

A Comparison of Entrepreneurism and Internationalization between Asian World-Class Universities

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Abstract This paper surveys the development of Asian universities and their path towards the American entrepreneurial type. The paper suggests Asian universities used internationalization and entrepreneurial missions to follow older American entrepreneurial universities with success towards world-class university status. Current studies are lacking on covering the significance of internationalization at Asian entrepreneurial universities and offer few typologies on the diverse Asian transformations of the past approximate thirty years. Thus, paper proposes a theoretical framework linking internationalization with innovation and classifies into 3 types, the various Asian entrepreneurial university transformations from an international comparative perspective. It then examines the type using case studies.

Keywords Korean universities, Asian universities, entrepreneurial university, world-class university, internationalization, open innovation

I. Introduction

Arguably the Baye-Dole Act in 1980 stimulated entrepreneurship, providing universities a legal framework to take ownership of federally supported research. In Asia, policies such as Brain Korea 21(BK21) in Korea, 985 and 211 Project in China, and the TOP30 in Japan, all fund select universities in the hopes of creating a world-class university (WCU). This is further spurred by the fact some Asian countries link national competitiveness to WCUs.

But the typologies on the various pathways of Asian WCUs lack lucidity. Thus, this paper selects 10 WCUs composed of one science focused and one flagship university from representative Asian countries, hoping to clarify the different

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paths taken towards the WCU.

To keep progress, policymakers and administrators use rankings compelling change towards the entrepreneurial university model. Entrepreneurialism leads WCUs to join industry to produce knowledge for the world's vexing problems, such as climate change and energy. This paper defines entrepreneurialism as research universities creating spin-off companies, licensing patents, establishing technology transfer offices, seeking of differentiated funding, and linking with industry to commercialize technologies, (Nelson, 2001; Thursby, 2004; Perkmann and Walsh, 2007). Moreover, entrepreneurial universities view innovation as a core mission and have departments and faculty who work as quasi-firms on economic and social development, besides teaching and research (Etzkowitz, 2003).

These entrepreneurial universities play a special role in an economy and National System of Innovation (NSI). The very best entrepreneurial universities in Asia can interchangeably be called Asian WCUs. Our study suggests Asian WCUs are catching up with American WCUs using internationalization for innovation to transform. This article express internationalization as English environment, top international faculty and alumni sometimes signified by Nobel winners, research strength measured by publications and citations in SCI and SSCI journals, and a record of those who return home from internationalized environments bringing new experiences and networks.

To examine our position, this paper builds a conceptual framework from an innovation perspective linking internationalization to innovation and offers a typology for Asian entrepreneurial universities based on historical development and level of internationalization. Then, case analysis assesses each type. The WCUs link to a NSI will be saved for later discussion.

II. Conceptual Framework

1. Universities in National Systems of Innovation

Innovation studies began from the study of the entrepreneur, firm, and to the system. Within the innovation literature, Freeman (1987), Nelson (1993), and Lundvall (2002) are credited with the term "national system of innovation" characterizing the systemic interdependencies within a given country. From this perspective, a system of innovation means the entire economic, social, political, organizational, and other factors that influence the development, diffusion, and use of innovations (Fagerberg, 2005).

Universities are widely credited as key actors in a national system of

innovation ever since Vannevar Bush (1945) called for expansion of government support for science. Since Bush, government and industry support began to increase. Now, universities and industry link around the world with many governments building science parks near universities attempting to replicate the “Silicon Valley type” (Mowery and Sampat, 2005).

Some frameworks on universities in national innovation systems are Mode 1, Mode 2, and the Triple Helix paradigm (Etzkowitz and Leydesdorff, 2000; Gibbons, 2000; Ready, 2011). The attributes of Mode 1 knowledge production are its academic context, disciplinary, homogeneity, and basic science orientation and the Mode 2 being a paradigm that is application based, interdisciplinary, and with knowledge production happening in various organizations like research institutes, government agencies, and spin-off companies. The Triple-Helix framework emphasizes university and industry and government coevolution with universities making it a central mission to contribute to economic growth, besides traditional functions like teaching and research. All of these perspectives place academia and the entrepreneurial university as a key actor within a NSI.

2. University Change towards Entrepreneurism

The university in terms of culture, management, and activities can be classified into frameworks on academic capitalism and university entrepreneurship (Slaughter and Leslie, 1997; Clark, 1998; Etzkowitz and Leydesdorff, 2000; Sporn, 2001; Yokoyama, 2006; Guerrero and Urbano, 2010). Yokoyama categorized 5 types of entrepreneurial universities and their organizational change in UK and Japan and Guerrero and Urbano ordered university entrepreneurialism into three stages in Spain based on data analysis: missions, governance, and organizational structures; support measures, entrepreneurial education, and attitude to entrepreneurialism; incentives for environmental factors, human resources, and alliance; as well as entrepreneurial activities as resources and capabilities in entrepreneurialism.

3. World-Class University

This study notes the Emerging Global Type (EGM), and some of its factors: (1) university missions as being global, (2) universities going beyond government support and tuition to get funding from industry and entrepreneurial activity, (3) links between university, industry, and government, (4) and worldwide recruitment of talent. However, the authors suggest only a few dozen fully developed EGM universities exist, and this paper excludes most if not all Asian universities from that type (Mohrman, 2008). Therefore,

this paper attempts to define the Asian WCU using rankings, such as the Academic Ranking of World Universities by the Shanghai Jiao Tong, THE World University Rankings by Thomson Reuters, and the QS World University Rankings (Liu, 2007; Mohrman, 2008; Salami, 2009; Altbach, 2011; Yang and Welch, 2011; Ramakrishna, 2012). Although criticized, rankings are widely accepted by research universities and this paper supposes Asian entrepreneurial universities ranked in the top 200 in at least two out of the three tables are WCUs from Asia. Feasibly, some universities are WCUs without being entrepreneurial universities even though a strong entrepreneurial trend surfaces around the world.

4. EU, WCU, and NSI Relationship

WCUs attract industry, receive the top talent, and receive the lion's share of government and industry funding. With immense resources, they drive knowledge production. The WCU framework can be linked with the micro perspective of universities under academic capitalism and university entrepreneurialism and the macro perspective of universities in NSIs on a two-fold understanding: Universities are hubs of knowledge production and best knowledge means the best national competitiveness (Seol, 2012).

5. Open Internationalization

Open Innovation is a paradigm assuming firms need a strategy based on openness, allowing for new ideas to come in and out for the best knowledge can be used anywhere. In a global landscape, firms should use other's licenses or patents and unused inventions should be licensed, spin-off, or joint ventured (Chesbrough, 2003). For WCUs with small-underfunded technology transfer offices and professors and departments that act as quasi-firms, they must be resourceful using open innovation to access global resources, collaborate internationally, and commercialize research (Chesbrough, 2007; Perkmann and Markus, 2007; Kafouros, 2008).

In Asia, for now, English is the lingua franca for research. Hence, innovation and internationalization or open internationalization is a requisite for Asian WCUs due to the global nature of knowledge and innovation. Open internationalization for universities means looking everywhere in manpower and technology and knowledge for the best resources. International collaboration is not novel in higher education or policy, but this type acknowledges internationalization as a key factor for Asian universities to transform into WCUs. Figure 1 lays out the various university formations and the role of internationalization within a NSI. This article attempts to identify

the relationship between innovation, internationalization, and the various types of paths taken by Asian universities during their evolution.

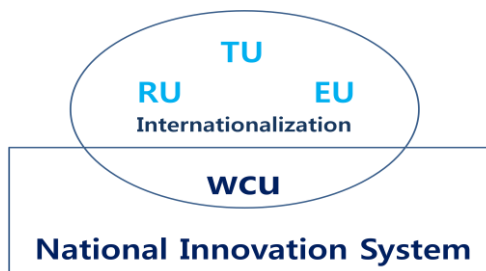


Figure 1 Possible combinations to WCU

Notes: TU=Teaching University, RU=Research University,
EU=Entrepreneurial University, WCU=World-class University

6. Level of Internationalization

This article measures internationalization in two ways: by level and type. Internationalization is only compared for entrepreneurial universities ranked on all major world rankings fitting our discussion on the WCU and Entrepreneurial university nexus. The first level is fully internationalized: courses in English, WCU recognition, long history of internationalization from immigration and geopolitical events, and self-propelling to attract the best students and researchers worldwide; second level is highly internationalized: able to attract talent worldwide, history of colonialism and internationalization, most courses in English, and common presence in worldwide rankings; third level is a changing internationalized institution: attracting some professors and students from abroad, some courses in English, history of returning researchers from abroad, and common presence in worldwide rankings. The ability of Asian universities to attract foreign students and professors indicates status as a center of knowledge production; faculty with international backgrounds reveals collaborative worldwide potential; classes conducted in English shows institutional internationalization; and university rankings suggest WCU status and research influence.

Table 1 Levels of internationalization

Internationalized	WCU	Attributes
Fully	Harvard MIT Caltech	<ul style="list-style-type: none"> - English as medium of instruction - WCU recognition - Long history of attracting world class talent - Beneficiary of immigration and world events
Highly	UHK HKUST NUS	<ul style="list-style-type: none"> - English is mostly used - Able to attract best talent in professors and students - History of colonialism and internationalization - Common appearance in worldwide ranking
Changing	SNU POTTECH Peking U Tsinghua U	<ul style="list-style-type: none"> - Some courses in English - Able to attract some international professors and students - History of foreign educated natives returning back to home - Common appearance in worldwide rankings

Notes: U of Hong Kong (UHK), Hong Kong U of Science and Technology (HKUST), National U of Singapore (NUS), Seoul National U(SNU)

7. Types of Internationalization

Asian universities undertook diverse stages from teaching to teaching and research to becoming entrepreneurial. This paper classifies the transformations of USA and Asian WCUs into three types based on general patterns. Type 1 is based on the fully internationalized type of this study, otherwise known as the American entrepreneurial type. This type is characterized by world-class talent, links with industry and government from the early 20th century due to a robust economy and events such as World Wars, and vibrant immigration before entrepreneurship. It is worthy to note the Cold War, like previous wars strengthened this government-industry-university nexus and spurred further entrepreneurship (Lowen, 1997).

American WCUs follow a pattern of research orientation in the 1880s, heavy internationalization in the 1920s-1940s, with roots of university entrepreneurialism beginning shortly after the Second World War with Stanford and MIT and Silicon Valley even though studies on the entrepreneurial university arose in the 1980s. Amid a long background in internationalization and entrepreneurship, American WCUs and even WCUs with strong academic traditions like Harvard typify Type 1, acting as models for entrepreneurial universities in Asia.

Asian flagships that receive the most support and have a long history depict type 2. They adopted research-orientations first, then entrepreneurialism, and later internationalization to become WCUs. University of Hong Kong (UHK), National University of Singapore (NUS), Seoul National University (SNU),

Peking University (PU), and Tsinghua are categorized as Type 2 at different stages of internationalization. Singapore and Hong Kong underwent a colonial period, perhaps allowing for rapid internationalization but attracting world-class talent came after economic development with entrepreneurial missions beginning in the late 1990s and 2000s, after Hong Kong's independence from the United Kingdom and with Singapore's strategy of internationalizing through key partnerships. Korean Universities dovetails Hong Kong and Singapore, first becoming research universities in the late 1980s, entrepreneurial in the late 1990s, and undergoing internationalization supported by policy in the last decade. Chinese universities began research orientations after economic reforms, entrepreneurship in the late 1990s, and internationalizing since. Patterns that emerge are: Type 2 universities had to catch up to American entrepreneurial universities in terms of even adding a research mission and as their economies shifted from manufacturing to knowledge, universities moved towards entrepreneurialism. Type 2 universities rose swiftly but the rises were not as dramatic as Type 3 universities.

Type 3 WCUs feature internationalization from inception. They were newly created, had clear entrepreneurial missions, and used internationalization to rapidly become WCUs. American WCUs have been around for over a century, but Type 3 universities catapulted from nowhere in the past couple of decades to become WCUs. A prime case is the Hong Kong University of Science and Technology (HKUST) created in 1991, which used entrepreneurship and internationalization to become one of Asia's best. Also, POSTECH created in 1986, from outset used internationalization to become one of Korea's top research universities. Nanyang Technological University (NTU) is somewhat difficult to classify, but can be categorized as Type 3 if viewed from 1991 since internationalization happened in proximity with research and entrepreneurial missions or Type 2 if viewed from historical roots. Type 3 indicates internationalization is forceful in transforming the university into a WCU.

III. Methods

Our study used documentation and case analysis. Universities chosen are some of the most highly ranked in country and all have entrepreneurial missions and links to industry in line with our criteria for discussing the entrepreneurial WCU. In the US, Harvard was examined because of its strong academic tradition with entrepreneurialism but more importantly, it acts as a model for flagships in Asia, as they benchmark against prodigious WCUs. Further, Caltech was studied because it directly modeled POSTECH, which may have influenced HKUST before its creation. These American WCUs

confirmed our Type 1 generalization but many other American WCUs/entrepreneurial universities follow similar patterns.

UHK and HKUST from Hong Kong, NUS and NTU from Singapore, SNU and POSTECH from Korea, and China's Peking University and Tsinghua were all selected because they are representative flagships or science-oriented entrepreneurial universities in their home country, elucidating the rise of the American WCU model. Taiwan universities share similar characteristics but were omitted due to space. Japan's universities put less emphasis on internationalization and have received strong support since the late 19th century so they were excluded. Finally, extensive studies on Asian WCUs existed and this study added new perspectives and further documentary analysis based on scrutiny of papers, official university documents, nongovernmental data, and government statistics.

Table 2 Rankings of universities in this study (2010/2011)

Research Univ.	Country	THE	ARWU	QS
Harvard	USA	1	1	2
Caltech		2	6	9
UHK	Hong Kong	21	201-303	23
HKUST		41	201-300	40
NUS	Singapore	34	101-150	31
NTU		174	301-400	74
SNU	Korea	109	101-150	47
POSTECH		28	301-400	112
Peking	China	37	151-200	46
Tsinghua		58	151-200	47
Tokyo	Japan	26	20	25
Kyoto		57	24	32
Osaka		130	75	45
National Taiwan U	Taiwan	115	101-150	87

Notes: Times Higher Education (THE), Academic Ranking of World Universities (ARWU), Quacquarelli Symonds (QS)

IV. Case Studies

1. Fully Internationalized University: American WCUs

The first academic revolution began in the United States, adding the German research type to the teaching-oriented university. The second academic revolution with entrepreneurialism may have begun with John Hopkins University founded in 1876 or with MIT around 1862 with its focus on applied science leading to links with industry, followed by Cornell in 1865 started by entrepreneur, Ezra Cornell, founder of Western Union and an academic, Andrew D. White, following the Morrill Act in 1862, which allowed for creation of land-grant colleges. Later, University of Chicago was established with the help of John D. Rockefeller and Leland Stanford, a railroad tycoon, started Stanford leading to links with industry and the startup of Silicon Valley (Thorp and Goldstein, 2010).

History shows as most Asian countries and respectively universities were hardly developed, the US attracted European immigrants and world-class researchers through the 1950s. Many escaped fascism and the Second World War and came to research at America's universities such as Harvard, Princeton, MIT, and Caltech. Additionally the Immigration and Nationality Act of Amendments of 1965 eliminated racial discrimination in immigrant quotas increasing immigration from Asia. With the world coming to the US, its institutions attained funds for basic and applied research for industry and military amounting close to 1 billion US dollars by 1960, 79 percent of which went to just twenty universities, including Stanford, Caltech, MIT, and Harvard (Lowen, 1997).

Internationalization and attracting world-class talent continues today, self-sustained. The historical lead is evident as rankings show two-thirds to three quarters of the best universities are in the United States with innovation systems in Silicon Valley, Route 128 in Boston, Research Triangle Park in North Carolina, all centered around WCUs. Researchers there work closely with venture capitalists and entrepreneurs as a direct consequence of working on the world's paramount challenges, acting as types for WCUs worldwide (Thorp and Goldstein, 2010).

2. Highly Internationalized: Hong Kong and Singapore

Hong Kong is renowned for its international vibrancy. Its WCUs are classified as highly internationalized. This internationalization supports Hong Kong having similar amounts of high-level research universities as China, despite only 7 million people as compared to 1.3 billion. Hong Kong

Universities rank high in part because of the usage of English that puts it in the mainstream of global science and scholarship (Altbach and Postiglione, 2012).

University of Hong Kong (UHK) is the largest university in Hong Kong, established in 1911. UHK always delivered instructions in English so its internationalization roots can be said to have started before having an entrepreneurial mission, but internationalization towards the WCU transpired within the last fifteen years. Currently, UHK has a few Nobel Laureates serving as professors, to include Charles Kao (2009, Physics) indicating its potential to attract world-class talent and as of 2010/2011 boasts 56% foreign professors, with 29.4% from the Chinese mainland, 25% from North America, and 23.4% coming from Europe. Also, 41.6% and 36.1% of undergraduate and graduate students are international, mostly from the Chinese mainland.

UHK opened up its technology transfer office in 2006 but its commercial arm, Versitech Limited was established in 1994 to create opportunities to turn innovations into start-ups, collaboration, or licensing deals so its entrepreneurial mission took place before the 1997 handover to China. UHK followed a traditional path from research to entrepreneurship and then a fresh internationalization stage free from colonial roots with the return of top Chinese researchers but could be viewed loosely similar to the American Type 1 of research mission to internationalization to entrepreneurial missions. Only loosely similar to Type 1 because of the effects of Japanese and British occupation and its lack of power in drawing world class researchers until later economic development, more similar with other Asian Tigers than the USA.

Hong Kong University of Science and Technology (HKUST) exemplify Type 3 transformation. In less than 20 years, it became one of Asia's top 10 research universities. 80% of professors at HKUST received doctorates from North America showing international vitality and instruction is in English. HKUST is unique because of its American influence instead of British. For instance, HKUST's founding President Woo Chia-Wei was the first ethnic Chinese to head a major university (San Francisco State University). The second President, Paul Ching-Wu also from the United States was the University of Houston Temple Chair of Science who was awarded the 1988 National Medal of Science, and current president Tony Chan worked at UCLA and was the assistant director of the U.S. National Science Foundation (Postiglione, 2011).

HKUST since inception was an internationalized research university with an entrepreneurial mission. In 1992, one year after the university's founding, R&D Corporation (RDC) was created along with a technology transfer office and entrepreneurship center to use HKUST's applied research and patents in creating spin offs, licensing, and joint ventures with mostly Chinese firms. A central factor in HKUST internationalization is the overseas Chinese who returned to play a part in China's development for emotional and social reasons.

HKUST used internationalization and modeled American WCUs to rapidly develop.

Singapore also has a colonial past, possibly enabling it to internationalize quickly and gain economic prominence shortly after independence from the UK and separation from Malaysia in 1965. Out of Singapore's four public universities, National University of Singapore (NUS) and Nanyang Technological University (NTU) are among the world's elite and Lee Kuan Yew, the first Prime Minister of Singapore governed for three decades, making English a common language to connect all ethnicities and tie Singapore to the world economy (Mukherjee and Wong, 2011); (Ramakrishna, 2012).

National University of Singapore (NUS) has roots from 1905. It once merged with University of Malaysia and separated to become University of Singapore in 1962. Finally, it joined with Nanyang University in 1980 to be its present form. Since 1962, NUS had a research mission and started its entrepreneurship in the late 1980s, setting up the Centre for Management of Innovation and Technopreneurship in 1988, which was renamed the NUS Entrepreneurship Centre in 2001, which is under the commercial arm of NUS Enterprise creating 70 spin-offs since 2002. Furthermore, NUS has three Research Centres of Excellence (RCE) and 21 university-level research institutes which affiliates with National Research Centres showing its embeddedness in the NSI.

NUS's internationalization towards the WCU could be said to have started in the late 1990s, a decade after its entrepreneurial mission. Singapore internationalized through convincing memorandums of understandings. These partnerships transferred western types along with foreign students. Singaporean universities got brand name recognition, and American universities were in better position for establishing university-industry linkages in Singapore and in the broader region. The partnerships in Singapore began with Johns Hopkins in 1998, continuing with links in medicine, engineering, logistics, and science with universities such as MIT, GIT, University of Pennsylvania, University of Chicago, Stanford, Cornell and Duke. These partnerships were all significant and heavily financed by the Singaporean government (Olds, 2007). NUS's development can be seen as Type 2: first research oriented, then entrepreneurial, then strong internationalization to take Singapore's institutions to WCU status.

Nanyang Technological University (NTU) also has roots from Nanyang University. After Nanyang University merged with University of Singapore creating NUS, Nanyang Technological Institute was established in 1981, starting English instructions. Finally, Nanyang Technological Institute merged with the National Institute of Education becoming NTU in 1991. The Nanyang Innovation & Enterprise Office was set up in 2000 with seed funding from the Economic Development Board focusing on entrepreneurship activities such as

licensing, spin-offs, patent management, and research agreements. Like NUS, NTU has significant partners in MIT, Stanford, Caltech, and Cornell among others and manages significant research institutes. NTU's development viewed from its final form in 1991 can be conceptualized as Type 3 like HKUST and POSTECH because research, entrepreneurialism, and internationalization happened in close proximity or Type 2 if NTU's historical roots are taken into account.

Hong Kong and Singapore WCUs are highly international but Type 2 rather than Type 1. Colonialism may have assisted later internationalization but is different from the forces that shaped American universities as they are more Asian-centric with a shorter history of internationalization and attracting the top global talent came later, rather than the historical development and worldwide allure of American WCUs.

3. Changing Internationalized University: Korea and China

Korea was one of the poorest countries in the world in 1953 and joined the OECD in 1996. After the Second World War, there were 11 doctorates in the whole country and in the early 1970s only a few dozen SCI papers existed with a climb to 300 papers in 1981 (Seol, 2012). Even with progress, Korea has not produced any Nobel winners, a fact that Korean scholars and policymakers target, observing it a sign of prestige. Historically, Korean universities played an important role in developing high-quality graduates but technology transfers to industry have been weak compared to other developed nations due to R&D led by Chaebols or corporations. Universities did not have an entrepreneurial mission until the late 1990s when encouraged by policy and previous attempts at industry clutters were weak. A reason why a national system of innovation never developed may be attributed to weak links between firms and universities and because Korean firms were an importer of technologies until the mid-1980s (Sohn and Kenney, 2007). Amid the WCU discussion and Korea's current knowledge economy, policymakers thrust for university internationalization. For example, Korea Advanced Institute of Science and Technology (KAIST) and Pohang University of Science and Technology (POSTECH) teach all graduate courses in English and there is consistent recruitment of foreign researchers and faculty.

Table 3 Foreign professors at Korean universities

Year	Full-time faculty		Full-time foreign faculty		Full-time foreign faculty rate(%)	
	Total(T)	Female(F)	T	F	T	F
1990	25,337	2,984	379	100	1.5	3.4
1995	33,938	4,195	435	114	1.3	2.7
1996	35,933	4,514	645	177	1.8	3.9
1997	38,801	5,006	893	257	2.3	5.1
1998	40,345	5,291	1,022	280	2.5	5.3
1999	41,226	4,197	988	273	2.4	5.0
2000	41,943	5,758	985	288	2.4	5.0
2001	43,309	6,111	1,073	304	2.5	5.0
2002	44,177	6,420	1,028	307	2.3	4.8
2003	45,272	6,731	1,043	290	2.3	4.3
2004	47,005	7,227	1,287	333	2.7	4.6
2005	49,200	7,973	1,597	454	3.3	5.7
2006	51,859	8,708	1,931	567	3.7	6.5
2007	52,769	9,092	2,212	653	4.2	7.2

Source: Korean Ministry of Science Education and Technology

Also, Korea has a tradition of returnees with American PhDs at major universities. It is estimated 40% of all university faculty received PhDs abroad, especially the United States: Majority of KAIST faculty received doctorates in the USA and in the case of POSTECH, 93.3% of faculty held USA doctorates (Kim 2005). Like China, many citizens educated abroad return for emotional and social motives. As for students, Korea attracts more foreign students than before, albeit at 1.4% of OECD students, which is less than Japan 3.6%, China 1.7%, and the United States 18% (OECD, 2011). Relatively, while foreign student recruitment is low, Korea sends the most students abroad out of all OECD countries except Germany and France in the Eurozone representing 4.8% of all who go abroad.

In the mid-1990s, no Korean university was even in the top 800 but by 2003, 8 research universities selected by BK21, a program encouraging internationalization, made the top 500 in the research oriented Shanghai Rankings (Jung, 2009). Any discussion must start with Seoul National University (SNU) as most consider it Korea's top institution. SNU created a research institute in 1987 and it was the first time a Korean university encouraged research, research management, and evaluation. Along with POSTECH, this marked the birth of Korea's research university.

SNU's clear mission to become a WCU was announced: first stage (2007-2010) to enhancing educational systems to place 10 of its field in the world's top 10; second stage (2010-2015) to secure the highest world-class level of research by focusing on interdisciplinary research, and lastly to lead the university to become a world-class research university by 2025. As for faculty, in 2006, SNU employed 1,924 faculty members, with 47 foreign professors and as of April 2011, there are 2,911 full time faculty members with 242 foreign professors (4%).

And in 2008, the university pledged to lecture 15% of its classes in English and the graduate school of International Studies conducts all courses in English. As of 2011, SNU had a total of 2,486 international students with 844 in undergrad, 999 in masters, and 643 in doctoral programs out of 28,010 students (Seoul National University, 2012). SNU's strength is in faculty publications. 4,427 articles were published in the Science Citation Index in 2008 (20th in the world) and 3,946 in 2005 (30th). On attracting the best talent outside of Korea, it is costly, one example being the recruitment of Nobel economist Thomas Sargent to a two year contract worth roughly over 1.2 million USD per year (Nobel laureate to teach at SNU, *The Korea Times*, 2012).

SNU is a large research institution, similar to stature in Korea as Harvard in the United States. But a couple of decades ago, it was unnoticed in worldwide rankings. Even now, only a small percentage of classes are in English and world-class talent outside Korea arrives occasionally, unlike self-sustaining American WCUs. Meanwhile, publication is impressive but heavily incentivized. Its type of internationalization is characteristic of Korean universities in that research missions were first added, then entrepreneurial, with internationalization incrementally increasing later.

Pohang University of Science and Technology admits 300 of Korea's best students per year and has 3,100 students total with 1,700 being graduate students. Established in 1986 by POSCO, one of the largest steel companies in the world, CEO Tae Joon Park envisioned a research-oriented university believing the need for homegrown talent to help the company into the 1990s. The CEO visited Pasadena in the early days and POSTECH modeled Caltech from inception. The result was a university in Korea, different from all other universities of the 1980s (Rhee, 2011). At the beginning, similar to HKUST, POSTECH relied on esteemed overseas Korean scientists to fill 60 to 70 percent of faculty positions who were dedicated to national development. Still now, most professors at POSTECH earned degrees from the United States and graduate courses have been in 100% English since 2010 with 40% of all other lectures being in English.

Even though countless courses are in English, no foreign students attend at the undergraduate level, and only 4% were graduate international students in 2009. As for faculty, foreign professors only make up about 10% (Pohang,

2012). This shortage of international vibrancy may be location, since Pohang only has a population of around 520,000 and is away from the capital of Seoul (Rhee, 2011). Through policy support to internationalize since the latter 1990s starting with BK21, Korean universities are entering new stages. University internationalization at POSTECH is Type 3, with research, entrepreneurialism, and internationalization starting together but with slower progress than Hong Kong or Singaporean universities in terms of internationalization, especially on attracting foreign talent. Nonetheless, in a short period, POSTECH scaled worldwide rankings to become one of the most prestigious universities in Asia. Its dynamic rise is impressive considering the age of the institution and epitomizes Type 3 development.

China's economy grew later than Japan and the Asian Tigers but is now the largest in Asia. With rapid economic rise, universities in China have also ascended. Without a historically innovative private sector, China's determination to develop its national innovative capacity resulted in heavy funding for its top universities. Universities were and remain an important source of technology transfer. In fact, 42,945 firms were spun off from universities during 1997 to 2004 and the university and industry collaboration grew much faster in China than other Asian countries on their rise (Hu and Matthews, 2008; Yang and Welch, 2011). In 1996, China made a "Law on Promoting Technology Transfer" rewarding great contributions and in 1998, then President Jian Zemin at Peking University's one-hundredth year anniversary spoke of the need to create WCUs leading to the 985 Project. The 985 Project funded universities using national and local funds to create WCUs and Peking University and Tsinghua University were the largest benefactors. Also, 6% of China's universities were earmarked for the 211 plans to transform Chinese universities well into the 21st century. The time period around the 985 and 211 can be viewed as the beginning of entrepreneurial roots and internationalization to grow from basic research institutions into future WCUs. Peking University was founded in 1890 as the Imperial University of Peking and is China's national flagship university. It became Peking University in 1912 and is a focal point of the Government's agenda to building WCUs for the 21st century and from 2001 to 2005, its researchers published near 8,000 SCI papers. Approximately 15,000 undergraduate and 15,000 graduate students attend and there is a medical school, law school, and a comprehensive graduate school in Shenzhen with over two thousand students, including 206 doctorate students and 43 full-time international students from 20 countries as of 2011 (Peking University, 2013). Peking University's rise to a WCU is in part due to its internationalization efforts. From 1998, Peking University focused on recruitment worldwide and overseas Chinese account for nearly 40% of Peking University's 3000 staff (Ngok and Guo, 2008). Peking University attracts world-class talent by offering high salary, jobs for spouses, international

schools for children, full-tenure, modern labs and research teams, and other heavy incentives. Even with some foreign talent, Peking University is a Chinese institution only conducting some English immersion programs for international students. Peking University's roots as a research university transforming into an entrepreneurial one internationalizing later follow Type 2. Tsinghua University was established in 1911 and is known as the MIT of China. Nobel laureates in Physics like Yang Chen-ning and Lee Tsung-dao are alumni and Tsinghua always places near the top of Asia rankings. Aside from 985 and 211 support, Tsinghua made its own goals to be a comprehensive research university during 1994-2002; to rank among world-class during 2003-2011; and to be an overall world-class university by 2012-2020 (Chen and Li, 2007; Yang and Welch, 2011). Tsinghua's strength lies in natural and technological sciences with postgraduates outnumbering undergraduates and with industry links, research projects, and emphasis on research like American WCUs. Tsinghua earns more SCI citations than any other Chinese University and along with Peking University are types of success for WCU development. In terms of internationalization, Peking University and Tsinghua are more like Korean universities rather than Singapore or Hong Kong but are able to attract world-class talent in research due to generous incentives. Both are world-class without an English-based curriculum, relying on the brainpower of their diaspora and strong support from national policy to be engines of innovation. Peking University and Tsinghua represent Type 2 but are characterized by exceptional technology transfer and spin-off companies and faster growth towards the WCU model than other Asian countries.

V. Discussions and Conclusion

1. Discussion

With internationalization favoring English-speaking countries, some questions surface. Mok (2006) warns against globalization being Americanization and encourages Asian universities to develop their own academic paradigms. Should Asian universities follow different paths rather than western-style internationalization? What drawbacks result from heavy English by Asian professors to mostly Asian students? If internationalization increases opportunities for open innovation, could domestic innovation and science suffer? Figure 5 illustrates the different paths characterized by American WCUs, Asian flagship universities, and dynamic Asian S&T universities towards the WCU model. Are there other paths to model, perhaps from Japan or Europe?

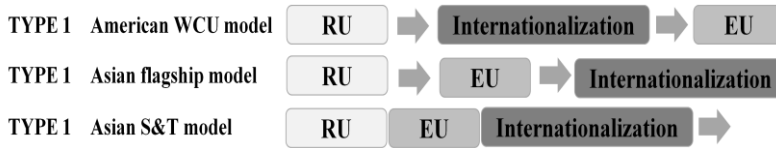


Figure 2 Different types of development

Table 4 Relationship between type, level and country

Univ.	Internationalization	Type	Strength of type	Country and culture
Harvard Caltech MIT Stanford	Full	(Type 1) RU→ internationalization →EU→WCU	-Long history of internationalization -Self sustained -WCU recognition -Strongly linked to NSI	USA / history of assimilation and immigration
NUS HKU SNU Peking Tsinghua	Highly / changing	(Type 2) RU→EU missions→ internationalization →WCU	-EU mission since '80s or '90s -Support for internationalization then fast catch-up -Flagship funding from nation	-Hong Kong -Singapore -Korea / knowledge economy -China: later development
HKUST POSTECH NTU	Highly / changing	(Type 3) RU→EU→ Internationalization from outset	-Rapid progress and right focus from outset -Science and technology orientation -Most dynamic type	-Hong Kong -Singapore / open to internationalization -Korea: slower development

2. Conclusion

This study compares Asian WCUs to the American WCU model and argues internationalization is an important factor for university transformation. The theoretical contribution is on classifying into 3 types based on entrepreneurship and internationalization, the different paths taken towards the WCU from an international comparative perspective. Asia in just decades, boasts many highly internationalized universities with Singapore especially generous in supporting partnerships, while Korean universities are undergoing internationalization supported by policy, and Hong Kong and Chinese

institutions using the power of its diaspora. Our hope is more will be discovered on the effects of internationalization on innovation at Asian universities and on the importance of the WCU to a NSI.

The limits for this theoretical study were the lack of equivalent data across different eras, countries, and universities. Moreover, some scholars expressed entrepreneurial missions as corporate takeover but this study's definition for the entrepreneurial university corresponds with our models and most world-class research universities around the world.

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