecosystem towards contributing to regional economic and social development. Second, university entrepreneurship emerges in research-based technology diffusion through intermediary activities generating new cash flow and profit.

In this article, we present a comparative case analysis of two leading research universities specializing in S&T in Korea: POSTECH (Pohang University of S&T) and KAIST (Korean Advanced Institute of S&T). The two research universities developed in different regions outside of Seoul with different university revenue operation systems, one that is national (public) and one that is independent (private), with different foundational goals and development paths. The phenomenon of university entrepreneurship is clearly observed in both POSTECH and KAIST.



I. From university to external diffusion

- Education, research, service + university - industry relationship
- Professionalism and organizational restructuring in University-Industry Foundations and related departments
- Increased number of technology transfers and best practices

II. From external to internal university collaboration

- Regional industries and startups at university
- RIS and professional organizations
- Implementation of Triple Helix

Source: Rothaermel (2010), edited and restructured

Figure 1. Conceptual Framework

External Environment: Innovation Network-Based-Factors in Regional Clusters and Industries

The examination of these two universities is a case study for technology diffusion and networks with external context, and compares the following internal factors: development path, leadership, organization, networks, and collaboration with external actors. To conclude, the current state of university entrepreneurship and its characteristics in Korea as well as the framework of relatively new fields of research towards progress on university entrepreneurship are assessed.

3. The development path of research universities: historical perspective of industry-university cooperation and the direction of change

3.1. Definition of university type

The concept of the research university and of S&T universities is important in this paper. Research universities emphasize research activities and graduate programs for advanced resources (Byun, 2005) while S&T universities specialize in teaching, research, and publication in the academic field of science and engineering.

3.2. The development paths of POSTECH and KAIST

POSTECH was the first private research university in the city of Pohang, and specializes in research and education in the field of science, engineering, and technology. POSTECH was established in 1986 by Tae -joon Park, former CEO of POSCO (Pohang Iron and Steel Company). The founding president of POSTECH is Dr. Hogil Kim, who envisioned a research-oriented university for the Korean nation (POSTECH Overview, 2013).

POSTECH was founded with investment from POSCO in the name of national progress in S&T. POSTECH is currently composed of eleven undergraduate departments and twenty-one graduate departments including five professional schools in S&T. POSTECH remains an elite institution of 268 full-time faculty, 1,410 undergraduates, and 2,229 postgraduates specializing in research and education in S&T (*POSTECH Overview, 2013*).

KAIST was the first national research university to specialize in science, engineering, and technology in Korea. It was established in 1971 by the Korean government as a national university awarding only graduate degrees. KAIST has played a critical role in technology national development and economic growth not only by conducting nationwide strategic research and development projects but also by training researchers and engineers (*KAIST at a glance, 2013*). KAIST has recently expanded their educational programs in both undergraduate and graduate students to six colleges, two schools, and eleven graduate schools in science, engineering, technology policy, and management (*KAIST at a glance, 2013*).

Table 1. KAIST and POSTECH

	KAIST	POSTECH
Type	National (Public) research university specializing in S&T	Independent (private) university specializing in S&T
President	Sung-Mo Kang ('13.2-'17.2)	Yongmin Kim ('11.9 - '15.8)
Establishment	By Korea Advanced Institute of S&T Law By Private School Law (1973)	By Korea Advanced Institute of S&T Law By Private School Law (1987)
Management (Board of directors)	20 directors, including government officials	12 directors, including the POSCO CEO (Board of Directors)
Annual Budget	USD 765M in fiscal year 2013 USD 171M (22.4%) (Government endowment) USD 55M (Government-supported organization expenses)	USD 372M in fiscal year 2013

Source: KAIST and POSTECH websites, 2013

3.3. The firm-led POSTECH cooperation system

POSTECH is important for the science community as well as in the history of university education in Korea as being both Korea's first research university and a successful regional (non-Seoul) university. The university's development path was carefully planned under the entrepreneurial spirit of former POSCO CEO Tae-joon Park and the first POSTECH President Hogil Kim. Their vision was crucial for POSTECH in developing its global

research capacity⁵. The significance of POSTECH's development is in its institutional vision and mission: to become a global S&T university through its unique collaboration model of POSCO (Industry), POSTECH (university), and RIST (private research institute) (*POSTECH, 2009*). POSCO plays a leading role in R&D activities and industrial investment. POSTECH facilitates basic and applied science research and education. RIST applies research and development (*POSTECH, 2009*). The course of innovative growth by POSTECH also facilitates the development of other research universities in Korea. Despite its strong record of research, publication, and intensive education in science and engineering, POSTECH faces challenges in developing a long-term strategy in its new growth phase. Compared to American research-intensive universities, POSTECH falls behind in technology transfer effectiveness and commercialization. University entrepreneurship and its concurrent activities have already emerged from POSTECH. First, the university fine-tuned its entrepreneurship class (TLO) and incubating center, and launched an industry-technology liaison center and the POSTECH Holdings Company creating a streamlined processing and regulation system. Second, POSTECH expanded its collaboration from POSCO to other POSCO Group companies for R&D and commercialization and established the Association of POSTECH Grown Companies (APGC) to promote entrepreneurial culture at POSTECH.

3.4. A Government-led KAIST collaboration system

KAIST was established under the S&T Act in 1981 and receives direct government subsidies and funding. It was developed under an overarching mission of economic development and R&D policy towards contributing to the Korean scientific community and technology innovation at the national level (*Jang, 2012*). KAIST as well as the S&T Act also aims for the development of Korean industry. The institute pursues theoretical work and practical applicability, nurturing human resources and undertaking long-term R&D as part of national S&T policies (*KAIST, 2013*). KAIST-industry cooperation has reflected the propensity of government-led initiatives. In order to create a cluster of government-funded research institutions, the Korea government established the Daedeok Research Complex in the city of Daejeon where KAIST is located. This configuration

⁵ In 2012, POSTECH was ranked 1st university under 50 years old in the Times Higher Education rankings and 28th among 500 world universities in 2001, being named one of 100 Innovators by Thomson Reuters in 2012. Industry income is a variable for examining innovation. It is critical that a university's ability to help industry with innovations, inventions and consultancy become a core mission of the contemporary global academy. This can be examined to capture such knowledge transfers by looking at how much research income institutions earn from industry. It suggests that "the extent to which businesses is willing to pay for research and a university's ability to attract funding in the competitive commercial marketplace are useful indicators of institutional quality" (Times Higher Education, 2013).

of KAIST, industry, and public research institutions has conducted a wide range of government-funded R&D projects (KAIST, 2013).

KAIST has gone through certain institutional changes in recent years. Although it has a leading role in scientific and technological development, KAIST recognizes the limitations of government-led collaboration and tries to nurture creativeness, innovation, and entrepreneurship for university management, going beyond government-funded research (Kim, Kwon, Kim, and Kim, 2010). Internal entrepreneurial efforts were made through research improvement activities (Kim et al., 2010). As a research university aiming to perform innovative research, KAIST shifted its research emphasis from “basic and less innovative and low-impact research” to “basic and/or innovative research and breakthrough technology” (Kim et al., 2010). KAIST sets its research agenda in the fields of energy, environment, and water. The core strategy of this agenda is to expand research from small individual projects to large systemic projects with multiple researchers. KAIST also focuses on the ownership of intellectual property rights of firms and universities (Jang, 2012).

In KAIST’s case there have been many factors influencing university entrepreneurship. Currently, KAIST’s research -based diffusion takes form through breakthroughs in the four fields in its research agenda and concurrent institutional changes that provide incentives to universities to patent inventions made possible through government or private funding (Rothaemel, 2007). Additionally, KAIST operates coordinated intermediaries as well as networks with SMEs and government-funded research institutions in the Daedeok Research Complex in Daejeon City.

3.5. Comparisons and implications

While having strikingly different histories and philosophies of institutional development, POSTECH and KAIST are both distinguished S&T research-oriented universities with strong science and engineering education and research. Their organizational structures create different paths of development, institutional management, and university-industry relations. POSTECH, a private university, maintains a close network with POSCO in collaborative R&D activities based mostly in Pohang. In contrast, KAIST was established under a special law and developed its technological and industrial competitiveness through government funding. KAIST is located in the Daedeok Research Complex in the city of Daejeon, and networks with government-funded research institutions such as the Electronics and Telecommunications Research Institute (ETRI) and a number of large firms and SMEs in its regional cluster. Beyond these differences, the two universities show similar patterns of entrepreneurial activities consisting of

leadership, organizational change, strategic management, and collaborative networking.

3.5.1. Entrepreneurial Leadership

A number of studies on university entrepreneurship focus on the individual characteristics of successful leaders (*Lee, Florida, & Acs, 2004*). Leadership in contemporary academia considers the demands of various stakeholders and in a changing process (*Randall & Coakley, 2006*). In a competitive economic environment, university leadership focuses on motivation, innovation culture, budget balancing, faculty support, and organizational effectiveness (*Randall & Coakley, 2006; Pounder, 2001*). Regarding leadership, POSTECH and KAIST have appointed globally renowned scholars who have already achieved successful commercialization of academic research in entrepreneurial universities in the US as their new presidents. The institutional leaders of both universities adopted strategic management for fundamental institutional changes by promoting internal innovation and external networks with a strong vision of academic entrepreneurship. Former KAIST president Nam Pyo Suh is from MIT and current KAIST president Sung-Mo Kang is from California State University. Current POSTECH president Yongmin Kim is from the University of Washington. As head of all departments, these three leaders practice entrepreneurial activities for university management. As entrepreneurs, they apply practical activities to encourage entrepreneurial culture by attracting diverse funding and building various collaborative networks.

3.5.2. Entrepreneurial Organization

As stated above, KAIST and POSTECH both selected their presidents from American research universities. The move implies that KAIST and POSTECH expect institutional innovation and structural change by experienced experts in order to push forward a new paradigm for university entrepreneurship: (i) the systemic approach of technology transfer and commercialization; (ii) the management of patent and intellectual property rights; and (iii) a new collaborative model in a university centered ecosystem. To develop a new model, we argue that the university needs to restructure institutional organization and facilitate a new initiative towards producing research effectiveness. In general, the organizational factors of an entrepreneurial university are the industrial liaison office, technology transfer office, incubators, and venture funds (*Rothaermel et al., 2007*). Based on these elements, we attempt to analyze the organizational similarity and differences between POSTECH and KAIST.

First, the liaison office plays an important role for industrial collaboration

and technology transfer to firms. Both universities run liaison offices, but differ in activities and scope. At POSTECH, the liaison office, established in 2011, and the industrial liaison center works closely with all industry-academy foundation teams. The office also runs alumni programs for POSCO group companies and the Association of POSTECH-Grown Companies (APGC). In contrast, KAIST launched its liaison program with an industrial-academic team and the Industrial Liaison Program (ILP) for venture and small-medium companies mainly in regional clusters and local companies at its incubating center. In short, POSTECH focuses on its synergy network with the POSCO group for R&D activities and alumni-run companies in the Pohang region, while KAIST promotes cluster synergy in the Daejeon region.

Secondly, technology-licensing offices (TLO) play key roles in commercialization such as managing intellectual property rights and patents. At the TLO, experts manage all commercialization and technology transfer processes: assessment, protection, marketing, and licensing. During 2007-2012, POSTECH earned an average of 1 billion KRW through technology transfer fees and has concluded 370 cases of technology transfer since 1987 (POSTECH, 2009). The TLO at KAIST also shows high performance, earning 3.8 billion KRW for transfer fees with forty-eight cases of technology transfer, raking in the top among Korean universities in 2011 (Jang, 2012).

Thirdly, incubators are an important factor for entrepreneurial universities. At POSTECH, a business incubation center and the POSTECH Holdings Company support technological and managerial issues for startups and venture companies. There are twenty-two companies registered and twelve enterprises residing in the incubation center (MEST, 2012). The POSTECH Holdings Company was established in 2012 in order to invigorate related entrepreneurial activities. It is notable that POSTECH recently restructured its incubating center and established its holdings company in order to encourage their entrepreneurial functions while building a streamlined process of “education-startups-incubating-commercialization” within the university. KAIST manages an incubation center and KAIST-affiliated companies because the Institute of S&T

Act prohibits the establishment of a technology-holding company within the institute. Currently, ninety-seven companies reside in the biggest incubating center at KAIST that has in turn produced nine KOSDAQ firms and thirty-eight professor startups (KAIST, 2013), therefore featuring higher performance and more advanced development than POSTECH’s.

Lastly, systemic funding is also crucial for entrepreneurial universities.

POSTECH's Venture Steering Committee makes strategic alliances with the POSTECH Venture Capital Company to foster startups and spin-offs. KAIST does not manage independent funds but establishes partnerships with major banks.

We have done a brief comparative analysis of organizational factors that characterizes Korean entrepreneurial universities. POSTECH has a relatively strong liaison office, holdings company, and TLO that reflect the culture of its large firm-university cooperation. In contrast, the TLO and incubating center of KAIST reflect the institution's partnership with SMEs and venture companies in regional clusters and a government-sponsored culture. These two Korean S&T research universities have dramatically increased entrepreneurial activities with competitive advantages and intermediary organizational restructuring in order to improve performance and productivity within universities (Rothaermel et al., 2007).

3.5.3. Entrepreneurial Activities: Network and Collaboration

Rothaermel et al. (2007) argue that "the research stream on environmental context including networks of innovation emphasizes that university entrepreneurship is a result of being embedded in networks of innovation, which in turn are influenced by the larger environment (p.765)." This section examines how the current status of POSTECH and KAIST is connected to an innovative net-work with external actors.

POSTECH has developed strong networks with POSCO's companies in Pohang and overcame geographic limitations by providing significant incentives for faculty and students. In Pohang, the iron and steel industry dominates regional culture and industry creating disadvantages for hightech and IT business creation, leaving a limited role and function for incubators. POSTECH continues to expand its partnership with POSCO into its other companies in Pohang and other regions. Further, POSTECH organizes the Association of POSTECH-Grown Companies (APGC) consisting of forty-seven alumni companies, venture capitalists, and patent attorneys in order to build bridges between POSTECH and POSCO, the manufacturing and high-tech industries, and students and graduates to invigorate startups with mentoring within a university. As a result, POSTECH utilizes its strong partnership with other big firms to create various linkages and strategically launch alumni-led companies to overcome regional disadvantages and nurture entrepreneurial culture in the new eco-system of entrepreneurial universities.

In KAIST's case, there exists a strong linkage with the central government and stable support from government-funded research institutions such as

the Electronics and Telecommunications Research Institute (ETRI) and SMEs at the Daedeok Research Complex in Daejeon City. KAIST has not only strong networks with star venture companies that have grown out of its incubating center and related science parks, but also has a geographically competitive advantage in attracting human talent to their centers of innovation. As an entrepreneurial university, the challenge for KAIST is to develop flexible responsiveness to increasing demand, implement strategic management, and establish new partnerships.

POSTECH and KAIST are science and engineering resource-base universities with visions of becoming world-class educational institutions. There has been increasing pressure on universities to become more entrepreneurial and foster technological advancement. This pressure comes from a concerted desire for universities to contribute more to the economic competitiveness of their regional communities. These two universities have looked towards entrepreneurial activities in response to such changing demands.

4. Conclusion

This paper explored how entrepreneurship and entrepreneurial activities emerged and developed at two of Korea's leading research universities specializing in S&T. Research findings reveal increasing university entrepreneurship, with POSTECH and KAIST developing the relevant roles and functions associated with the concept. We examined these findings focusing on the internal organizational shifts towards external networks and collaboration. We recognize that entrepreneurship is an important field of study in public and university administration. Our observations may be limited, and we suggest future research should focus on the institutional environment and the business impact of university entrepreneurship.

The traditional roles of universities (namely research and education) are still important. However, it is noteworthy that many aspects of university entrepreneurship seem daunting in the current academic environment. Networking and collaborating among both traditional actors and new actors are crucial in the entrepreneurial university paradigm. It is not easy to implement a new model in place of an existing organization, to structure a new organization and to bring new talents to an institution. Friedman and Silberman (2003) addresses these concerns with how to become more entrepreneurial, suggesting they need to be determined in the absence of conflict between traditional and entrepreneurial roles and with a diverse set of strategies offering incentives for faculty or other actors' involvement in entrepreneurial activities. Looy, Ranga, Callaert, and Debackere (2004) attempt to reconcile opposing views by observing that the mission of

universities requires a balance of traditional and entrepreneurial roles.

With our presentation of the current status of university entrepreneurship in two of Korea's leading research universities, we encourage scholars, educators, and policymakers to consider this new phenomenon and enrich their understanding of this new paradigm for sustainable university development./.

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