Centre of Excellence as a tool for capacity-building

Case study: Korea

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OECD
BETTER POLICIES FOR BETTER LIVES

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IHERD

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Executive summary

The OECD is currently undertaking a study on Centres of Excellence (CoE) under the Innovation, Higher Education and Research for Development (IHERD) project. CoE is a policy measure, applied by governments in many parts of the world in order to promote a robust research and innovation environment. This is achieved by encouraging institutional profiling and generating a critical mass of researchers. CoE initiatives are a flexible instrument and have been applied in several different ways and for different purposes, such as to promote basic research, innovation, social development and education. Because CoEs are often located in higher education institutions, these initiatives increasingly influence the management of institutions and academic careers.

The study will develop and propose an analytical framework to provide guidance for policy-makers and research managers considering adopting CoEs as a tool for promoting capacity building and research excellence in prioritised areas in the context of developing countries. The analytical framework will be developed and tested on a mix of countries to ensure that a wide range of knowledge and experiences emanating from different types of CoE schemes, is taken into consideration. For example, one set of case studies will look at Australia, Canada and Sweden, countries that have applied a wide range of CoE instruments over a long period of time. These studies will be able to provide insights into the contextual conditions, including policy and institutional requirements for setting up and managing CoEs in order that they best meet the intended policy objectives. A second set will look at emerging economies and developing countries which have recently adopted the instrument including South Africa and India. A further study will look at the African Union´s initiatives to build up CoEs in Africa, as outlined in Africa's Science and Technology Consolidated Plan of Action. The case studies and the feedback on the analytical framework will be fed into a synthesis report. This will present conclusions on requirements at the policy and institutional levels for making CoEs a viable instrument for supporting the development of local research capacities, and to produce excellent research in key areas in developing countries.

This case study highlights the differences between the more developed CoE systems and those being trialled in Korea. Korea has been developing its CoE programme since the 1990s, however it is evident that the system is not a CoE system according to the IHERD definition.

Two key programmes have been established in Korea to encourage skills and build research; the Brain Korea 21st Century programme and the World Class Universities programme.

The BK21 programme has been promoted as fostering a talented workforce for Korea's key growth engines and boosting research capabilities of universities which were relatively weak in terms of national innovative systems. The second phase of the programme has been implemented, its missions are (MOE, 2005):

1. Fostering word class research groups to nurture next-generation scientists and engineers;
2. Establishing infrastructure - both physical facilities and institutional arrangements, such as an improved faculty evaluation system and accountability for research funds to help research universities meet their own needs for high quality manpower as well as those of industry;
3. Promoting local universities that will lead to innovations in those areas.

Strong results have emerged from the BK21 programme. The number of graduates from participating universities has increased, with the success of job finding also increasing for these students. Research coming from these universities has also increased, as has the number of publications in high ranking journals and the productivity of researchers.

The second programme is the World Class Universities project. This is programme was designed to cultivate world class research-oriented universities which develop technology of future growth engines, study convergence of different disciplines, and help train talented manpower by hiring foreign scholars.

The purposes of the programme are:

1. To innovate the research environment of universities through securing foreign scholars with high research competence,
2. To promote research ability in key areas for future national growth, and
3. To educate the next generation of academic research. Funded areas include humanities & social science, natural science, engineering and biotechnology, which are high value added areas of future growth engines and convergence.

The project was categorised into three types: establishing departments with hired foreign scholars, hiring individual foreign scholars to existing departments, and attracting world renowned scholars. The programme has had a number of positive impacts. It has increased the internationalisation of the universities involved by attracting foreign students, researchers and increasing accessing to networks. It has also increased the ranking of a number of the universities involved.

Table of Contents

Acronyms and abbreviations

BK21	Brain Korea 21st Century
KETEP	Korea Institute of Energy Technology Evaluation and Planning
KEIT	Korea Evaluation Institute of Industrial Technology
KIAT	Korea Institute for the Advancement of Technology
KOFAC	Korea Foundation for Advancement of Science and Creativity
MEST	Ministry of Education, Science and Technology
MKE	Ministry of Knowledge Economy
MOTIE	Ministry of Trade, Industry and Energy
MSIP	Ministry of Science, ICT and Future Planning
NIPA	National IT Industry Promotion Agency
NRF	National Research Foundation
RRC	Regional Research Centre
S/ERC	Science/ Engineering Research Centres

1. Policy Context

Korea's R&D structure

The *Lee Myung-bak* administration came into power in 2007. Since then extensive government reorganisation has been carried out, leading to the integration of the Ministry of Education with the Ministry of Science and Technology to create MEST, and the Ministry of Commerce, Industry & Energy was combined with the Ministry of Information & Communication to become MKE. Due to such re-arrangements roles have been split between basic research and university support by MEST and applied research & industry support by MKE. When President *Park Geun-hye* came into office in 2013, MKE transformed into the Ministry of Trade, Industry and Energy (MOTIE) by removing the information and communication area, and MEST became MOE without the science & technology field. Information and communication and science and technology now belong to the same ministry of MSIP.

In Korea, 30 different ministries and agencies deal with research and development (R&D). More than 60 percent of the total budget is concentrated to MEST and MKE. Most of the work is concentrated to MEST (31.6%) and MKE (30.4%). The governmental reforms have also had the effect that governmental agencies have been integrated or divided.

Structure of R&D Agencies

Most of the ministries have agencies in charge of R&D programs. Under the umbrella of MEST, the NRF (National Research Foundation) is responsible for academic research support and KOFAC (Korea Foundation for Advancement of Science and Creativity) is in charge of STEM support. MKE consists of agencies that are divided by the ministry's different responsibilities, and mostly take care of R&D support of their designated industry.[1]

The organisation most closely related to CoEs (Centres of Excellence) is the NRF. NRF is not only responsible for the overall planning of research in all areas of academic discipline, but also has the mandate to discover new academic areas through the integration of different academic fields.

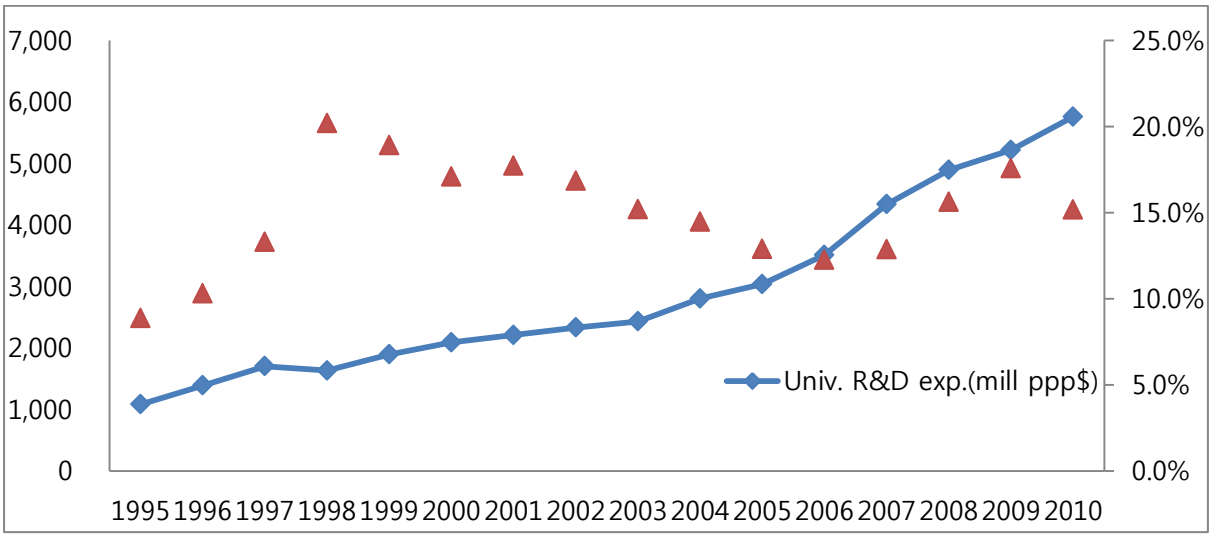
[1] KIAT (Korea Institute for the Advancement of Technology) is in charge of policy development of industrial technology, KEIT (Korea Evaluation Institute of Industrial Technology) is responsible for the management of industrial R&D programs, KETEP (Korea Institute of Energy Technology Evaluation and Planning) is in charge of energy and natural resource R&D and NIPA (National IT Industry Promotion Agency) is in charge of information and communication R&D. With transformation of government units in 2013, NIPA now belongs to MSIP and rest of the agencies stays the same.

The mission of NRF is following[2];
• Supporting academic and RD activities • Fostering and utilising researchers in academia and RD • Promoting international cooperation for academic and RD activities • Facilitating survey, analysis and application of useful resources for research funding as well as development policies • Assisting in managing research performed by academic and RD organisations • Promoting cooperative exchanges between domestic and overseas institutes and organisations in the fields of academia and RD NSF R&D budget in 2012: 3,132 billion won

Korean Innovation system & background of CoE programme planning

The Korean Innovation system has been characterised by greater importance on government funded independent institutes and relatively less focus on universities in terms of engaging in R&D activities. In the 1990s the innovative capabilities of universities were low and not specialised, resulting in a majority of four-year universities running graduate programs.

Figure 1. Universities' R&D expenditure & R&D activity ratio



Source: NTIS (www.ntis.go.kr)

In the 1980s the government support to academic research focused on individuals. This was changed in the 1990s when the government decided to increase the research base within universities by supporting larger programmes. One good example is S/ERC (Science/ Engineering Research Centres) based on a model established in the USA. The S/ERC was the first project to encourage research teams of universities as they had been scattered throughout the university. Since then the number of programmes supporting research groups has increased

[2] http://www.nrf.re.kr/nrf_eng_cms/

and the RRC (Regional Research Centre) programme was created which encourages universities to cooperate with local companies. The funding of the S/ERC has been relatively modest.

The main effort to establish Centres of Excellence started with the Brain Korea 21st Century (BK21 programme) and was followed by the WCU (Would Class University Program, 2008-2012). The following chapter will cover these programmes in more detail.

2. Brain Korea 21st century (BK21) Program

2.1 Strategic orientation

Aims and intended impacts

As Korea has become a more knowledge-based society since the late 1990s, there has been increasing demand for evolving from a "catch-up" to "first mover" strategy in terms of national innovation. To make that happen there was a need to nurture innovative capability in the universities. The dominant view was that the competitiveness and specialisation efforts of each university were not satisfactory, because the innovation system had mainly focused on government funded institutes. Accordingly, there was a growing awareness that competitiveness should be enhanced based on specialisation and the restructuring of universities (Seong et al, 2008).

The major objectives of the first stage of the BK 21 project were:

1. Fostering world-class research universities which function as infrastructure in producing primary knowledge and technology and promoting specialisation of local universities;
2. Introducing professional graduate schools in order to cultivate professionals in various fields;
3. Transforming the higher education system in order to facilitate competitive growth among universities based on the quality of their students and academic productivity.

Two evaluations were carried out in 2005 and 2006 which showed that the first phase of BK21 was successful although the programme was considered to be biased toward research performance and hence undervalued links between universities and industry as well as the economic contribution of universities (MoE 2005, MoE 2006).

The government decided to commit for a second phase of the BK21 programme, which increased the emphasis on the links between the universities and the industry. These links were stressed in the mission to meet industry demand for highly skilled labour. MoE announced three missions for Phase II (MOE, 2005)

4. Fostering word class research groups to nurture next-generation scientists and engineers;
5. Establishing infrastructure - both physical facilities and institutional arrangements, such as an improved faculty evaluation system and accountability for research

funds to help research universities meet their own needs for high quality manpower as well as those of industry;

6. Promoting local universities that will lead to innovations in those areas.

Significance of the Programme and the role of STI

BK21 has been promoted as fostering talented workforce for Korea's key growth engines and boosting research capabilities of universities which were relatively weak in terms of national innovative systems. As shown in table 1, BK21 was designed to focus basic source technology and the fields with good future prospects.

Table 1. Programme purpose & funded areas (Phase II, BK21)

Area	Program purpose	Funded areas
Basic science & technology	◦ To foster world class researchers for the basic source technology to enhance capabilities of science & technology	◦ math, physics, chemistry, biology (bio-technology), earth science
Applied science & technology	◦ To nurture top-level workforce for promising technology areas that can be key engines of the country 10 years later ◦ To incubate basic source technology, promising high technology, science for aging society and areas integrated with different disciplines	◦ information technology (electric & electronic engineering, telecommunication, computer), mechanical, material and chemical engineering, construction, applied biology, energy and environment
Humanities & social science	◦ To train excellent manpower vital for advanced society of the 21st century ◦ To educate creative professionals for cultural value creating areas such as humanities, social science and art	◦ overall humanities & social science(including design & media arts)
Specialised service	◦ To foster capable workforce for business administration and medical science that meets global standard to respond to opening of global service market	◦ MBA, medical science

Source: NRF (2012)

2.2 Institutional support and operational conditions

Funding

The total BK 21 budget for the seven-year period of Phase I was 1.4 trillion won (about $1.2 billion) for a period of 1999-2005, and 1.75 trillion won (about $1.56 billion) for Phase II, 2006-2012.

Table 3. BK21 Budget by research group (*Sa-up dan*) during Phase II (million won)

Year	Science & Technology		Humanities & Social Science		Specialised Service	
	Basic S&T	Applied S&T	Humanities & Social S.	Design	MBA	Medical Science
Mean	719	1 044	440	382	825	530
'06	853	1 193	547	443	1 125	820
'07	853	1 196	511	395	1 020	802
'08	807	1 127	489	392	1 065	772
'09	775	1 112	471	385	1 062	746
'10	717	1 003	424	342	974	542
'11	690	990	404	382	680	355
'12	701	1 008	420	346	938	228

Source: NRF (2012)

Programme funding allocated by academic discipline (MoE, 2006b). All research groups must secure matching funds from their universities equivalent to at least 5% of BK21 funding. The grant structure of each BK21 award is as follows: about 70-80% of BK21 funding goes to scholarships and stipends of graduate students, post-doctoral researchers, and contract-based research professors. Grant allocations among recipients vary by academic fields (table 4).

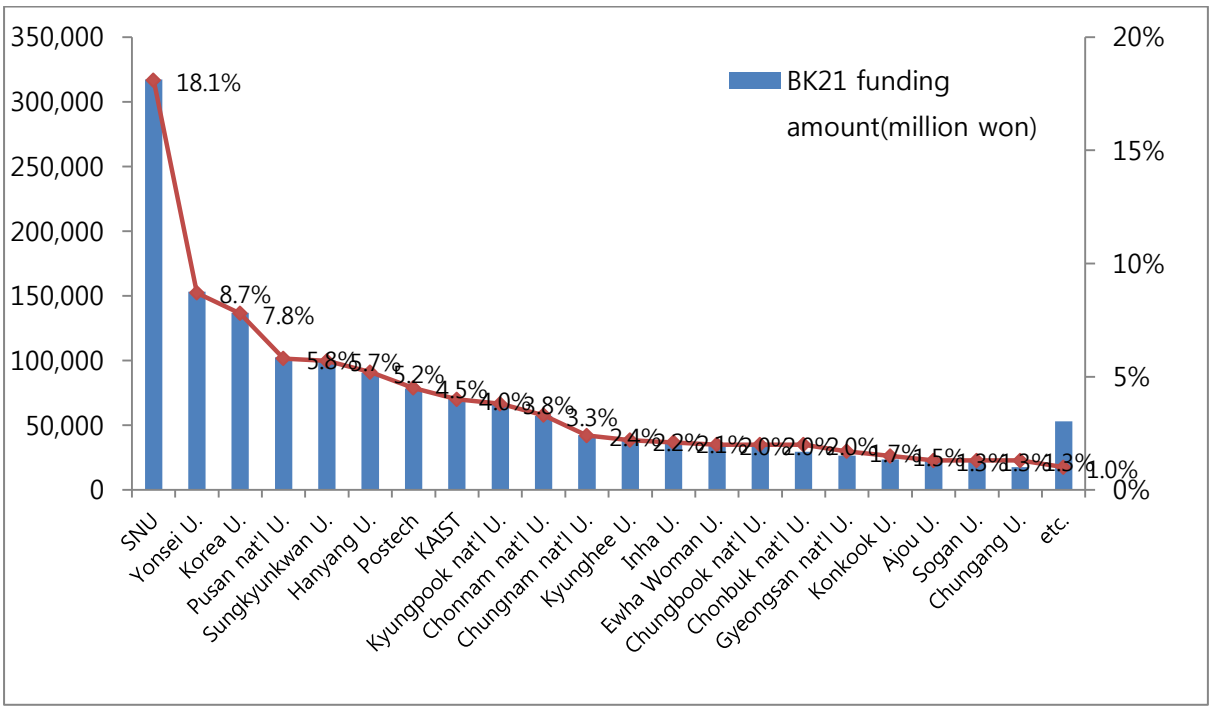
Table 4. Guideline for fund allocation by activities

Supporting Activities	Basic	Applied & Interdiscipline	Humanities & Social science	Specialisation
1. Scholarship	over 55%	over 60%	over 50%	over 50%
2. Post-Doc & Contract Res Prof.	within 20%	within 20%	within 20%	within 20%
3. Intern. Collab. and etc	within 25%	within 20%	within 30%	within 30%
4. Curriculum update	-	-	-	-

Source: NRF (2012)

As funding was mostly provided to top performing groups, it naturally resulted in university restructuring. In Phase I of BK21 (1999-2005) approximately 90% of BK21 funding was allocated to 48 research groups in 14 universities in the areas of science and engineering. In Phase II, top ten universities received 80% of the total budget, meaning only those with excellent research results were funded.

Figure 2. BK21 funding ranking among universities during Phase II



Source: NRF (2012)

Guideline for Selection

Research groups are ranked within each academic discipline. Ranking criteria are weighted differently for different groups. For applied science groups, criteria are weighted equally. For basic science groups more weight was given to university reform and specialisation, while industry links were not considered.

Table 5. Selection Guideline for Applied Science Research Groups: Phase II

Area	Indicators	World Class Univ.		
		Sci & Eng		Hum & Soc
		Bas	App	
Education	•Curriculum •Employment of graduates •Publication & presentations by graduate students •Globalisation of graduate education	**35%**	25%	**38%**
R&D	•Government-funded R&D •Faculty research performance	**35%**	25%	**30%**
Link to Industry	•Industry R&D projects •Technology transfer •Exchanges with industry •Supporting systems and plan for university-industry collaboration	-	**25%**	-
University Reform and Specialisation	•Investment in human resources & physical infrastructure •Institutional reforms to be a research university •Research Group: Goals and Visions, Structure, Competition, Evaluation Plan	30%	25%	32%

Source: MoE (2006)

Performance Evaluation Criteria

Phase I had two types of evaluations: (type 1) annual and interim evaluation to assess how each recipient research group was progressing and (type 2) programme evaluations to assess the programmes' overall effects (Seong et al., 2008). These evaluations were designed to monitor the adherence to specific contractual terms and promises that had been made by the recipient groups before the award selection. The interim evaluations in 2002 and 2004 during Phase I were to assess overall progress of the research groups in achieving their goals. At the end of Phase I, programme-level achievements were presented as aggregated performance indicators for the individual research groups e.g., the number of papers published by BK21 recipients, summaries of survey results on how much influence the programme had on its recipients, or national-level R&D and technology indicators such as the total number of papers published by Korean authors.

Research groups in Phase II were also evaluated annually for their adherence to contractual terms and their progress in proposed work plans (MoE, 2006). With the annual evaluation result, 2 or 3 research groups from at the bottom have to be adjusted to the funding within 20 percent. The interim evaluation in 2008 and 2011 allows for adjustments through the replacement of poorly performing participants with others, and research groups that are the poorest performers had to compete with new entrants to stay in the programme. In 2012, when

phase II ended, there was a final evaluation of both research groups and the entire programme (MoE, 2006b).

Governance/organisation

For each academic discipline, a *Sa-up-dan* was formed, which is a large research group at the department level. *Sa-up-dan* required 70% of the department's faculty members to participate. A research group was obliged to satisfy several conditions. It must have a doctorate programme with enrolled PhD candidates. The number of faculty members participating in the research group must be at least seven for liberal arts and social science groups, ten for basic science groups, and 10-25 for applied science groups. For applied science groups, the minimum number varies by discipline. Participating professors must also produce publications of the minimum average number of the previous three years.

In Phase I, 68 *Sa-up-dan*s (48 for science & technology, 20 for humanities & social science) were funded. In Phase II this increased to 500 centres in 70 universities.

2.3 Capacity building and impact

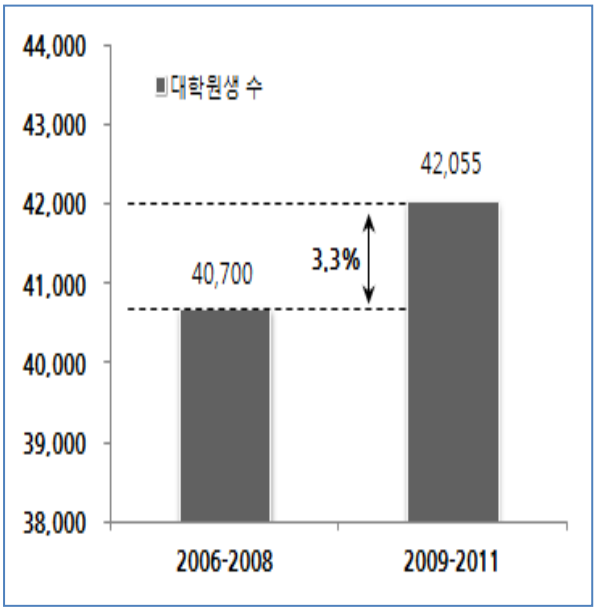
Research capacities with HE structural change

BK21 research groups are supposed to find other funding for research projects, equipment and facilities. Through this process, BK21 funding may serve as financial leverage for recipients to secure other funding, especially by signalling academic excellence. The BK21 funding gives departments and universities an incentive to align their behaviours with their decisions, including those related to research infrastructure and operation and management of departments in order to support the standards that the BK21 programme seeks to foster.

The design of BK21 strongly supports structural reform in academic departments of graduate schools. The specialisation rule of the BK21 programme encourages universities to downsize or eliminate weak departments and to encourage poorly performing faculty members to leave. Some universities offer bonuses to professors whose papers are published by top journals and have established a special scouting fund to recruit top notch professors with high salaries. These universities also hired more postdoctoral researchers to increase the number of publications. As BK21 grants are designed to be a good incentive to attract good graduate students, non-recipient departments may face more challenges when recruiting high-quality students (Seong et al. 2008).

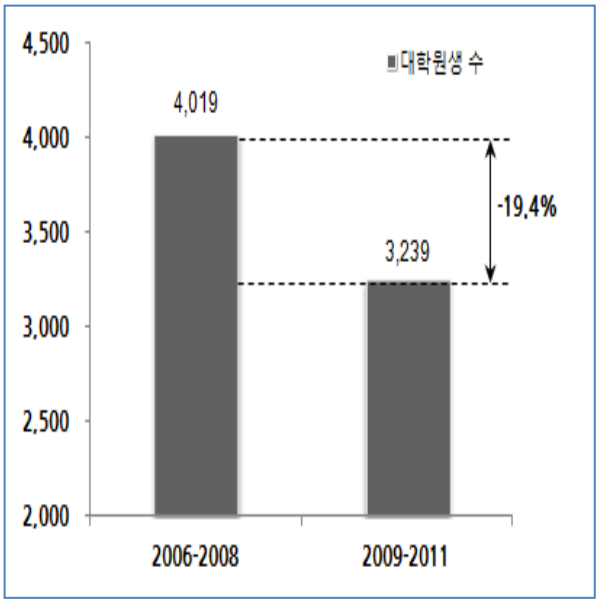
The number of graduate students from 422 teams of *Sa-up-dan* who participated from 2006 to 2011 increased by 3.3%, while the number of graduate students who belonged to eliminated *Sa-up-dan* in 2009 decreased by 19.4%.

Figure 3. Changes in the number of students who participated in the BK21



Source: NRF (2012)

Figure 4. Changes in the number of students who belonged to eliminated departments from the BK21



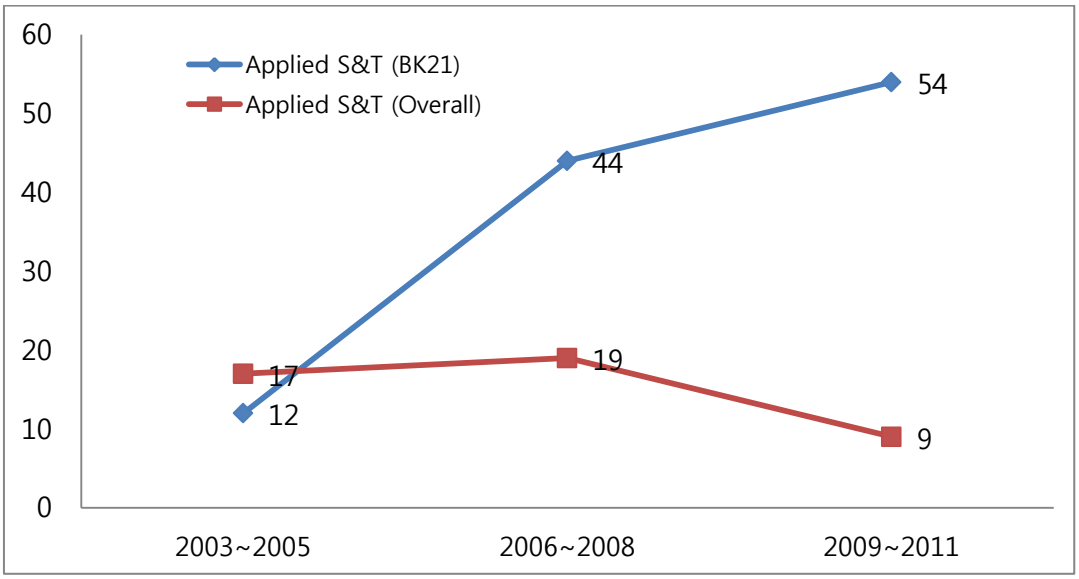
Source: NRF (2012)

Since the inception of the BK21 project, the number of articles written by Korean scholars and published in SCI journals has increased. While the number of publications was 3 765 in 1998 prior to BK21, the number increased to 7 060 by 2004 when Phase I was over. In terms of the size, the national ranking rose from 18 in 1998 to 13 in 2005. The number of published dissertations in SCI per 100 million won had increased from 0.69 in 1999 to 0.91 in 2008, indicating great improvement in university research productivity during the BK21 period.

University-Industry Link

In Phase II closer university-industry links became the key target. This closer cooperation resulted in increased funding to research from industry. During the phase II, a professor who was funded by BK21 fund received three times more money than the average of all the universities for industry research. While the average industry research fund for a professor was 9 million won in 2010, a BK21 participant professor received 30 million won in 2010. In addition, when comparing to the period before BK21, the industry research fund for applied science & technology discipline in a university has risen by four times between 2009 and 2011.

Figure 5. Contract research fund from industry per professor in applied science & technology area: Comparison between Overall and BK21 program (million won)



Source: NRF (2012)

Social-economic/development (capacity)

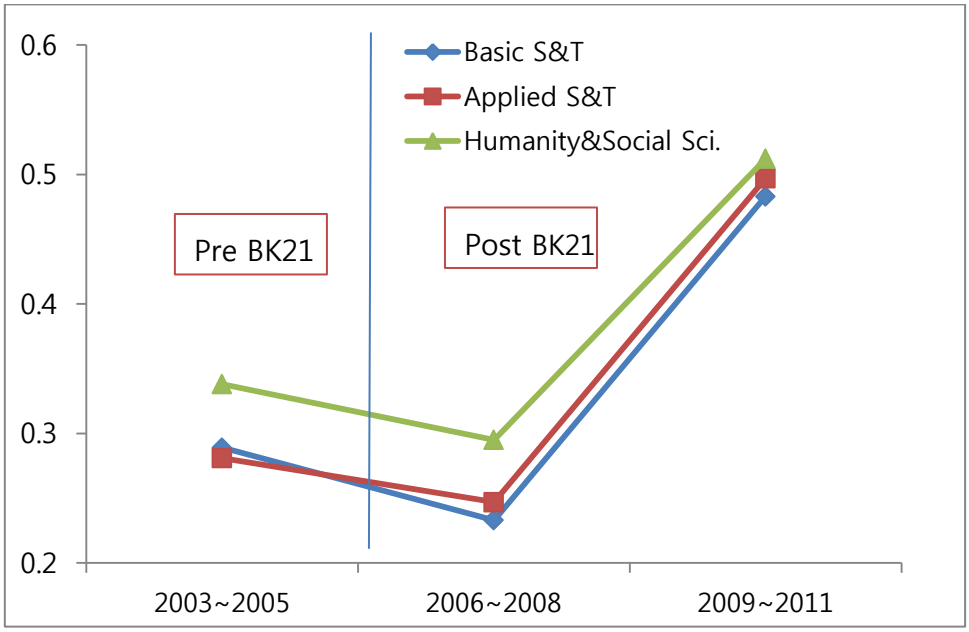
BK21 also contributed to finding jobs for participant students. The NRF survey result (NRF, 2012) showed that there was significant correlation between participation in the BK21 project and employment. 91.5% of masters and doctors students involved in BK21 successfully found jobs while only 82.2% of those from non-BK21 programmes were successful.

Training and skills

BK21 has contributed to the provision of competent manpower in key areas of importance to Korea. This has been achieved by increasing the number of masters and doctoral degrees, including researchers with a doctoral degree. During Phase I, 50 874 masters, 23 000 doctors and 8 100 post-doctorate places were funded, while an annual average of 36 588 masters and doctors and 15 319 new researchers (post-doctorates and research professors) have benefited from the project during Phase II (approximately 2 500 people per year). In addition, BK21 scholarships have dramatically enhanced research capabilities of students as better conditions were provided for research activities. New researchers were able to concentrate on research without having to focus on funding resulting in enhanced dissertation performance per person. With regards to applied science and technology, the number of dissertation publications per person increased from 0.453 in 2006 to 0.764 in 2011. The BK21 project also contributed to the research performance of graduate students. Between 2003-2005 and 2006-2008, there was a downward trend in paper publication performance by graduate students, but during the project period, performance has been enhanced for science and technology and humanities and social

science. Growth was 67.34% for basic science and technology, 77.18% for applied science and technology and 51.5% for humanities and social science. Performance of new researchers who participated in the BK21 programme was enhanced in terms of both quality and quantity. It is also safe to say that sending students overseas for study and inviting foreign scholars helped boost global mind-set and confidence of graduate students.

Figure 6. Number of publication per participant graduate student (2003-2011)



Source: NRF (2012)

Globalisation

The BK21 project has helped boost global competitiveness of universities in Korea. According to the BK21's own evaluation, 78% of beneficiary graduate schools under Phase II have shown better research competitiveness. International university assessments such as SITU also showed improved rankings of Korea's schools (NRF, 2012).

Table 6. Evaluation result of BK21 universities (million won)

University	SJTU ranking		QS ranking	
	2005	2010	2005	2011
Seoul National University	101-150	101-150	63	42
Yonsei University	201-300	201-300	-	129
Korea University	401-500	201-300	150	190
Pusan National University	-	401-500	-	401-450
Sungkyunkwan University	301-400	301-400	-	259
Hanyang University	401-500	301-400	-	314
Postech	301-400	301-400	245	98
KAIST	301-400	201-300	198	90
Kyungpook National University	401-500	401-500	-	-
Inha University	-	-	-	451-500
Kyunghee University	-	401-500	-	245
Ewha Womans University	-	-	-	344
Sogang University	-	-	-	392

SJTU(Shanghai Jiao Tong University), THES(the Times Higher Education Supplement)-QS (Quacquarelli Symonds Ltd)

Source: SJTU ranking (http://www.arwu.org);
THES-QS ranking(http://www.topuniversities.com)

The programme has also encouraged universities to be more globally open. BK21 has contributed to globalisation of the educational environment of graduate schools, enabling more inflows of full-time foreign professors and foreign students. The ratio of full-time foreign professors at BK21 schools has gradually grown to an annual average of 12%, indicating a more globalised education environment. The number of full-time foreign professors of BK21 universities has increased from 1.13 in 2007 to 1.83 in 2011. In addition, the inflow of foreign students has facilitated more international exchanges during the same period. The ratio of foreign students in a department of BK21 reached 8.5%, which is higher than 5.8% of the average of all universities in Korea.

3. World Class University (WCU) Programme

3.1 Strategic orientation

The WCU programme is one of the key projects initiated by the *Lee Myung-bak* administration with the purpose of attracting a talented workforce from overseas as nations around the world fiercely compete to secure the best and brightest. There was a realisation that the level of quality of Korea's SCI dissertations was not satisfactory although the number of publications increased, which may lead to compromised reputation of universities in Korea. MEST has announced that this is a programme to cultivate world class research-oriented universities which develop technology of future growth engines, study convergence of different disciplines, and help train talented manpower by hiring foreign scholars.

The purposes of the programme are:

4. To innovate the research environment of universities through securing foreign scholars with high research competence,
5. To promote research ability in key areas for future national growth, and
6. To educate the next generation of academic research. Funded areas include humanities & social science, natural science, engineering and biotechnology, which are high value added areas of future growth engines and convergence.

The project was categorised into three types: establishing departments with hired foreign scholars, hiring individual foreign scholars to existing departments, and attracting world renowned scholars. The first category requires creating new departments in convergence areas with Korean scholars and full-time foreign scholars hired for at least three years. The foreign scholars' ratio must be no less than 30% of the overall number of professors. The second type requires hiring one or more foreign scholars as a full-time professor for an existing department and running a collective research team. Type 3 requires inviting a foreign scholar as a part-time professor. Type 1 fits the definition of a CoE.

Table 7. WCU project operation (Feb, 2011)

Type	University	Sa-up-dan	Fund (million won)	Fund for each *sa-up-dan* (million won)	Hired foreign scholars
1	19	3	106,900	3,000~5,000	206
2	20	47	35,800	around 1,000	72
3	30	70	12,100	200 or less	64
Total	**36**	**154**	**154,800**		**342**

Source: NRF (2011)

3.2 Institutional supporting and operational conditions

Funding

The budget for WCU amounts to 825 billion won (USD 617 million) for the five year period. (2008-2012). The WCU project provides labour cost of foreign scholars and professional staff and the direct cost of the establishment of research labs and equipment.

Table 8. WCU project's funding items

Item	Detail
Labour cost	- foreign scholars: around 300 million won (actual expense can be appropriated according to the level of the discipline or the status of the scholar such as a nobel prize winner or a renowned scholar) - professional staff : around 35 million won per person
Direct cost	- research expense of foreign or Korean professors: 100 million won or less per year - research lab & equipment for foreign scholars : 200 million won or less per year (humanities & social science excluded) - labs, research equipment and materials for foreign scholars
Indirect cost & incidental expense	- 30% of the project budget

Source: NRF (http://www.nrf.re.kr)

Guideline for selection

WCU chooses and evaluates *Sa-up-dan*s based on excellence. An applicant should apply for either a national unit (which means 'not located in Seoul and *Kyungi* province') or a regional unit for funding, although a regional university may apply for both. The selection process involves three steps of deliberation. In the first step called discipline panel deliberation (60%), Korean scholars from the same disciplines evaluate applicants based on excellence. In the second step of the international peer review (30%), foreign scholars assess publications and research proposals submitted by applicants. In the third step (10%) the project steering committee makes a final decision.

Table 9. Discipline panel evaluation indicators of WCU type 1

Area	Evaluation guideline	Percentage
Discipline panel deliberation	Proposals -validity of newly created discipline -legitimacy & excellence of discipline workforce -suitability of teaching plans -academic, economic and social contribution of the research and education	45%
	Each team member's research performance for the past 5 years -number of papers of different disciplines published in top 10% journals -total paper citation counts of the team -paper citation counts per paper -editor experience of an academic journal -previous research fund reception -domestic and international patents	45%
	University's conditions and supporting plan -substantial support plan for each area -educational & research infrastructure	10%

Source: MEST (2008)

Annual assessment

An annual assessment result can lead to budget cuts and incentive provisions, and an interim evaluation can cause elimination from the project, project budget reduction and incentive provisions. A total of 15 S*a-up-dan*s have received incentives after being evaluated as "the best" by the 2010 interim evaluation, while 5 had to give up the project and 7 were eliminated as "disqualified".

Table 10. Score allocation of annual evaluation (type 1)

Area	Evaluation items	Detail	Score
Education	1. forming & operating the curriculum	performance of formation and operation compared to the plan	15
	2. academic activities	excellence in course operation	10
	3. recruiting more students	academic activities of foreign scholars, *sa-up-dan*s' academic activities at home and abroad	8
Research	1. forming research environment	status of labs and offices	-
	2. executing research	collective research progress compared to the plan	10
Utilising foreign scholars	1. hiring and managing foreign scholars	satisfied conditions for hiring foreign scholars	15
	2. overseas performance of foreign scholars	distributing & sharing research result	15

Others	1. operating *sa-up-dan*s	substantial & excellent operation of *sa-up-dan*s	5
	2. satisfaction of education	survey on students' satisfaction	7
Future plan	plan for 1st year operation of the project	substantial and creative project plan excellent strategy of world class	10

Source: NRF (2009), annual evaluation plan of 2009 WCU project

Governance/organisation

Support is provided on a *sa-up-dan* basis which is based on a discipline. For type 1, a new discipline or department can be created, while type 2 and 3 require some of the participating professors from the existing disciplines to form a *Sa-up-dan*.

To operate the WCU project, MEST decides and announces the project plan and final funding and manages project performance, while the NRF is responsible for applicants' registration, selection process and budget execution. The WCU committee carries out deliberation and provides advice with regards to the project plan, evaluation and management. The committee consists of 16 members including different academic specialists, economic & industrial leaders and journalists who are appointed by president of NRF.

3.3 Capacity building and impact

Research capacities

According to the interim assessment, S*a-up-dan*s that participated in the WCU program have enhanced their research quality. The number of papers published by WCU S*a-up-dan*s between 2009 and 2011 increased from 2,917 to 3,299. 89.5% of these were SCI publications.

Table 11. Annual paper publication through the WCU project

Year	number of non-SCI papers	number of SCI papers	overall	SCI paper ratio out of all papers
2009	306	2,611	2,917	89.5%
2010	483	4,320	4,803	89.9%
2011	354	2,934	3,288	89.2%

Source: NRF (http://www.nrf.re.kr)

Domestic professors improved their research performance since participating in the WCU programme (MEST, 2010b). The number of papers published in the top 10% of journals such as SCI increased from 1.13 to 1.69 per person, a 29% growth rate since participation. Impact factor analysis shows 30.2% enhancement (an increase from 13.6 to 17.7).

Infrastructure

As type 1 includes a budget for laboratory establishment and research equipment, participant universities were able to purchase the latest equipment so that they can actively start to create a world class research environment. As a result, 74% of students from WCU *Sa-up-dans* who were surveyed responded that they were satisfied with the enhanced offices and labs.

Training and skills

The number of diplomas granted in 2010 and 2011 was 1 131. Type 1 enabled the building of infrastructure for convergence education, and student satisfaction with their major related to convergence curriculums was high (MEST, 2010a). Type 1 S*a-up-dan*s have created 32 convergence disciplines.

Domestic students increased their confidence after learning from foreign scholars and their global mind-set has been expanded through presentations at global academic symposiums, study abroad and courses taught in English. There was a transformation to a global manpower nurturing system through overseas research-focused universities and double diploma systems. Seoul National University and Korea University have been pursuing double diploma systems in cooperation with Purdue University and Nottingham University.

Table 12. Diplomas granted through the WCU project (2010, 2011)

Classification		Liberal arts	Science & engineering	Total
Degree	doctoral	3	259	262
	master's	15	624	639
	bachelor's	9	199	208
	others	0	22	22
Total		27	1104	1131
Unit	national	17	825	842
	local	10	279	289
Total		27	1104	1131

Source: NRF (http://www.nrf.re.kr)

Globalisation

Globalisation is one of the key targets of the WCU programme. In terms of human resources, the programme has not reached the level required for attracting foreign scholars or students, however programme participants believe that the WCU project is attractive enough to bring them in the future. In light of research networks, universities have shown great progress in becoming more international. The interview and survey result shows the WCU project has indeed helped the research network become more global than before. Hired foreign scholars

were regarded as having global networks and perspective, and student exchanges through such professors were active. In addition, as collective research activities on a global level become easier for domestic professors, some tangible results started to show. A high number of domestic and overseas patents were produced by *sa-up-dans*. The total number of patents applied for between 2009 and 2011 was 631, including 204 overseas patents.

Table 13. Patent applications through the WCU project (2009-2011)

Classification		Liberal arts	Science & engineering	Total
type	type 1 (establishing new disciplines)	5	292	297
	type 2 (hiring individual scholars)	2	260	262
	type 3 (inviting world renowned scholars)	0	72	72
Total		7	624	631
professors	domestic professors	5	602	607
	foreign professors (foreign scholars)	2	22	24
Total		7	624	631
patents	domestic patent application	2	425	427
	foreign patent application	5	199	204
Total		7	624	631
unit	National	5	504	509
	Regional	2	120	122
Total		7	624	631

Source: NRF (http://www.nrf.re.kr)

According to the two year performance analysis by NRF (2011), the project has had a positive impact on the rankings of domestic universities in the world university assessment. Engineering moved up 35 places in the ranking and bio technology increased by 72.

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