Transferring Korean Experience in R&D Funding System Development to Mongolia through Korean ODA

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ABSTRACT

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Technology and innovation are acknowledged to have been the most important contributing factors to impressive development. The Mongolia during the last years has due to its efficient innovation policy focused on increasing R&D expenditures and supporting knowledge society initiatives. Despite the strong cuts in other public sectors during the economic recession, the technology policy was felt to be the major driving force toward better times. Now, Mongolia is facing a situation in which it has replaced its position as a catching-up country looking at other countries as role models, for a position in which it is itself closely examined by other countries.

In principle, institutional and organizational structures of innovation systems would are arranged according to innovation policy priorities and other additional, more general policy issues. In fact, countries often already

have institutional arrangements that are the result of political discussions, cultural or social manifestations, or ad-hoc decisions made at one point in history. It should be clear that there is clear interaction between policies and structures that impact each other in either direction. Following organizational structures and missions are the instruments that these organizations use to accomplish their missions and, again, in principle should be designed in such a way that they can meet the needs of targeted groups individually as well as collectively.

This research presents the main results from the study that took a systems approach by looking at the broad innovation policy developments, examining organizations functioning within the innovation system, and instruments used by these organizations, took a case study approach and started from the needs of specific R&D performers and looked at what kind of public funding is available through which types of instruments to support the innovation activities of these performers in the different countries.

This research focused on to define R&D funding system of Mongolia. This closely correlated to the Program for to develop national innovation system in Mongolia, Law on innovation of Mongolia and Master Plan of Science policy strategies and states the means of implementing the objectives, clarifying the financial, legal terms and results in a detailed manner. Also Mongolia need to support strongly an investment in innovation technology, R&D funding system to make a big step into the development of knowledge-based economy in our country.

The purpose of this research is to survey institutional structures and processes related to government funding for R&D in a selection of country. This research should identify interesting structures, policy measures, and examples of funding instruments that Mongolia might adapt.

This research aimed to elaborate key issues related to the trends towards globalization of R&D funding and their implications for developing countries especially Mongolia. The research questions that this study aim to answer:

1) What is its R&D potential? How can the establishment of R&D funding abroad affect the transfer of technology – one of the main potential benefits from the official development assistance?

2) What types of R&D are the most desirable for development? What benefits and costs are involved and, how can policies in home and host countries influence the allocation of such activities and their economic impact?

That wide-eyed sense that anything is possible through R&D —that we can help solve some of the most critical challenges by increasing our knowledge and understanding of the world. On the basis of lesson learn from the comparison, defined policy guidance of R&D funding system of Mongolia, some suggestions to Government of Mongolia which good experiences we can domesticate to our country, what provisions should be adopted for the effective implement ability of acts by Korean ODA.

The Korean experience shows that there are many things to consider for building a NIS, R&D funding and technological development, also business supporting factors are also important for the appropriate NIS to be developed. Furthermore, it indicates that R&D funding system building is a long term project and needs systematic approach.

Keywords: S&T policy and development, National Innovation System, R&D development, R&D funding and system, ODA, Korean ODA,

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TABLE OF CONTENTS

LIST OF TEMPORARY TABLES

LIST OF FIGURES

LIST OF GRAPHS

I. INTRODUCTION

This chapter describes related about the background that consists of the objectives significance, purpose and research question and outline of the study.

1. The Background of Research

Mongolia transferred from centrally planned economy to market economy suffered from a severe economic recession during the beginning of the 1990s. Technology and innovation are acknowledged to have been the most important contributing factors to impressive development. The Mongolia during the last years has partly been due to its efficient innovation policy that clearly focused on increasing R&D[1] expenditures and supporting knowledge society initiatives. In that sense, the deep recession had a positive impact because it enabled both Mongolian industry and government to initiate reforms. Despite the strong cuts in other public sectors, the technology policy was felt to be the major driving force toward better times.

Now, Mongolia is facing a situation in which it has replaced its position as a catching-up country looking at other countries as role models, for a position in which it is itself closely examined by other countries. However, experiences and lessons learned from other countries can still provide useful information for thinking about government structures and policy processes. Maintaining a specific and static public strategy based on past results for the development of a sustainable, creative, and competitive environment could result in Mongolia losing its advanced position with respect to its innovation system. The biggest challenge of policymaking today is to learn from experiences, within Mongolia and beyond, and adapt strategies quickly and continuously. A critical evaluation of structures and actions elsewhere can provide the ideas that are needed to create innovative innovation policy.

[1] R&D – Research and Development

Furthermore, in an increasingly global world, government actors should also engage themselves in networks across borders and do work jointly. This research is the result of a survey of institutional structures and processes related to government funding for R&D in a selection of some Asian countries. The study covers all public funding related to innovation in South Korea. It identifies interesting structures, recent or on-going changes, and policy instruments. For purposes of this objective two separate studies were initiated.

In principle, institutional and organizational structures of innovation systems would follow from innovation policy priorities and other additional, more general policy issues. In fact, countries often already have institutional arrangements that are the result of political discussions, cultural or social manifestations, or ad-hoc decisions made at one point in history. It should be clear that there is clear interaction between policies and structures that impact each other in either direction. Following organizational structures and missions are the instruments that these organizations use to accomplish their missions and, again, in principle should be designed in such a way that they can meet the needs of targeted groups individually as well as collectively.

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In the 21st century Mongolian science and technology follows the primary principle to be a nation developing science based on new knowledge and advanced technology, to practice the national innovation system as a driving force for social and economic development for 2020, and to ensure secure and quality living of the people by creating and producing advanced

knowledge and by continuously supporting the science and technology progress and development.

Mongolia has determined an objective to introduce an innovation in all the social and economic sectors widely, to promote high-technology industries and to create knowledge-based economy, and developed several policy documents including “Millennium Development Goals-based Comprehensive National Development Policy in 2008-2021”, “State Policy on high technology industries, in 2010”, “Master plan to develop science and technology of Mongolia between 2007-2010” and “Program to develop National innovation system in Mongolia between 2008-2015”, “Law about of innovation”, “State Policy on information, communication and technology (ICT)”.

This research will focus on to define R&D funding system of Mongolia. This closely correlated to the Program for to develop national innovation system in Mongolia, Law on innovation of Mongolia and Master Plan of Science policy strategies and states the means of implementing the objectives, clarifying the financial, legal terms and results in a detailed manner. The Mongolia need to support strongly an investment in innovation technology, R&D funding system to make a big step into the development of knowledge-based economy in our country.

2. The Purpose and Research Question

The purpose of this research is to survey institutional structures and processes related to government funding for R&D in a selection of country. This research should identify interesting structures, policy measures, and examples of funding instruments that Mongolia might adapt.

This research aims to elaborate key issues related to the trends towards globalization of R&D funding and their implications for developing countries especially Mongolia. The research questions that this study aim to answer:

1) What is its R&D potential? How can the establishment of R&D funding abroad affect the transfer of technology – one of the main potential benefits from the official development assistance?

2) What types of R&D are the most desirable for development? What benefits and costs are involved and, how can policies in home and host countries influence the allocation of such activities and their economic impact?

That wide range sense that anything is possible through R&D —that we can help solve some of the most critical challenges by increasing our knowledge and understanding of the world.

But innovation is improbable without proper funding, so we project how political developments and economic conditions around the globe will affect R&D support in future. This forecast is for researchers and policymakers alike because of the multiplier effect R&D investment can have, both in cultural and economic terms. There is an important relationship between R&D and economic growth, between political stability and industry creation, and the nurturing of research in developing nations.

While R&D funding is not the sole indicator of how a nation, region or industry will perform, it certainly is a fundamental consideration among

other factors like science, technology, engineering and property rights, capital markets, healthcare, infrastructure, and immigration policy.

As more and more countries begin to formulate policies that support innovation, they need to learn from the experiences and good policy practices of dynamic economies, especially those from the developing world. This thesis research will focus: to research global and Korea's innovation policy and strategy of national innovation system and R&D funding, to compare the similarities, differences, implement ability and effectiveness of some countries experience, implementation and evaluation method.

On the basis of lesson learn from the comparison, will define R&D funding system of Mongolia, some suggestions to Government of Mongolia which good experiences we can domesticate to our country, what provisions should be adopted for the effective implement ability of acts by Korean ODA[2].

[2] ODA – Official development assistance is a term coined by the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD) to measure aid. The DAC first used the term in 1969. It is widely used as an indicator of international aid flow. It includes some loans.

3. Outline of the Thesis

The contents of this paper proceed as follows: Chapter 1, the background that consists of the objectives significance, purpose and research question and outline of the study. Chapter 2, the literature review, which was divided into three parts; the first is general overview on a discussion of theory and precedent study review that intends to give a clear understanding on applied R&D, its benefits, types and policy environment to promote R&D-related FDI and its benefits for host and home countries; the second is experiences of NIS in developing countries; the third is the present situation the R&D funding system. Chapter 3 describes the research scope and methodology current R&D system used in the study. Chapter 4 will show the Korean R&D funding system, which was divided into three part: the first the Korean NIS and some programs, R&D policy trend, governance system and main actors, legal framework on R&D, the second the Korean R&D funding trend, future challenge and system, the third part consists ODA and Korean ODA, the R&D funding system transfer brief cases of Vietnam through Korean ODA. Finally, Chapter 5 will be define Mongolian R&D funding system which was cover three parts: the first current situation of Mongolian R&D development, S&T development and legal framework of R&D, the second is define to R&D funding system of Mongolia, the third recommendations to government how to invite Korean ODA for R&D funding of Mongolia, and then, the conclusion will be made.

II. A THEORETICAL CONCEPT OF THE R&D FUNDING SYSTEM

This chapter describes related about literature review about issues concerning this study: general overview on a discussion of theory and precedent study review that intends to give a clear understanding on applied R&D, its benefits, experiences of NIS in developing countries; and the present situation the R&D funding system.

1. A Discussion of Theory and Precedent Study Review

In recent years, innovation has moved centre stage as the main driver of economic growth - be it through incremental or radical innovation (UNCTAD, 2007). Innovation activities include knowledge generation and transfer, the purchase of technologies, product commercialization as well as R&D. As such, the ability to perform, commission, measure and manage R&D is an important facet of economic competitiveness and national development. There are several reasons which are local development problems require local solutions and perspectives. Technological solutions are socially and culturally embedded and, as such, must take indigenous knowledge systems into consideration. Culturally sensitive R&D that works alongside and collaborates with indigenous knowledge practitioners offers the potential to transform this R&D into various innovations. Also highly qualified personnel are an important asset for development. Such human resources are trained and developed in higher education institutions (HEIs). The R&D carried out in HEIs is one of the drivers of quality in higher education. R&D is central to the capacity to adopt and adapt technologies through technology transfer.

In accordance with the approach advocated by the Frascati Manual[3] (Based on OECD's "Frascati Manual", 2002 edition), this study defines R&D as "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". The term "research and experimental development" is used as synonymous to the term "research and development" and both are abbreviated by the expression "R&D". The term R&D covers three activities: basic research, applied research and experimental development:

- ✓ **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

- ✓ **Applied research** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

- ✓ **Experimental development** is systematic work, drawing on existing knowledge gained from research and/ practical experience, which is directed to producing new materials, devices and products, to installing new systems, processes and services, or to improving substantially those already produced.

The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty. (Based on OECD's "Frascati Manual") A prototype is an original model constructed to include all the

[3] The Frascati Manual is a document setting forth the methodology for collecting statistics about research and development. The Manual was prepared and published by the Organisation for Economic Co-operation and Development. The manual gives definitions for: basic research, applied research, Research and development; research personnel: researchers, technicians, auxiliary personnel. It also organizes Field of science into main and sub-categories. It deals primarily with measuring the expenditure and personnel resources devoted to R&D in the industry sectors performing it: higher education, government, business, and private non-profit organisations.

technical characteristics and performances of the new product. The design, construction and testing of prototypes normally falls within the scope of R&D. The construction and operation of a pilot plant is a part of R&D as long as the principal purposes are to obtain experience and to compile engineering and other data. Those elements of industrial design work, which include plans and drawings aimed at defining procedures, technical specifications and operational features necessary to the conception, development and manufacturing of new products and processes.

The R&D funding system: Internationally, performance-based research funding systems (PRFS) operate within a hierarchical system of governance, in which there are layers of authority from government through ministries, their agencies and down to the research-performing organizations. Policymaking tends to be quite strictly separated from policy implementation. Most countries have difficulty in coordinating aspects of research and innovation policy across ministries but this is to a degree countered by having analytical resources decentralized across various organizations. Research organizations tend to be of five types:

- universities;
- scientific research institutes;
- research and technology organizations (RTOs) supporting industrial innovation;
- public service research organizations;
- national resources or infrastructures such as libraries and museums.

These are steered and funded through various combinations of unconditional block funding and performance-based funding, which may be based upon a performance contract and/or a system that counts or assess results of research. It is also unusual in being among the minority of countries with a high ratio of project-based to institutional funding of research. Internationally, the use of

PRFS is believed to improve both the amount and the quality of the output from research organizations. Quite small performance-based adjustments to institutional funding lead to large changes in the behaviour of individual researchers and of the research system as a whole. PRFS can be tuned to reach different policy objectives, for example to concentrate research in a small number of institutions or to boost overall research capacity across the system. However, they also promote 'gaming' and there is evidence that they favour traditional and mainstream research approaches over unorthodox and interdisciplinary ones.

A. The Funding Principles

A pre-requisite for the proposed funding model is that there are separate budgets or budget lines for different types of research organisations. The thinking behind this pre-requisite is that different types of research organisations fulfil different missions and functions in society. Hence, they should not be made to compete for the same budget pot as this may lead to some research organisations not being able to fulfil their roles any more. This pre-requisite is in line with international practice where different budget pots for different types of research organisations are normal. The distribution is generally contingent on: laws, history, politics, policies, individuals. In the end, how much money to allocate to the different pots is a policy decision.

Ideally, such decisions are based on a long-term R&D strategy or basic long-term principles for the R&D policy accepted by all major political forces. For the future, ideally the responsible ministries should base their funding decisions on a thorough understanding of the research organisations funding mix such us institutional, competitive and contract funding. On this basis it will be possible to determine better how large the pot for their type of research organisations should ideally be. The key parameters of the new Evaluation Method, especially those that determine funding, are components of a wider policy mix for R&D. Many policy decisions such as the policy mix from the interplay of a complex set of drivers that are specific to the national research

and innovation system. In this section summarised some key aspects of R&D governance systems that need to function well if they are to produce good policy. The tradition of new public management increasingly means that principals everywhere set objectives for those below them, rather than micro-managing them. Policy coordination matters because it provides a way to ensure the overall coherence of research and innovation policy – an aim is to make sure that one part of the system does not rely on another part to deliver something, which it turns out is not delivered. It is increasingly important as research and innovation policies have to confront the societal challenges such as climate change, ageing and so forth, which cut across the needs and abilities of individual parts of the system such as ministries to deal with them.

The way in which national R&D activities are governed by the state is complex in all countries. The private sector, of course, steers itself – though the state can use incentives such as subsidies, tax breaks and regulation to encourage certain types of behaviour. Within the state, there are multiple stakeholders – policymakers, funders and performers – in relation to R&D, all of whose decisions affect the actual pattern of R&D activity. In such a complex system the overall characteristics of the national effort are emerge from the way the different actors in the system behave.

The organisation and governance structure effectively the way in which the state connects R&D activities to social needs. Government is a major influence. But the individual ministries also have a strong say, with each representing a particular sector of society. In principle, each ministry has an understanding not only of the overall needs of its sector but the kind of research needed to advance knowledge and develop policy. In many cases, some of this need will be expressed through a PSRO owned by the ministry. In research policy as in policy more generally, therefore, the spending ministries make competing claims about their needs – and have an annual battle with the finance ministry about how many of these claims can be afforded. The relative power of government centrally and the individual ministries varies among systems but the outcome is rarely the result of a

simple top down decision. It emerges from the competition among claims – a competition that can in many systems benefit from being expressed in an arena such as a policy council, where it is possible to coordinate and negotiate. Such an arena may also be helpful to focus the national effort in pursuit of a strategy, make sure all the needed parts of the system function and make it possible for the national system to change direction when circumstances change. One of the biggest of these changes currently is the emergence of grand challenges as policy priorities. To a greater extent than earlier policy focus such as industrial development and growth, the grand challenges require joint and consistent activities across many disciplines and many sectors of society. They therefore appear to imply a need to change the way research and innovation governance is structured and the need to tackle them needs to be built into any such governance system. For a comparatively decentralised governance system to operate well, the individual actors need to be able to analyse, express and lobby for the satisfaction of their own sector needs. This means that people with relevant skills and capabilities and the independence not only to undertake the needed analysis but also to be able to present its results to the wider policy community must populate them.

B. Governance of Public Research Performers

Research-performing organisations have become increasingly autonomous from government and the state over time. This means in practice that principals micromanage them less than before and to a greater extent use incentives to encourage them to implement policy, while recognising that there are also many aspects of their behaviour that the state simply does not need to regulate. Perhaps the most important limitation on universities' autonomy is that most countries use a central agency to accredit degree courses. In the UK, the Quality Assessment Authority uses peer review to monitor degree standards and advises on which organisations should be allowed to grant degrees. In all the countries considered, the universities now effectively set their own strategies and control their internal budgets. In particular, they are free to use their institutional research funding as they

themselves choose. The academies and research councils that control most of the scientific research institutes set their own policies while the RTOs have always needed a high degree of autonomy in order to be flexible enough to serve their largely industrial markets. The spread of the new public management means that PSROs are increasingly managed by objectives, leaving them to decide for themselves how to reach these objectives. In many cases, governments also want to see the labs winning industrial income in addition to fulfilling their tasks for the state, so this is another factor encouraging autonomy. For the purpose of this comparison, we distinguish among five different types of research-performing organisation. At some points in this research refer to the first two collectively as scientific research organizations.

- Universities – or, strictly, research universities

- Scientific research institutes – which, like research universities, conduct fundamental or applied research but either have no teaching responsibilities or only provide education at PhD level.

- Research and technology organisations (RTOs) – which conduct applied research and experimental development and provide technical services to support industrial innovation. These can be distinguished from technical consultancies in that they receive institutional funding from the state.

- Public service research organizations - They produce knowledge the government needs in order to legislate or regulate or they produce public goods such as standards, certification or weather forecasts that society needs but that private companies lack the incentives to make. Some PSROs are run by private companies on behalf of government.

- National resources or infrastructure – such as libraries and museums, which enable others to do research and which may otherwise be needed for social, educational or cultural reasons. Normally, these

need to do some research of their own in order to support their infrastructural function.

2. The R&D in Developing Countries

In Annex to the Frascati manual 2012, from a global perspective, R&D is concentrated in the European Union, the United States and Japan. Within the developing world, R&D is also concentrated in a relatively small group of countries in each region, notably the BRICS[4] (Brazil, Russia, India, China and South Africa). However, a shift in the global distribution of R&D is under way. This is reflected in increases in the gross domestic expenditure on R&D (GERD [5]), the volume of internationally indexed scientific publications, and patenting activity in developing countries. Across most OECD countries, the business enterprise sector accounts for the largest share of GERD. This has also become an important feature in some emerging economies, but in many developing economies, business enterprise R&D expenditure (BERD[6]) is often much smaller than in the Government and Higher education sectors. Emerging economies and developing countries are a heterogeneous group whose innovation systems and associated R&D measurement systems exhibit wide variety both internally – by region, institution, sector and even project – and internationally. R&D activities are undergoing significant changes in many developing countries. R&D has tended to be largely funded by national governments, but new sources of funds are emerging. Foundations, non-governmental organisations (NGOs[7])

[4] BRICS is the acronym for an association of five major emerging national economies: Brazil, Russia, India, China and South Africa. The grouping was originally known as "BRIC" before the inclusion of South Africa in 2010. The BRICS members are all developing or newly industrialised countries, but they are distinguished by their large, fast-growing economies and significant influence on regional and global affairs; all five are G-20 members. Since 2010, the BRICS nations have met annually at formal summits. Russia currently holds the chair of the BRICS group, and hosted the group's seventh summit in July 2015.

[5] GERD - % of GDP. The indicator provided is GERD (Gross domestic expenditure on R&D) as a percentage of GDP. "Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications" (Frascati Manual, 2002 edition, § 63).

[6] BERD- Business enterprise expenditure on R&D covers R&D activities carried out in the business -sector by performing firms and institutes, regardless of the origin of funding. While the government and higher education sectors also carry out R&D, industrial R&D is arguably most closely linked to the -creation of new products and production techniques, as well as to a country's innovation efforts.

[7] NGOs - A non-governmental organization (NGO) is any non-profit, voluntary citizens' group which is organized on a local, national or international level. Task-oriented and driven by

and, in particular, foreign organisations play increasingly important roles in this capacity. The contribution of domestic and foreign businesses appears to be growing across a wider range of developing countries.

The definition and categorisation between developed and developing economies are debatable. Many of the developing countries are in Africa, Asia, and South America. A typical developing nation has a shortage of food, few sources of power, and a low gross domestic product (GDP[8]). Normally, it is understood as any of the world's poor nations. Once these were called underdeveloped countries, but most economists now prefer the terms developing country or Less Developed Country (L.D.C.). After the zollapse of the Soviet Union, the term transition economy was also introduced, and later, emerging market has been recognised as a technical term for the dynamic developing and transition economies. In parallel with those income-based classification, leader, follower, and laggard are introduced in the classical Abramovitz's convergence and catch-up concept of the economic growth, based on the different levels of national technological congruence and social capability. The terms, 'Forging ahead', 'Catching Up', and 'Falling Behind', once were used among the leader's league, Laggards or Latecomers, were applied later to the developing world.

In 1995, 1996 Hobday has tried to apply the concept of 'latecomer' at the firm level, contrasting the idea with that of leaders and followers in the business literature. At the firm level, a latecomer firm can be defined as a manufacturing company that faces competitive disadvantages in attempting to compete in export markets. In contrast to leaders and followers, latecomers confront at least two major barriers: technology and export market. Regarding

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people with a common interest, NGOs perform a variety of service and humanitarian functions, bring citizen concerns to Governments, advocate and monitor policies and encourage political particpation through provision of information. Some are organized around specific issues, such as human rights, environment or health. They provide analysis and expertise, serve as early warning mechanisms and help monitor and implement international agreements. Their relationship with offices and agencies of the United Nations system differs depending on their goals, their venue and the mandate of a particular institution.

[8] GDP Gross Domestic Product is the broadest quantitative measure of a nation's total economic activity. More specifically, GDP represents the monetary value of all goods and services produced within a nation's geographic borders over a specified period of time.

technology barriers, most latecomer firms are located in developing countries with a small pool of advanced technology and R&D. Firm's operating conditions lag behind the leaders in technology. Insufficient industrial and technological infrastructure, and poorly established research, development & engineering (RD&E) institutions and educational systems also impact on the latecomer firms options (see Hobday, 1996). Another disadvantage of latecomers is in international marketing. The latecomer's local market tends to be smaller and underdeveloped. As a result, latecomers must devise strategies to overcome entry barriers if they wish to compete in the larger, more advanced markets of developed countries. To increase export sales to the world market, latecomers, therefore, need to overcome both technological and international market barriers by implementing an appropriate strategy in the short and long term.

Dahlman and Nelson (1996) use empirical data such as; S&T manpower, R&D expenditure and educational figures, to analyse the relationships among social absorptive capability, NIS and economic performance by measuring and comparing 14 developing countries' technological capability. They concluded that most critical element of any successful development strategy is the development of human resource.

Only the social absorptive capability by itself, as measured by high technical human capital, is not sufficient to explain why some economies have performed much better than others. The macro and incentive environments, including the importance of a strong outward orientation of private sector on the innovation system, also affected the NIS in the latecomer economies. The effective utilization of foreign technology is more important than doing a lot of R&D in some East Asian NIEs such as Hong Kong and Singapore.

Other more applicable and conceptualized studies on NIS are Arocena and Sutz (1999) and Gu (1999). They point out further that industrial innovation in developing countries is highly informal, i.e., not products of formally articulated R&D activities. In addition, dominant cultural patterns of these

countries undervalue scientific knowledge and technological innovation. Gu (1999) elaborates more that NIS in developing countries has the following distinctive characteristics:

a) NIS in developing countries is less developed by order. NIS in developing countries should be studied in the context of economic development, i.e., it is important to ask how did innovation related activities *start*, and how they continued to *improve* once started in relation to their local conditions and changing internal and external environment.

b) NIS in a developing country is specifically related to the country's development level.

   Therefore, it is important to connect level of NIS development with level of economic structural and institutional development.

c) Extraordinary intensive learning of the countries like Korea and Taiwan was the crucial factor for their successful catching up, which required and was supported by the rapid development of their NIS. Studies on NIS in developing countries should pay high attention to purposeful strategic management for catching up.

d) As market mechanisms in developing countries are still under-developed, the role of the market in developing countries in terms of promoting learning needs to be perceived differently from that of developed countries.

e) Unlike developed countries, capital accumulation, rather than intangible assets such as knowledge and learning, is the main contribution to technical progress in developing countries.

While disagreeing the importance of competitive economic factors, most authors strongly agree that an educated workforce is a necessary though not sufficient condition for an effective NIS. Most approaches differ in other

important aspects. Authors such as Freeman and Lundvall lay an emphasis upon organisational matters related to learning, the interaction between the production system and the process of innovation. A narrow view only considers organisations and institutions involved in searching and exploring – such as universities, technological institutes and R&D departments. The broad definition includes "all parts and aspects of the economic structure and set-up affecting learning as well as searching and exploring" (Lundvall 1992, p. 12)

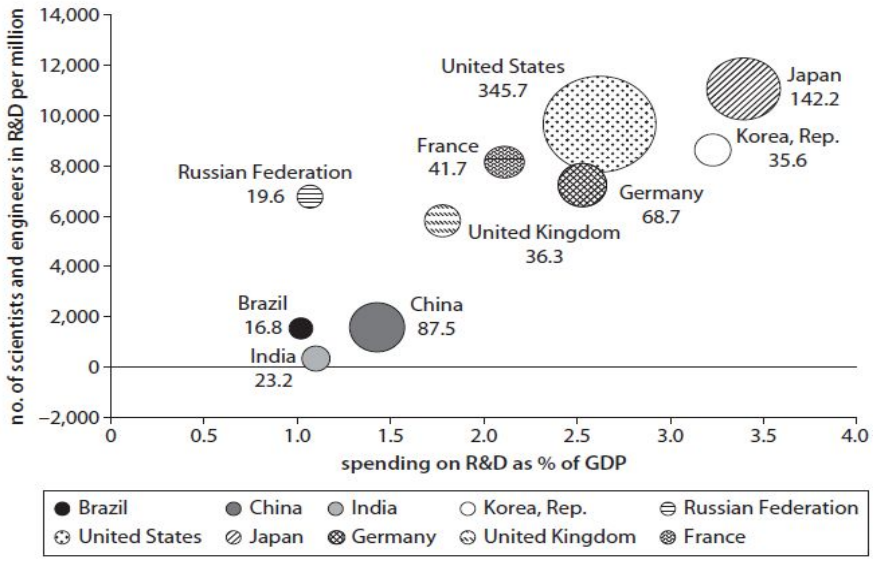
Other authors, like Nelson (Nelson 1988), focus on the production of knowledge and innovation, mostly related to law and economics and thereby stressing institutional factors. In his opinion a NIS should consider how well institutional set-ups take into account and solve the private / public dilemma of information and technical innovation. After all, since Lundvall's (Lundvall 1992) and Nelson's (Nelson 1988) contributions, the NIS approach has gained even more in popularity, amongst politicians as well as amongst innovation researchers.

3. The Developing Countries Funding in R&D

Although the role of R&D in developing countries is somewhat different from that in developed countries, developing countries need research capability to know what knowledge is relevant, and to acquire that knowledge. They also need to be able to adapt technology to local conditions. In agriculture, for example, developing country researchers need to understand various soils, climates, weather, pests, and tastes. For industry, they need to understand various raw materials, climates, and local preferences. For services, they must understand various forms of social organization, cultural norms, and customs. At early stages, R&D focuses mainly on the search for and acquisition of existing technology and on its adaptation to local conditions. As countries catch up with the world frontier and increase their R&D capability, they begin to push back that frontier. They may have done so earlier when trying to develop technologies more appropriate to their specific circumstances, as part of the green revolution in agriculture, for instance. Eventually, though, these countries also conduct more basic research. Some countries, however—even a country as advanced as Japan—still do relatively little basic research and continue to concentrate primarily on applied R&D. Although the United States formerly did more basic research than any other country, its share of basic research has declined with the cutbacks in government spending. In fact, some are concerned that the country is now doing too little basic R&D (National Academy of Sciences 2007).

For the largest spenders on R&D, compares R&D expenditure and the relative intensity of scientists and engineers. The data relate to 2006, and both China and India have considerably increased their R&D spending since then. The Chinese government has an explicit strategy to go beyond acquiring global knowledge through copying, reverse engineering, FDI, and technology licensing and to invest in innovation on its own account. In 2006, it announced a 15-year plan to increase expenditures on R&D to 2.0 percent by 2010 and to 2.5 percent (the average level of developed countries) by 2025.

Figure 1. Relative R&D Expenditures and Number of Scientists and Engineers



Source: Author's calculation based WDI 2008,

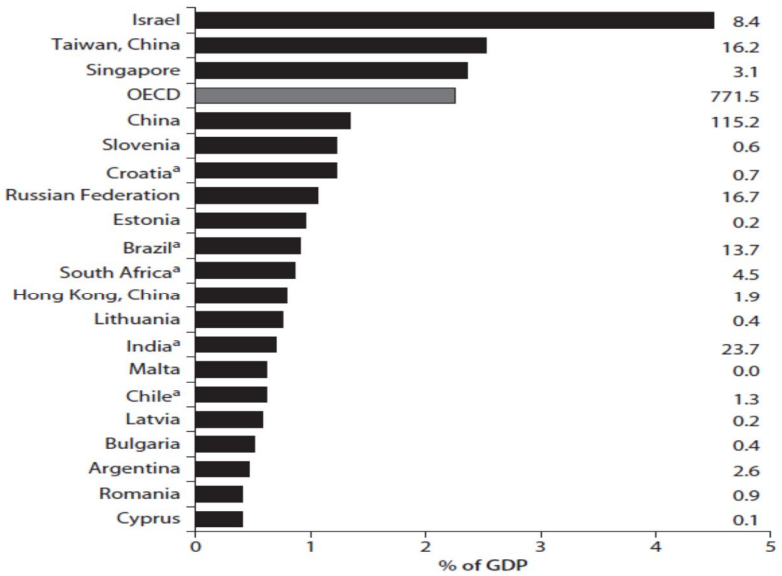
with some adjustments for India based on Dutz 2007.

The Main R&D Actors in OECD[9] countries, the business sector finances on average 63 percent of R&D, the government finances 30 percent, including universities and foundations and others finance 7 percent.

Graph 1. R&D Expenditures as a Percentage of GDP for Selected Economies, 2005 PPP[10]

9 OECD = Organisation for Economic Co-operation and Development; PPP = purchasing power parity. Expenditures for China and India are overstated because values of purchasing power parity are based on the pre-December 2007 conversion factors that overstated these economies' dollar values by 40 percent. a. Data are for 2004.

current US$ billions



Source: OECD 2007.

The situation is similar for the performance of R&D, except that the private sector and universities have larger shares since the government finances some R&D undertaken by the business sector and universities. The private sector also finances some university research, thereby increasing the share of R&D conducted by universities. In most developing countries, the government and the business sector play the opposite roles for both financing and performance of R&D. The government is the main financier and the main performer of R&D, because the private sector is generally less developed and comprises smaller firms whose limited capabilities still keep them behind the global technological frontier.

Table 1. R&D expenditure by source of financing:

[10] PPP-Purchasing power party compares different countries currencies' through a market "basket of goods" approach. Two currencies are in PPP when a market basket of goods (taking into account the exchange rate) is priced the same in both countries.

Main OECD and 10 developing and emerging economies, 2005

Country	Business enterprises	Other (other national and foreign sources)	Government
Russian Federation	30.0	8.1	61.9
Poland	33.4	8.9	57.7
Slovak Republic	36.6	6.4	57.0
Turkey /a/	37.9	5.1	57.0
Hungary	39.4	11.1	49.4
Mexico	46.5	8.2	45.3
South Africa (2004)	48.6	15.8	35.6
EU-27[11] /a/	54.0	10.6	35.4
Czech Republic	54.1	5.0	40.9
OECD	62.5	7.8	29.7
United States /b/	64.9	5.8	29.3
China	67.0	6.6	26.3

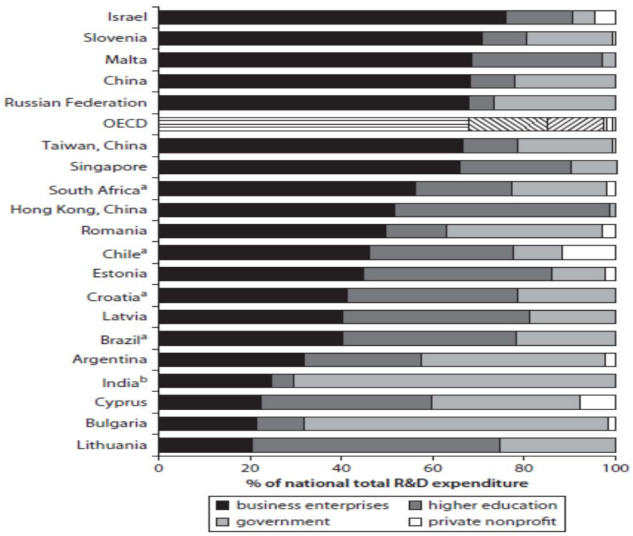
11 EU-27 = the 27 countries of the European Union; a. Data are for 2004. b. Data are for 2006.

Korea, Rep.	75.0	2.0	23.0
Japan	76.1	7.1	16.8

Source: Based on OECD 2007, 27.

These expenditures have been the pattern for some countries recently moved to developed country status. The Republic of Korea is a good example. In the mid-1960s, Korea's per capita income was not much higher than Ghana's, its R&D spending was just 0.5 percent of GDP, and the government financed 80 percent of R&D and the business sector only 20 percent. Because the Korean government was very eager to have the private sector undertake more R&D, it provided incentives such as duty-free imports for research equipment and materials and accelerated depreciation, offered tax incentives, and exempted graduates who opted to go into research from military service.

Graph 2. R&D Expenditures by sector as a percentage of national total



Source: OECD 2007, 29.

Although generally not based on R&D, much grassroots innovation takes place in developing countries as the result of people's experimentation and practical experience in dealing with their daily challenges. That the efficiency and effectiveness of many of these innovations can be improved with some R&D is acknowledged in countries such as India, which has systematically collected grassroots innovations and has a well-organized grassroots innovation system.

A. Public Sector R&D in Developing Countries

Developing countries need to create and commercialize knowledge because new knowledge is key to competitiveness. This is particularly true for larger countries, even low-income ones, such as India, that have a critical mass of resources and competences for a significant R&D effort. Even smaller poor countries have to have some capacity for creating knowledge. At a minimum, they need R&D capability for assessing relevant global knowledge, helping negotiate and acquire it, and adapting it to local conditions.

Key Policy Issues: The allocation of limited public resources and the effectiveness of their use is a critical policy issue. Unfortunately, most developing countries do not allocate or use these very limited resources very well, and better allocation of public resources should be a priority, including a better definition of what areas the government should support. A second priority is more effective management of these resources, particularly their contribution to the economy. It is difficult to justify pure academic research in countries with pressing social and economic needs when more applied R&D can make a significant contribution. Many developing countries do not monitor public research institutes adequately or impose effective accountability standards. Those institutions that contribute little to meeting the needs of the economy should be restructured.

Poor countries also need to undertake some basic research so that people who understand global scientific and technological trends can help their countries access relevant knowledge, adapt it to their needs, and work

with other researchers to solve scientific problems. As has been pointed out, the price of admission to international research networks is local scientists who do basic research (Wagner 2008). While it makes sense for developing countries to invest in areas in which they already have a comparative advantage to enhance that advantage, not simply maintain it, it is also important for them to invest in new technological areas such as genetic engineering, biotechnology, and nanotechnology. The public sector will have to play a greater role in carrying out this type of riskier and more uncertain research as part of a strategy of exploring new areas with potentially high returns. Such investments are needed so that countries can move rapidly into areas that show promising results.

Therefore, countries need to put in place not only appropriate policies but also public and private supporting institutions to create new knowledge and to facilitate the acquisition and dissemination of that knowledge. In addition, a key problem in most developing countries is that even when relevant knowledge is created in public labs or universities, it is not commercialized.

Therefore, the supportive infrastructure that technology parks, business incubators, technology transfer centers, and venture capital to commercialize knowledge is essential; East Asia—particularly China; Korea; and Taiwan, China—is a good example of this approach. (Yusuf and Nabeshima (2008)) It is also necessary to make sure that the country develops the necessary human resources to undertake and manage R&D and to commercialize relevant knowledge. Obviously, how much a country should invest in its R&D and commercialization infrastructure will depend on its resources and size. The richer and more developed its institutions and human capital are, the more it can do. Even some countries poor in average per capita income, such as China or India, have the critical mass of resources, institutions, and people to create and commercialize knowledge. They will still benefit tremendously, however, from continuing to improve the acquisition, dissemination, and effective use of existing knowledge.

B. Private Sector R&D in Developing Countries

In developing countries, the productive sector does relatively little R&D, for various reasons:

- Because most firms are behind the global technological frontier, it makes more sense for them to buy or copy existing foreign technology, which is generally cheaper than undertaking risky R&D.

- Because domestic markets are generally less competitive and more segmented than those in developed countries, they face less pressure to develop new technology and must overcome more barriers to entry and to exit.

- Most firms do not have the scientists and engineers to undertake formal R&D.

- The very large majority of firms are too small to have the resources to invest in R&D.

- The cost of capital is also generally higher than in developed economies.

- The macroeconomic environment is often more unstable and not conducive to undertaking lengthy R&D. Because intellectual property regimes are generally less developed, firms face a greater risk that any technology they develop will leak out or be appropriated by others.

- Transactions costs are higher for setting up, operating, and expanding firms than in developed countries (IFC[12] 2009).

[12] IFC-The International Finance Corporation is an international financial institution that offers investment, advisory, and asset management services to encourage private sector development in developing countries.

C. Main Firms Doing R&D in Developing Countries

The firms that undertake R&D tend to be large public enterprises in natural resources or large conglomerates in electronics, telecommunications, auto and engineering, domestic appliances, and basic commodities, such as paper, mining, iron and steel, food products, or other products based on natural resources.

Table 2. TOP-10 R&D companies from developing and emerging economies, 2007

Company	Country	Industry	R&D expenditures (US$ millions)
Samsung (9)	Korea, Rep.	Computing, electronics	6,536
Hyundai Motor (62	Korea, Rep.	Auto	1,197
LG Corporation (63)	Korea, Rep.	Other	1,952
Petrobras (117)	Brazil	Chemicals, energy	879
Cia Vale do Rio Doce (140)	Brazil	Minerals	717
Petrochina (142)	China	Chemicals, energy	699
Kia Motors (148)	Korea, Rep.	Auto	649
Korea Electric Power (149)	Korea, Rep.	Other	649

Hynix Semiconductor (150)	Taiwan, China	Computing, electronics	635
Gazprom (159)	Russian Federation	Chemicals, energy	605

Source: Jaruzelski, Dehoff, and Bordia 2005.

Only 93 developing countries are among the 1,000 companies that spend the most on R&D worldwide. Almost three-fifths are concentrated in Korea and Taiwan, China, followed by China and India. Companies in East Asia specialize mostly in computing and electronics; in India and Eastern.

III. RESEARCH METHODS CURRENT SYSTEM

This chapter describes the research scope and methodology current R&D system and funding used in this study.

1. The Research Scope and Methodology

Innovation is a complex process. It has technological, economic, social and cultural dimensions. It involves scientists, developers, marketers, and customers and it relates to processes, products, and services. Governments may devise broadly-based policies and support schemes that touch many aspects of innovation; on the other hand they may concentrate on precisely-targeted measures designed to tackle a particular problem; or they may do both.

In this study I have taken the connection with organizational change and the marketing of new products extends innovation policy to relate to a broader terrain. This approach runs the risk that every single organization has in a direct or indirect manner a connection with the national innovation system and R&D funding. In drawing up the system, however, a certain cut off point needs to be defined where certain organizations or structures of the governmental system are excluded. For this meant that the link with "development, spread and efficient use of new products, services, and processes" needed to be explicit.

First, considered only funding flows and relationships among organizations within the national boundaries. Thus, excluded supranational policies and funding although they often get reflected in national policies and instruments in any case. Second, only looked at public policies and funding sources in the public domain. Private expenditures toward research and technology development were not taken into consideration. Private intermediary organizations designed to (partly) spend public money, however, were taken

into account. Finally, some countries have large expenditures in the defense sector, while others have much smaller budgets appropriated. While policies oriented toward the technology development in the defense sector have often dual or spin-off purposes, funding is ruled by complete different regulations and objectives. Thus, this research covers only non-defense related public funding.

To organize this research, first developed an analytic framework to structure the study. This framework uses two levels of analysis:

- Systemic level: National Innovation System (NIS) overview
- Organizational level: analysis of functions of R&D funding organizations.

1) Systemic Level

The position of government in the total NIS has important implications for the role it assumes in stimulating innovation and for the instruments that it selects to achieve its objectives. The concept of an NIS is becoming increasingly familiar as the importance of links among science, technology, economics and public policy is recognized and 'linear' models of innovation give way to system-oriented approaches that acknowledge complex feedback loops and learning processes among different actors and phases of innovation. Briefly, an NIS can be classified in terms of:

- ***public policy*** – Those objectives and activities formulated by government that aim to achieve the establishment of a strong science base, development of new technologies, and promotion of the competitive position of the country as a whole. This includes direct RTD support, indirect support through e.g. tax policy and targeting of support to particular fields, disciplines or institutions.
- ***institutional factors*** – These include the public and private organizations and their infrastructure, and the legal framework in

which they function especially with regard to intellectual property rights.

- ***external factors and constraints*** – These refer to autonomous developments or national characteristics which do not typically result from the behavior of the actors in the system, and over which the actors have little or no control.

We have distinguished among three types of actors in the national innovation system. These types can be distinguished as to their proximity to policy or research performance, depending on the perspective that one takes. Within these categories, the actors can be separated from operating in the public to private sectors:

- Financing/policy agencies and organizations are involved insofar as they finance R&D and define the policy directions. These comprise governmental agencies at the national or the regional levels, and organizations within the business sector.

- Intermediary organizations to which financing, steering and organizational tasks within the innovation system are delegated. These organizations comprise research councils, public-private partnerships, independent public agencies, or special national research programs and agencies.

- RTD performers and innovators. Universities, not-for-profit research institutes, for-profit research firms, SMEs[13], and large companies form this category of organizations.

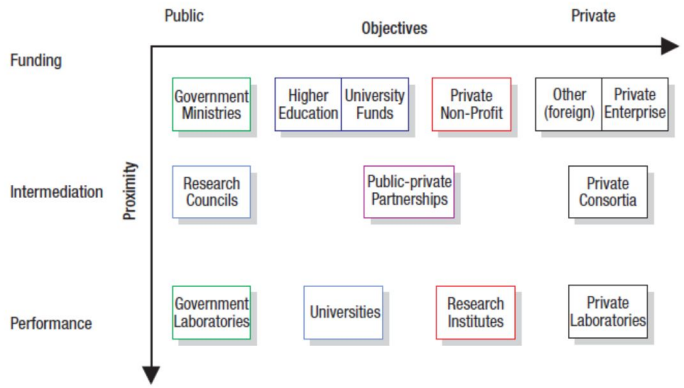
Different relationships exist between the three types of agencies and organizations. This is related to differences between the political structures, legal frameworks, and cultures in the various countries as well as to differences in innovation policies.

[13] SMEs Small and medium-sized enterprises sometimes also small and medium-sized businesses (SMBs) are businesses whose personnel numbers fall below certain limits.

The structure of the respective systems is also related to different notions concerning the relationship between public and private financing of R&D. Particularly during last years, many countries have experienced changes in financial markets and more private financing is available both for research and start-up companies. Substantial differences exist with respect to the relationship between the financing, intermediary and executing agencies and organizations relative to amount of funds coming from the different financing bodies. Particularly, the roles of intermediary organizations are currently undergoing change.

These several dimensions and the different actors that are distinguished within them can be presented in the following generic figure. At the upper row are the financing organizations, the middle row represents the intermediary organizations, and at the bottom are the R&D performing organizations.

Figure 2. Player and their role with respect to financing of R&D system



Source: Government funding for R&D, Technology review122/2002

2) Organizational Level

To answer a series of research questions, an analysis of the systemic level would not be sufficient. Thus, a closer examination of some of the individual actors within the NIS was required. This level can be presented in

the following figure. Four categories of organizational characteristics are separated:

- Role and function reflect the main mission and tasks of an organization. This also includes the relative position of an organization with respect to other organizations in NIS.

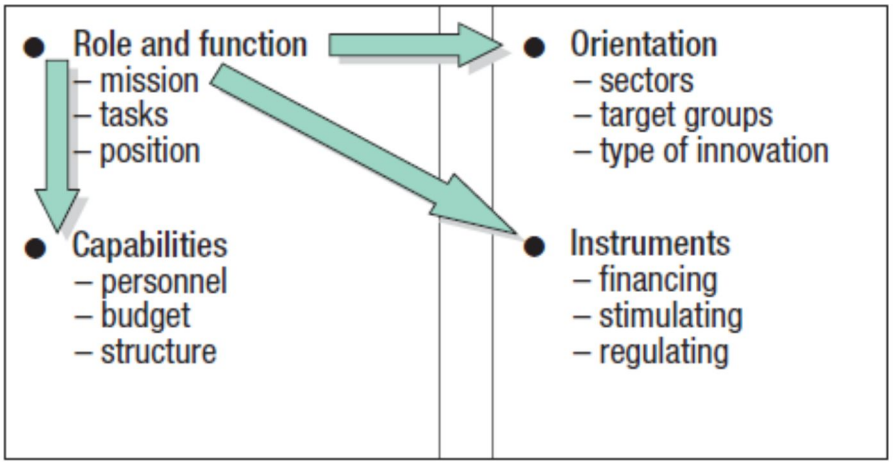
- Capabilities of an organization reflect its personnel, budget and structure.

- Orientation of an organization highlights any specific emphasis that an organization may have with respect to the industrial sectors, target groups (universities, SMEs), or type of innovation.

- Instruments describe the means that an organization uses to reach its goals (e.g., financing, stimulating, and regulating).

There is obviously a clear relationship among these characteristics, primarily driven by the role and function of an organization. For each organization information over these four categories was collected.

Figure 3. Organizational characteristics analyze



Source: Government funding for R&D, Technology review122/2002

3) Organization of Research

This research concentrates on the R&D funding of Korea that have been able to demonstrate good performance of and favorable development in Korean innovation system. There are several criteria for the selection of country. A first one are the known innovative characteristics of some countries, a second one is the lead capacity some larger country have, and a third one is the comparable situation to the Mongolian context. Selecting country criteria provides useful insights.

IV. THE R&D FUNDING SYSTEM OF KOREA

This chapter describes the Korean R&D funding system with into three part: the first the Korean NIS and some programs, R&D policy trend, governance system and main actors, legal framework on R&D, the second the Korean R&D funding trend, future challenge and system, the third part consists ODA and Korean ODA, the R&D funding system transfer brief cases of Vietnam through Korean ODA.

1. The Korean R&D Governance System

1) The Korean NIS

The primary components of a national innovation system are a country's endowments and how government and industry leverage those endowments. A scarcity of natural resources has motivated Korea to look at its human capital as its biggest endowment, and the country has invested heavily in education, science and technology, and a "knowledge-based" economy. The Korean national innovation system is split to strongly separated pillars which represents a very focused approach on the different aspects of innovation-related policies. This means that for science, technology, information and communication, economic and business development policies separate organization bear responsibility for policymaking in that specific field supported by specific implementation or management agencies. There has been a huge need to better coordinate the national innovation policy. In 1999, the National Science and Technology Council (NSTC) was launched. All the ministries with direct or indirect link to the S&T policy are represented in this council. In addition to reviewing and coordinating national S&T policies and R&D programs it decides on the allocation of S&T budget. So far NSTC is the only official coordination activity across the ministries and their R&D agencies in the Korean innovation system. (Erik Frinking, Mari

Hjelt, Irma Essers, Päivi Luoma, Sami Mahroum, Government funding for R&D, 2002)

The challenges presented to the Korean Innovation System require several fundamental and structural changes. Some are more directly related to particular innovation actors and activities; but some are, directly and indirectly, related to the much wider context of the economic system as a whole. The role of the NIS in a knowledge based economy is as the primary producer of knowledge which enables sustained economic growth; however, at the same time, the configuration and constellation of the NIS is conditioned by a much broader socio-economic context. Some of these changes are already underway in Korea, particularly in the wake of the financial crisis. Government, industry and research communities are all making painful efforts to reform. Some of these efforts are very positive, but some need to be more carefully designed.

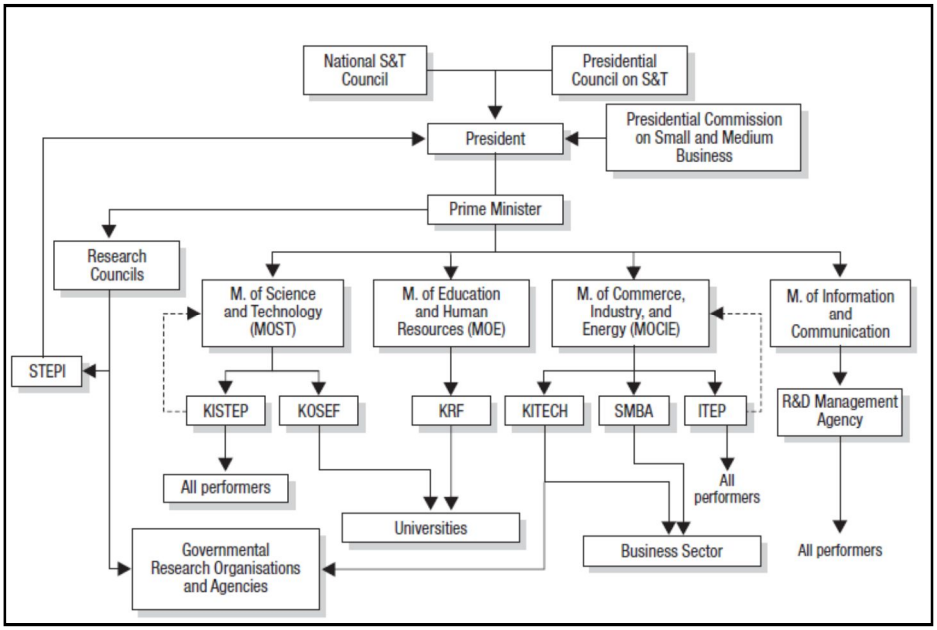
The main characteristic of Korean innovation system is that the responsibilities are clearly split between different ministries. Altogether eight ministries with their own R&D management agencies perform their own R&D activities. The most important ministries related to innovation policy are the Ministry of Science and Technology (MOST) and the Ministry of Commerce, Industry and Energy (MOCIE). In addition to these, the Ministry of Information and Communication (MIC) has an increasing role in the national innovation policy. The Ministry of Education and Human Resources (MEHR) influences innovation policy through its relevant role in the national research policy. Other ministries are focusing on issues that including innovation that are strictly on their own fields. There are several councils reporting to the Presidential Office on innovation matters. These include the National S&T Council, the Presidential Council on S&T, and the Presidential Commission on Small and Medium Business.

The first one is the most important council to the national innovation and S&T policy. Intermediary level is dominated by the R&D management agencies of

different ministries. They differ from each other in their scope of innovation and technology as well as the characteristics of the performers they are funding. There is no formal coordination between management agencies of different ministries, and they are legally independent from each other.

In Korea, private sector is the most significant R&D performer. Public performer level is dominated by the government supported research institutes. The role of other research institutes and universities has traditionally been small. However, the need to increase the role of the universities has been recognized. Figure presents the general structure of the Korean innovation system. Some of the most important players of the system are described below shortly.

Figure 4. Korean National Innovation System.



Source: Government funding for R&D, technology review, 122/2002

Government's Role in Innovation: Through state-led research and education and corporate R&D, Korea has developed a robust science and technology capacity. The country is currently emphasizing R&D in the areas of green technologies, value-added services, and technology convergence—merging

telecommunications and network technologies into a single device, for example. The government also ensures that, through its support of industry-oriented research centers, there is a central locus of research geared towards the development of platform and infrastructural technologies that fundamental technologies that enable subsequent creation of other products and processes.

Industry's Role in Innovation: Korea's industry and economy is dominated by business conglomerates called "chaebol"[14]. These companies have moved from safe technology investments and incremental innovation toward cutting-edge science-based innovation by adopting Western business practices; as the country has developed, Korea's historical focus on manufacturing has shifted to services and investing in R&D at the forefront of technology.

Parts of the South Korean national innovation system were reformed in 1999. The NSTC[15] was established to coordinate national S&T policy. STEPI[16], a government-funded research organization specializing in S&T policy research, was reorganized as an independent institute under the "Korea Council of Economic and Social Research Institutes (KCESRI)". In its current role STEPI functions as the nation's policy think-tank providing expert analysis and advice on major S&T issues. KISTEP[17] which was formerly the Division of R&D Planning and Management of STEPI was formed as an independent organization.

2) The Korean R&D Policy Trend

The NSTC announced the 'Advancement Plan of National R&D System,' in 2010, whose main directions are to seek creative and convergence-oriented R&D, establish a globally open innovation system and produce quality R&D outcomes. This measure involves ten ministries. To respond to the need to integrate different fields of technologies and strengthen R&D linkage amongst ministries for maximal efficiency of national R&D

[14] e.g., Samsung, Hyundai, Pohang Iron and Steel Company, and LG electronics
[15] National Science and Technology Council
[16] Science and Technology Institute
[17] Korea Institute of S&T Evaluation and Planning

investment, the government plans to implement the 'National Inter-ministerial Joint R&D Planning' starting in 2011[18]. Korea's economic growth has been led by chaebol – large, highly diversified, family owned companies. With the recognition of the increasingly important role of SMEs, the target of government support for corporate innovation has shifted away from large firms and towards SMEs through more direct funds for research in SMEs as well as tax waivers, tariff exemption for R&D equipment, and military service exemption for researchers. Enhancing knowledge circulation as well as knowledge production is increasingly a crucial element for Korea's innovation policy. In order to facilitate cooperation amongst industry, academia, and research institutes, the government announced the 'Plan for Advancing Cooperation amongst Industry, Academia, and Research Institutes' in September 2010.

The Korean government modified a five-year Comprehensive Regional Science and Technology Promotion Plan, which was set up in December 2007 at the end of previous government, in 2010. At the end of October 2010, the government has also laid out a new development plan with the aims of changing the roles, missions and management systems of GRIs towards more mission-oriented and open systems, a stricter evaluation system, more efficient human resources and organisational management system as well as a more stable research environment.

As most government ministries have their own research policies and funding programmes that The National R&D Program, The 21st Century Frontier R&D Program The Creative Research Initiative (CRI) Program, The National Research Laboratory (NRL) Program, The Nano-Bio Technology (NT-BT) Development Program, The Nanotechnology Development Program, The Biotechnology Development Program, The Space Technology Development Program, Atomic Energy R&D Program and Venture Capital programs,

[18] www.nstc.go.kr

In September 1999, the government launched a long-term strategic initiative: the Long-term Vision for S&T Development Toward 2025 (Vision 2025). The goals are grouped in three time frames, spanning a 25-year period. Each time frame is defined by a unifying theme that characterizes the primary focus of activity for that period.

First Step (by 2005): Place the Korean scientific and technological capabilities at competitive levels with those of the world's leading countries by mobilizing resources, expanding industrialized infrastructure, and improving relevant laws and regulations.

Second Step (by 2015): Stand out as a major R&D promoting country in the Asia-Pacific region, actively engaging in scientific studies and creating a new atmosphere conducive to the promotion of R&D.

Third Step (by 2025): Secure a scientific and technological competitiveness in selected areas comparable to those of G-7 countries.

The Korean government has emphasised international cooperation for promoting cross-border flows of knowledge in accordance with increasing globalisation. The Korean government is establishing a global open innovation system through promotion of networking and co-projects with global partners and pursuing strategic S&T international cooperation with a view towards becoming a global S&T leader, as is stated in the S&T Basic Plan devised in 2008 and the Advancement Planning in S&T in 2010. The MKE and MEST are major players to strengthen internationalisation of Korean R&D and to improve cross-border flows of knowledge. Since 2010, the Korea Institute for Advancement of Technology[19], on behalf of the MKE, has operated four kinds of programmes to fund international collaborative joint research projects among industry, academia and public research organisations in Korea and overseas countries for technology development.

[19] KIAT, www.kiat.or.kr

The National Research Foundation[20], on behalf of MEST, has managed two programmes, which consist of several projects to improve international cooperation as follows:

• Internationalisation of S&T, which consists of international collaborative research such as global research laboratory (GRL), establishment of a base for internationalisation through global networking, attracting foreign research centre;

• Supporting conclusion of MOUs, with foreign organisations, which includes exchange information and researchers with foreign organisations through symposium, fellowships and postdoctoral programmes.

Korea served as a chair country for the Summit and addressed the issue of strengthening science and technology cooperation in diverse areas with countries such as Russia and India. The Korean government has also made strategic endeavour to strengthen multilateral cooperation with East Asian countries to solve such problems as climate and environment within the region and to widen reciprocal cooperation with developing countries such as Vietnam, Uzbekistan and Brunei and the like.

3) The Korean R&D Governance

One of the most important development in the nation's science and technology policy is the government's endeavour to strengthen the roles and functions of the NSTC, which to date has been the highest yet weak policy decision-making body, into the most powerful research policy-making body with due evaluation and funding power to allocate government budget for R&D. The government upgraded the seniority of the Council to Commission, renaming it the National Science and Technology Commission and repositioning it as a powerful administrative commission under the authority of the Presidential office at the end of March 2011. The ever-strengthened version of the NSTC is expected to play a critical role in the advancement of

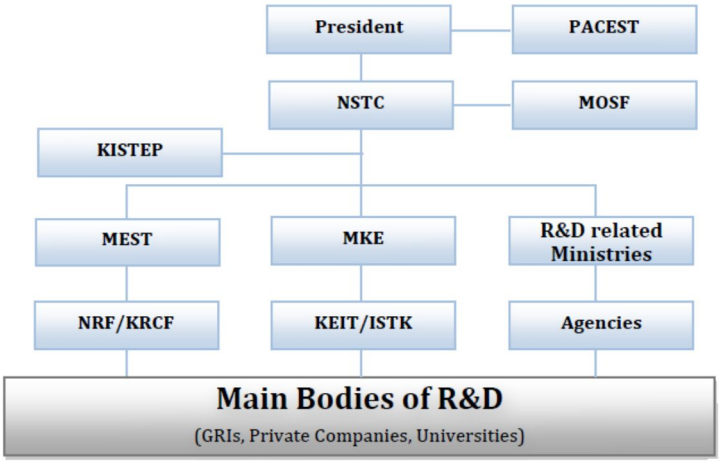
[20] NRF, www.nrf.re.kr

the nation's science and technology and furthermore, redirect the eco-system of the nation's science and technology into an optimal and dynamic one. In July 2010, the government announced the creation of a new position at the Office of the President, Senior Secretary to the President for Education, Science and Culture. The Senior Secretary is responsible for identifying and developing new growth engines in the areas of science and technology, broadcast and information technology, and green growth. It is also incumbent upon the Senior Secretary to devise future strategies and ensure their due implementation. There are advisory bodies at the top administrative level such as the President Committee on Green Growth (PCGG) and the Presidential Advisory Council on Education, Science and Technology (PACEST) chaired by the President.

The MKE relies on the Korea Evaluation Institute of Industrial Technology [21] and the Korea Energy Management Corporation [22] for the performance management of R&D projects. MEST relies on the National Research Foundation of Korea[23] for funding and performance management of national R&D projects, mainly in the areas of fundamental science and university research including humanities and social sciences. These organizations publicly propose various R&D programmes, garner proposals from researchers, select appropriate researchers for projects, review the performance of the projects in the middle of the project management, evaluate the final performance at the end of one year period regardless of the multiannual projects and report the final results to their ministries and the NSTC.

[21] KEIT, www.keit.re.kr
[22] KEMCO, www.kemco.or.kr
[23] NRF, www.nrf.re.kr

Figure 5. Organisational Chart



Source: Mini country report/ South Korea, Thematic Report 2011 under Specific Contract for the Integration of INNO Policy Trend Chart with ERAWATCH (2011-2012), July 2011, December 2011

There are main think-tanks for policy advice, STEPI and KISTEP in the public sector and the Samsung Economic Research Institute[24] in the private sector. STEPI and KISTEP play important roles in providing significant policy evidence to the NSTC and ministries through various tools such as technology foresight exercises, National Technology Road Mapping (NTRM), benchmarking, technology impact assessments, to name a few. Particularly KISTEP which had been under the auspice of MEST moved into the NSTC as a main supporting agency. KISTEP conducts evaluation on the performance and effectiveness of every project at programmes level and evaluates, with meta-evaluation method, the results of organisational evaluation of GRIs on behalf of the NSTC. The results of those evaluations are reflected in next year's R&D budget.

Many scientists and experts in universities and organisations such as the Korean Federation of S&T Societies, the Korean Academy of S&T, take part in the foresight and impact assessment process. The key research performers

[24] SERI, www.seri.org

are the private sector, public sector research organisations (PSROs) and the higher education sector that is in large part comprised of Korea's universities. The organisational performance in GRIs is evaluated by the umbrella Councils, the ISTK and KRCF, annual evaluation for their managerial performance and every three year evaluation for their research performance. The results of evaluation are reflected to researchers' incentives, the following year budget and possibility of next term of their president.

A. Advisory Councils

National Science and Technology Council (NSTC) was established in January 1999 to review and coordinate national S&T policies and R&D programs and to set priority for the allocation of S&T budgets. It is linked directly to the Presidential Office and chaired by the President. It consists of all of the ministers with direct or indirect link to the S&T policy as well as some representatives of the S&T community. The Ministry of Science and Technology serves as the secretariat for the NSTC. NSTC is the level where the national S&T policy is coordinated.

Presidential Council on Science and Technology (PCST) is an advisory body comprising leaders representing diverse areas of science and technology including people from industry as well as research. The PCST reviews important science and technology policies and related matters to advise the President. PCST is not directly dealing with the allocation of money.

Presidential Commission on Small and Medium Business formulates policy programs for SME's. It is located under the Presidential Office. The Commission is comprised of vice-ministers from related ministries as well as experts from the SME sector. The policies are implemented through the Small and Medium Business Administration (SMBA) which is governed by the Ministry of Commerce, Industry, and Energy. However, as well all the related ministries try to cooperate to regulate supporting functions for small and medium businesses.

Research Councils: Five Research Councils were established in 1999 to oversee the operation of the Government-supported Research Institutes. The Research Councils are on the areas of basic science, industrial technology, public technology, economic and social science, and humanities research. The research councils are located under the Prime Minister's Office. This new system has provided more autonomy to individual GRI's and made them more accountable for the management. These measures are expected to bring about improved research productivity, strengthened linkages between institutes, and more effective diffusion and utilization of research results.

B. Ministries and Their R&D Management Agencies

Ministry of Science and Technology (MOST[25]) was established in 1967. It has tried to play a role as the central agency for overseeing national S&T policy, administering S&T affairs and coordinating national R&D. Its functions include providing technology forecasting and support for the development of core technology, future-oriented technology and large-scale technology. Also, it promotes basic and applied research conducted by government- supported research institutes (GRI's), universities and private research institutes. Moreover, it formulates policies for human resources development and promotes public awareness on S&T. MOST has two R&D management agencies.

Korea Institute of S&T Evaluation and Planning (KISTEP[26]) was formed as an independent organization in 1999. It was formerly the Division of R&D Planning and Management of Science and Technology Institute (STEPI). KISTEP has the responsibility of implementing government policy to intensify planning, managing, and evaluation of national R&D. KISTEP plans and manages the national R&D projects of the Ministry of Science & Technology. In addition to this, it would be ready to do this for other ministries as well. KISTEP aims at systematizing and improving the

[25] http://www.most.go.kr/index_e.html
[26] www.kistep.re.kr

management of the R&D system and tries to be customer oriented in its work. Moreover, KISTEP studies trends and technology demands, analyzing S&T indicators and related information, carries out survey, analysis, and evaluation of national R&D programs, and assists those programs by technology forecast and assessment. Also, it supports the nation's international cooperative S&T activities and reinforces the national S&T innovation system through international S&T cooperation. KISTEP supports R&D of all types of performers but the funding goes mainly to the business sector and governmental research organizations.

Korea Science and Engineering Foundation (KOSEF[27]) was established in 1977 for enhancing the nation's scientific and technological development through cultivation of research, and promotion of science education and international cooperation with other countries. It provides funds only for universities. KOSEF supports universities to secure scientific and technological manpower by carrying out a variety of programs designed to accelerate academic activities, international cooperation and collaboration between industry and academic community.

Ministry of Education & Human Resources Development (MOE[28]) was launched in January 2001 when the organization of the former Ministry of Education was restructed and its scope expanded. The Ministry was upgraded to the rank of deputy prime minister and is responsible for formulating and coordinating policies on education and human resources development. It is in the special focus of the ministry to make the citizens ready for the challenges of an information and knowledge based society and to be constructive members of the global community. The R&D management agency of MOE is Korea Research Foundation (KRF).

Ministry of Commerce, Industry and Energy (MOCIE[29]) plans and implements relevant policies to promote regional industries, to promote the

[27] www.kosef.re.kr
[28] www.moe.go.kr
[29] http://www.mocie.go.kr/engindex.htm

shift towards an environment-friendly industrial structure, and to take responsibility for matters related to the promotion of distribution, logistics & business service industries. It links industrial policy to SME and venture business policy. It formulates and implements trade policies, including plans for trade promotion and support activities which identify new markets, attract investment and facilitate economic cooperation in the private sector. The R&D management agencies of MOCIE are Korea Institute of Industrial Technology (KITECH), and Korea Institute of Industrial Technology and Planning (ITEP). Also Small and Medium Business Administration (SMBA) is located under MOCIE.

Korea Institute of Industrial Technology (KITECH[30]) was founded in 1989 to enhance the nation's industrial competitiveness through technological innovation with a special focus on SMEs. It develops technology which is too costly for small and mid-size businesses to pursue on their own. It provides comprehensive support and improvement for SMEs ability to develop and apply new technology. It disseminates R&D methods, enhanced technical results and technological innovations to SMEs, and gives technical support for SMEs emphasizing their actual technology needs.

The Small and Medium Business Administration (SMBA[31]) is a central government agency that also functions as the secretariat of the Presidential Commission on Small and Medium Business. It seems to have overtaken many of the SME related activities of KITECH. It develops and implements SME policy, analyzes industry trends, helps aid restructuring reforms and assists small businesses. It provides finance, credit, human resources and information services, marketing and distribution for SMEs. It assists the promotion of start-up venture companies including aiding with the selection of industrial sites. As well it helps with the development, cooperation, and guidance of technology for the SME sector. SMBA has 11 regional offices which are entrusted with the mission to improve cooperation between local

[30] www.kitech.re.kr
[31] http://www.smba.go.kr/english/introduction.html

government offices and related local SME organizations and to execute supportive policies for local small and medium businesses.

Ministry of Information and Communication (MIC[32]) has an increasing role in the national innovation policy. Among its tasks is to formulate information and communication related policies. MIC has its own R&D management agency.

4) The Korean R&D Legal Framework

In addition, the government has started to recognize the growing importance of intellectual property and is paying due attention. In April 2011, the National Assembly enacted the Basic Law for Managing Intellectual Property and the Intellectual Property Management Council was established in July 2011 on the basis of the Law, under the Prime Minister's Office and chaired by the Prime Minister. The Council will be responsible for facilitating the creation, protection, and utilization of intellectual property and for giving advice and recommendations to the NSTC for IP-centered R&D budget and programs.

South Korea's legal framework upon which RTD and S&T policies are based. These operate within the National Innovation System: the network of organizations that stimulate and control R&D activities.

The Science and Technology Framework Law (Law No. 6353, 2001) is the main law covering systematic promotion of S&T at the national level. Important provisions of this law include the establishment of policies and plans for S&T and the overall support mechanism for related projects and agencies. It also aims to provide the legal mechanism for inter-ministerial coordination of R&D activities and to establish an institutional system to foster an innovation prone culture in South Korean society. The law replaces two previous S&T laws, which were the Science and Technology Promotion

[32] www.mic.go.kr

Law (Law No. 1864, 1967) and the Special law for Scientific and Technological Innovation (Law No. 5340, 1997).

The Technology Development Promotion Law (Law No. 2399, 1972) provides financial and tax incentives to encourage and facilitate the technological development activities of private enterprises.

The Promotion of Engineering Services Law (Law No. 2474, 1973) deals with the improvement of the engineering industry, which contributes to manufacturing enterprises and expedites the commercialization of R&D results.

The Promotion of Basic Science Research Law (Law No. 4196, 1989) provides financial support promoting innovative research in basic science at R&D institutes and universities to encourage innovation.

The Dual-use Technology Program Facilitation Law (Law No. 5535, 1998) was enacted upon the recommendation by four ministries, namely: MOST, the Ministry of Information and

Communications, the Ministry of Commerce, Industry and Energy, and the Ministry of National Defense. It aims to strengthen the nation's industrial competitiveness and military readiness by facilitating dual-use research and development and promoting technology exchange between the private sector and the military.

2. The Korean R&D Funding System

1) The R&D Funding Trend

According to the 'Science and Technology Basic Plan: 577 Initiative', which was produced in August 2008, the Korean government set up the national R&D investment objectives of devoting 5% of GDP to R&D by 2012. In order to achieve the goal, the Korean government has promoted private investments in R&D through adequate national research and innovation systems and various policy instruments as well as a highly increasing ratio of government expenditure on R&D each year. Various tax incentives to encourage more private investment in research and innovation were implemented. There is no evidence of decrease of R&D investment by the business sector due to economic crisis or depression. Many government departments including the MKE and the Small and Medium Business Administration (SMBA) have made efforts to set up direct financial support scheme and micro-credit loans, without any collateral or even technology evaluation, for both technology-based SMEs and individual-based entrepreneurial founders. With this financial scheme, it is expected to raise technology funding to KRW 7.1 trillion by 2012. Along with it, the government is set to tie prospective results from government funded researches with technology funds, thus making easier technology transfer and raising money for their commercialisation. The S&T investment fund of MEST and the Technology Entrepreneurship Investment Fund of the MKE are some of these types of funding.

The Korean government also introduced public procurement policies in 2006 for innovation-oriented SMEs and has increased procurement of innovative goods and services based on new technology with various instruments such as obligatory procurement of some proportion by local governments and national companies, giving a priority for products with technology certification such as NEP (New Excellent Product), NET (New

Excellent Technology), the GS (Good Software), and the EPC (Excellent Performance Certification) by governmental organisations, increasing procurement of green products, pre-commitment of procurement for SMEs participating in national R&D projects. The MKE and the SMBA in charge of procurement policies have tried to regularly hold workshops and communication activities between local governments and technology-based SMEs at both national and regional level to promote public procurement. The policy turned to be effective; the proportion of public procurement of goods and services of innovation-oriented SMEs accounted for up to 7% and more than 2 trillion KRW in 2009. The proportion of technology transfer produced by the GRIs and universities compared to the total R&D investment has increased to 12.8% in 2009 from 4.6% in 2004.

Korea ranked 7th in Gross Expenditure on R&D (GERD) and 5th in GERD per GDP in the world in 2008. Despite the global financial crisis of 2008 and 2009, the GERD has increased an average 10.7% each year between 2008 and 2011. In terms of total investment in innovation, many government departments and agencies have allocated specific budgets to specific measures, which were initially declared in policy documents and programming documents.

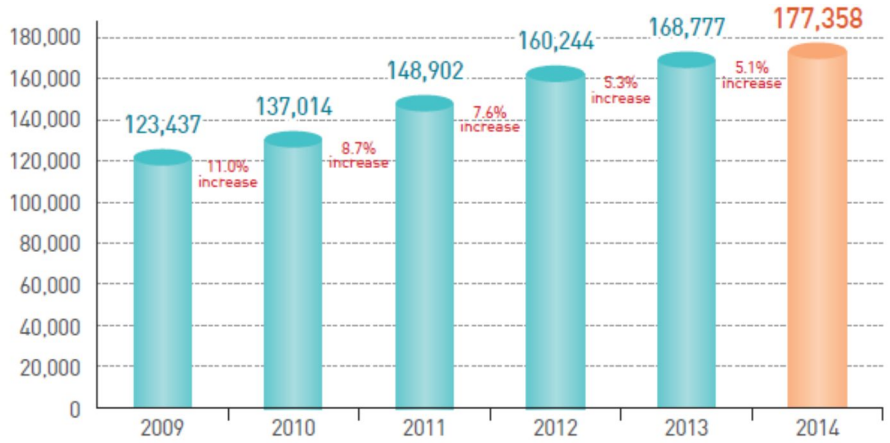
The NRF manages R&D projects, which are selected through all-year-around open competition and carried out by individual researchers or research groups in universities. The fields of research are not confined to science and technology; it runs the whole garner of areas including humanity and social sciences. The majority of those projects are planned by bottom-up approaches by researchers and professors. The R&D program of MEST and the MKE are mainly top-down and mission oriented addressing specific technological areas and instruments and political issues. The Korean government has taken diverse policy measures to promote and sustain the creation and growth of innovative enterprises, markets and innovation culture, particularly focused on strengthening global competitiveness of SMEs,

industrial development strategically related to regional innovation and green growth through new and renewable energy.

The ratio of Korea's investment in national R&D projects marks a huge growth each year. The Korean government keeps on expanding its investment in creative R&Ds to create future sources of national livelihood and invested KRW 17 trillion 735.8 billion in 2014, a 5.1% increase over the previous year. With such rapid increase of research fund for national R&D projects, Koreans' interest in research fund and the expectations for the results of investment becomes even bigger, making the demand for rational, efficient, and transparent execution of research fund to rise as well. The most fundamental method for more efficient and transparent investment of R&D support fund is rational execution and management of R&D funding.

Graph 3. Government R&D budget (2009-2014)

Unit:(KRW 100 million)



Source: National assembly -2014

2) The R&D Funding future challenge

In terms of GERD and BERD, Korea's ratios are amongst the highest in the world. The government R&D investment both in public and private

sector has successfully increased, allowing the level of Korea's R&D investment to be one of the highest in terms of the GDP ratio.

Despite the high level of research mobilisation for national R&D and concerted efforts made by many ministries for policy and programme planning, the efficiency and effectiveness of R&D investment and policy implementation are not pronounced high due to the excessive competition for project selection at the operational level, different interests between ministries and the weak role of a central body for coordination as well as a still low level of institutional funding for the GRIs. The priority setting by the government departments has been unsatisfactory due to internal divide by many divisions and the lack of coordination between the departments. Main debate regarding the priorities has emerged regarding the balance between fundamental S&T and industrial technology and between existing investment area and newly emerged area such as green technology. In spite of R&D globalisation, the total level of investment for internationalisation of S&T and global open innovation are very low. The main investment has usually going to small projects' base including still tiny participation in overseas R&D programmes and organisations.

3) The R&D Funding System

The Korea has shown a very successful model of economic progress and social development through government intervention. Its R&D system has contributed to this success through strategic acquisition of foreign technologies and national capacity building process. The country's R&D system is conceptualized as evolving, reflecting the continually changing socio-economic demands of the country in a global economy, with the government performing the key role of managing the acceleration and facilitation of R&D contribution to the socio-economic development of the country. Based on this conceptualization of the R&D system, the following sections review Korean experiences of R&D system evolution statistically and diagnose them qualitatively. The Korea is well-known for its success in

making the R&D system contribute to meeting the nation's socio-economic demands. The system has also shown a strong adaptability to adjust to the continuous changes in the global economy.

Kim (1997) divided the Korea's innovation system into three stages: specific phase in 1960s and 1970s, transition phase in 1980s and fluid phase in 1990s. This transition might influence the change of the Republic of Korea's R&D system in the 2000s to be more focused on the original technologies. During the first phase before 1980, government research institutes (GRIs) played major roles in the R&D system. Then, industrial R&D began to dominate the R&D system during the second phase from the early 1980s to the financial crisis of the late 1990s. After the financial crisis, the R&D system in the country began to diversify, with more active R&D activities by universities and technology ventures, and increased government R&D investment with more focus on basic R&D. The three stages are qualitatively diagnosed based on critical review of the related policy reports and presentation materials (Hwang, 2003, 2007a and b; Cho et al, 2007; Kum, 2007; Choi, 2007).

In the 1960s, the key concern of the economy during the period was manufacturing technologies for industrialization. The Korea Institute of Science and Technology (KIST) was established in 1966 for technology assimilation and development of industrialization. In the 1970s, the Korea expanded into strategic industries such as shipbuilding, machinery, industrial chemicals, electronics, automobiles, etc. As KIST could not cover all these areas, specialized GRIs were created as technology windows for diversified technological needs of strategic industries. These GRIs were nurtured by contract research emanating from the government and the industry. Thus, in the 1970s, GRIs were major players for technology acquisition and assimilation by the country's industries.

In the second phase during the 1980s and 1990s, the socio-economic R&D demands were for critical and essential technologies to overcome

technology protectionism and secure competitive advantages in the international market. As R&D in the private sector started picking up in response to these demands, the 15 GRIs were restructured into nine large institutes for enhancing efficiency. University participation in government sponsored research was still very little in the 1980s, but limited contribution to the industrial needs was realized in the 1990s.

In the third phase, after the financial crisis of the late 1990s, emphasis was placed on fundamental technologies to lead the global technology market for continuous growth in knowledge economy and public technologies (such as technologies for environmental protection) to meet various social demands. GRIs began preparing future industries and public needs under the regime of three Research Councils established by the GRI law of 1999. GRIs with specific missions began operating on specific R&D programs under various ministries. The government R&D program thus adjusted its focus towards frontier programs for the 21st century and next-generation growth engine technologies. The role of universities in basic research became more important and industry-academic linkages were encouraged. The private sector realized the necessity to develop technologies needed for future knowledge-intensive industries and directed the work of their research institutes towards this. It also began working with GRIs and universities in strategic partnership to develop a domestic technology base and join the NIS.

The R&D system has successfully adapted and transformed, responding to the changes in socio-economic conditions and demands during the rapid growth of the country's economy and provided appropriate technologies for industrial development. The strategic intervention of government was also an important trigger for the successful R&D system transformation through the last five decades. The government S&T administrative framework also continued to evolve to ensure successful coordination among the various R&D ministries responsible for the continuous expansion of R&D investment and R&D performers. The evolution of Korean R&D system is now a well-known successful model of

S&T system for industrialization of developing countries. The future of Korean R&D system is not certain and is currently under review for restructuring adjustment to make it more efficient and contribute to the socio-economic development. The current issues of the system include coordination of R&D ministries and actors, expansion of strategic basic research, R&D human resource enhancement, specialization of GRIs, research capacity building of company research institutes and triggering public-private partnerships among GRIs, universities and company research institutes.

3. ODA and Korean R&D Funding System Transfer Case

Official Development Assistance (ODA) refers to aid provided by the official sector such as the government's aid to developing countries for the purpose of promoting economic development and social welfare. ODA includes technical assistance[33] and funds provided to the governments and territories of developing countries or to international organizations. ODA was initiated after World War II, when many advanced industrialized countries began providing assistance for their former colonies to alleviate poverty, putting into practice the global community's collective spirit of cooperation. This definition of ODA has been widely accepted since the Organization for Economic Cooperation and Development's Development Assistance Committee (OECD DAC[34]) was launched in 1961.

1) Korean ODA and System

The Korea had a history of being an ODA recipient before its remarkable achievement. It is an important characteristic of Korea's ODA that the country has been both a recipient and a donor, displaying how it transitioned from one of the most impoverished countries in the world to becoming an advanced industrial economy. Korea began to provide aid in the 1960s when it was still receiving a lot of ODA from the international community. The first ODA activity as a donor was a training program for developing country officials in 1963. Since then, Korea's ODA activities have expanded to provide goods, funds and expertise to developing countries. In January 2010, Korea joined the OECD, DAC, positioning itself as a donor of Official Development Assistance (ODA) in the international community. Korea received about USD 12.7 billion from 1945 to the late 1990s. Korea's

[33] Technical Assistance includes transfer of technology, knowledge, know-how, and production skills. Education and training, dispatch of experts, policy and skills consultation, support for survey and research, establishing funds for scientific research and technical development.
[34] The OECD DAC was established in 1961 as a committee of major donor countries, which aims to promote mutual cooperation, information sharing, and policy coordination among its members. It is one of the three major committees of the OECD including the Economic Policy Committee and the Trade Committee.

effective use of foreign aid has made the nation a good example of successful assistance. Korea has been active in global debates and processes for international development cooperation. In 2010, Korea comprised of major donors and provides more than 80% of global ODA and hosted the G20 Seoul Summit and played a leading role in forging the Seoul Development Consensus. At the end of 2011, Korea hosted the HLF-4 at Busan and contributed to shaping a new global consensus to build a more effective development cooperation system. With the enforcement of the Framework Act and Presidential Decree on International Development Cooperation in 2010, Korea leveled up its ODA by designing various policies and strategies to improve the quality of its ODA. In 2012, Korea received the first official Peer Review[35] since joining the OECD DAC, which allowed an opportunity to review its ODA implementation system and to further commit to improve its aid effectiveness.

The Korean government began to provide ODA more systematically with the establishment of the Economic Development Cooperation Fund (EDCF[36]) in 1987 and the Korea International Cooperation Agency (KOICA[37]) in 1991. The Korean government has worked hard to upgrade its ODA system to conduct more effective aid. Korea has provided ODA by concessional loans

[35] OECD DAC Peer Review: The OECD DAC conducts periodic reviews of the policies and programs of each member once every four or five years. Peer review reports provide comparative analysis on the member countries' ODA policies, which helps share the experience on the effective implementation system and contributes to establishing consensus and rules among OECD DAC members.

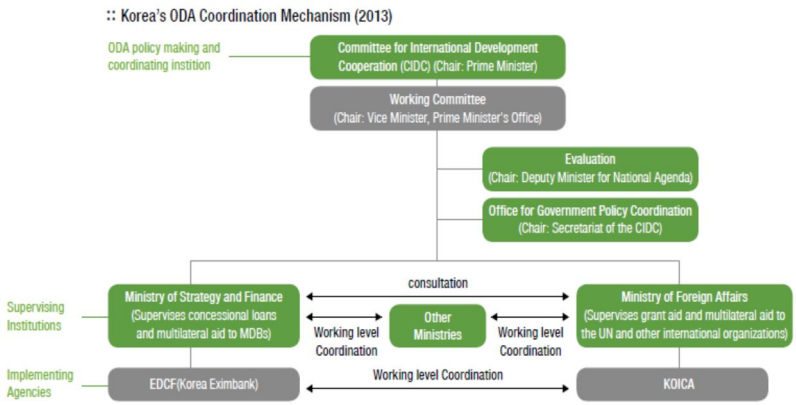
[36] The Government of Korea established the Economic Development Cooperation Fund (EDCF-on June 1, 1987 with the purpose of promoting economic cooperation between Korea and developing countries. Drawing on Korea's own development experience over the years, the EDCF assists partner countries by providing funding for their industrial development and economic stability. The highest policy-making authority of the EDCF is the Fund Management Council, which is composed of 12 members, most of whom are ministerial-level government officials. The direction of EDCF operations and the assumption of principal policy-making responsibilities rest with the Ministry of Strategy and Finance (MOSF), which also coordinates policy matters with other relevant ministries. Entrusted by the MOSF, the Export-Import Bank of Korea (Korea Eximbank-is responsible for the administrative operation of the EDCF, including appraisal of project, execution of the loan agreements, and loan disbursements. Other duties include principal/interest payments collection, project supervision, and ex-post evaluation of project operations.

[37] KOICA-The Korea International Cooperation Agency (, Korean: 한국국제협력단) was established in 1991 by the South Korean Ministry of Foreign Affairs and Trade as a governmental organization for Official Development Assistance (ODA) to enhance the effectiveness of South Korea's grant aid programs for developing countries by implementing the government's grant aid and technical cooperation programs.

and grants; thus, it is important to coordinate loans and grants in order to improve aid effectiveness. Accordingly, Korea's ODA system has required a sound coordination mechanism between the policies and programs/projects in concessional loans and grants. In 2010, the Korean government established an integrated ODA policy-making and implementation system with the Committee for International Development Cooperation (CIDC) at the center based on the Framework Act.

The CIDC is the highest-level government body that deliberates and decides on key issues related to ODA and coordinates strategies and policies of ODA in order to facilitate a more effective and systematic implementation of ODA. The CIDC was established under the PMO according to the Presidential Decree in 2006, and was provided a legal status with the promulgation of the Framework Act in 2010. It operates two sub-committees, which are the Working Committee and the Sub-Committee for Evaluation. The PMO acts as the secretariat for the CIDC, and helps with the daily operation of the CIDC and its sub-committees by working on policies, evaluation, and project coordination of ODA.

Figure 6. ODA Coordination Mechanism of Korea



Source: Korea's ODA, 2014

The coordination mechanism for ODA in Korea includes three levels, which are the overall policy-making and coordinating institution, supervising ministries and implementing agencies. The CIDC is the overall coordination committee chaired by the Prime Minister, and composed of 15 Ministers, the heads of KOICA and Korea Eximbank[38], respectively, and several civilian experts. The project implementation procedures are different in detail for each implementing agency, but they generally follow the process: preparation appraisal, approval, implementation, and post-project evaluation and management.

2) Korean ODA Policies and Strategies

The Korean ODA policies mission of international development cooperation is to reduce poverty in developing countries, improve the human rights of women and children, achieve gender equality, realize sustainable development and humanitarianism, promote economic cooperation, and pursue peace and prosperity of the international community. This mission forms the basic foundation of Korean ODA, which guides the decision-making process of the ODA policy and its implementation.

The government of Korea promotes its international development cooperation by respecting global norms and standards and by sharing Korean successful development experiences with developing countries. Thus, it enacted the Framework Act and the Presidential Decree, and established the Strategic Plan, providing the legal basis and basic direction of its ODA policies. The government of Korea will continue to increase its ODA volume and ODA ratio by 2015 and improve its ODA system to help Korean partner countries

[38] Eximbank - The Export-Import Bank of Korea, also commonly known as the Korea Eximbank (KEXIM), is the officialexport credit agency of South Korea. The bank was first established in 1976. Its primary purpose is to support South Korea's export-led economy by providing loans, financing mega projects and thereby facilitating economic cooperation with other countries. The bank manages the following government funds:

- Economic Development Cooperation Fund (EDCF): The EDCF evaluates and implements aid projects in developing countries.
- Inter-Korean Cooperation Fund (IKCF): The IKCF oversees an economic cooperation program with North Korea and serves as a clearing settlement bank with the Foreign Trade Bank of North Korea.

attain poverty reduction and capacity building. The government of Korea suggests the following three main strategies for ODA system improvement:

- "Elaborate Development Cooperation Contents" to apply Korean development experience to its ODA contents;
- "Improve the ODA Implementation System" to enhance ODA effectiveness;
- "Strengthen Korean Participation in International Activities,"

That includes participating actively in global norm creation in international development cooperation and enhancing humanitarian assistance commensurate with Korean global standing.

The CIDC recently agreed that the main policy direction of Korean ODA should reflect the needs of developing countries and at the same time offer development cooperation based on Korean comparative advantage and strengths, thereby providing a "Win-Win ODA."

The Korea has been striving to achieve the Millennium Development Goals (MDGs) and alleviate poverty, in its role as a responsible member of the global community. Korea expands the ODA volume[39] commensurate with its global economic standing considering the global norms and expectations as well as its domestic conditions. The Korea plans to maintain a strong concentration in Asia with an increasing share for Africa. The government of Korea has focused its ODA on Asia due to geographical proximity and cultural familiarity. The government of Korea will maintain around 55% of bilateral ODA for Asia until 2015, and will provide ODA based on the level of poverty and development, and on ability to repay the loan of each partner country. Korea will also provide 10% of its ODA to the Middle East and CIS (Commonwealth of Independent States) by 2015, and will continue to expand

[39] The ODA volume in 2014 is about KRW 2,230 billion, about 2.2billion USD (0.16% of GNI), and it would reach KRW 3,500 billion, about 3.5 billion USD, if Korea's ODA reaches its goal of 0.25% of GNI.

its support for fragile states and provide tailored ODA to meet the needs of its priority partner countries. Lastly, about 5% of bilateral aid will be allocated to Oceania and other countries, which are designated as under-aided countries. These nations will be provided with expanded humanitarian assistance, Korea's development experiences, technical cooperation, and infrastructure as a comprehensive development.

The Korean government will improve its aid effectiveness with improved linkages between concessional loans and grants. For example, KOICA's feasibility study can lead to an EDCF project, or the output of EDCF projects can be strengthened with technical support through grant aid. In addition, Korea will work on fostering the basis for economic growth by linking a concessional loan project to a Knowledge Sharing Program (KSP), which provides know-how and development experiences to developing countries. This could enhance the capabilities of the developing partner countries to design their own development policies, thus providing the foundation for self-reliant growth.

Project for the Establishment of the Vietnam-Korea Institute of Science and Technology (V-KIST) in Vietnam

The Korean grant aid cooperation projects contribute to sustainable socioeconomic development beyond poverty eradication in developing countries. In particular, since Vietnam has recognized that science and technology development is crucial for its development, the Korean government has provided USD 35 million for the V-KIST project since 2013.

The V-KIST project aims to establish a research institute devoted to science and technology in Vietnam, similar to the Korea Institute of Science and Technology (KIST), with a grant from KOICA. The V-KIST will be located at the Hoa Loc Technopark in Hanoi and is expected to develop into a leading science and technology research institute in Vietnam with the full support of the Vietnamese government. This project is expected to create a sustainable growth engine for Vietnam, which could help it from falling into a middle-

income trap after reaching GDP per capita of USD 1,633 (2012). In addition, the Korean research team selected core research fields for Vietnam's development in cooperation with the Vietnamese researchers as a part of the DEEP program, and those fields include advanced materials, renewable energy and environment, IT and BT fusion technology and food processing. The Korean government also plans to provide related education and consultation in order to help Vietnam conduct research on its own. In other words, this project is a comprehensive cooperation package including infrastructure, consulting and capacity building. It shows that Korean grant aid projects have developed from simple provision of resources and implementation of infrastructure to the level of the provision of core growth engine with developing countries. KIST, which led Korean economic growth by developing industries and disseminating science technology, is itself a national research institute initially established by the US grant aid. This is a symbolic case that shows Korea's achievement of becoming a donor from a recipient country.

The V-KIST project is a joint cooperation project of KOICA with the Ministry of Science, ICT and Future Planning (MSIP) and KIST, which is a good example that successfully combines the local network of KOICA and the sectoral expertise of government ministries. This project was first discussed at the Korea-Vietnam Summit Meeting in March 2012, and the MOU was signed in September 2013 in Vietnam. This project is scheduled to be finished by 2017.

V. DESIGNING R&D FUNDING SYSTEM OF MONGOLIA

In this chapter describes the current situation of Mongolian R&D development, S&T development and legal framework of R&D based on research organizations, personals, funds, administration system and regulation acts of R&D. Based on previous 4 chapter research study researcher define the R&D funding system of Mongolia, and recommendations to government how to invite Korean ODA for R&D funding of Mongolia, and then the conclusion.

Brief introduction of Mongolia[40]

Mongolia is home to a vast desert in the south, large freshwater lakes in the north-west and dry, grassy plains throughout most of the rest of its territory. Although its borders stretch 8220 km, its only neighbours are the superpowers Russia and China, a fact that has shaped much of Mongolia's political and economic history. The country has a vast wealth of mineral resources – over 6000 deposits of roughly 80 different minerals in total, worth an estimated $1.3trn, including coal, copper, gold, silver and iron ore.

Geography: Mongolia covers a total surface area of around 1.56m sq km, making it the 19th-largest landmass in the world. The landlocked country is home to a vast desert in the south, large freshwater lakes in the north-west, and dry, grassy steppes and plains throughout most of the rest of its territory. Ulaanbaatar, the capital, lies just in the country's north-eastern and is home to some 1.3m Mongolians – around 46% of the country's population, as per the 2010 census.

Language: Roughly 90% of the population speak Mongolian, most of them using the Khalkha Mongol dialect, which is the official language of Mongolia

[40] Country report 2014 Mongolia, by Oxford Business Group, 2014.

and belongs to the Altaic family of languages. Since 1963, the language has been written using the Cyrillic alphabet, although with the support of the government, the traditional alphabet is gradually being reintroduced.

Population: The population is currently estimated at 3.0m people and is growing at a rate of about 1.49% per year. Given its small population and large landmass, Mongolia ranks as the least densely populated country in the world. The country is ethnically homogenous, with around 95% of the population being of Mongol origin, some 90% of whom hail from the Khalkha Mongol ethnic group and speak the Khalkha dialect of Mongolian. Other ethnic groups include the Buriat, Dorvod and Tuvad. The most significant non-Mongol ethnic population is a substantial Turkic minority, which accounts for around 5% of the population. Many of these individuals are Kazakhs and they make up the majority of the western-most province of Bayan-Ulgii.

Natural Resource: The country has a vast wealth of mineral resources – over 6000 deposits of roughly 80 minerals in total, worth an estimated $1.3trn. The main proven mineral reserves include coal (20.79bn tonnes of 2013), copper (83.55m tonnes), gold (2459.5 tonnes), silver (27,918.5 tonnes), iron ore (1.09bn tonnes), fluorspar (1.01bn tonnes), zinc (36.58m tonnes), alongside rare earths and uranium (134,000 tonnes), according to figures from the Mineral Resources Authority of Mongolia. The mining sector is a major contributor to the local economy, accounting for 22% of GDP, 61% of industrial value-added, 94% of export value and 85% of FDI in 2012, according to figures from the National Statistics Office. Major ongoing mining projects include Tavan Tolgoi, the largest undeveloped coking and thermal-coal deposit in the world, and Oyu Tolgoi, the world's largest undeveloped copper and gold mine, with 2013 seeing the commercialisation of the first phase of the latter project.

Climate: Mongolia's weather varies significantly across its broad expanses, and is relatively warmer in the southern deserts than elsewhere. Due to its

landlocked status, the weather is extreme continental, and Ulaanbaatar, with it high elevation and distance from the sea, is the world's coldest capital. In January, temperatures fluctuate between an average of -32°C and -19°C in the city. Temperatures of -40°C are not uncommon during this time of year. In the summer, temperatures usually peak in July, alternating between 11°C and 22°C, and sometimes even higher. As a result, over the course of the year, Mongolia sees a temperature range of nearly 70°C. The wettest month is July, with precipitation averaging about 76 mm in the capital.

Economy: As of 2012 GDP was pegged at $10.3bn, with slightly more than a fifth of this coming from the mining sector. Driven by foreign direct investment in mining projects – totalling some $4.4bn in 2012 alone – GDP growth in recent years has been among the fastest in the world. Real growth ratcheted up from an average of 9.2% per year in 2006-08 to 12.1% in 2010-12, according to Bank of Mongolia, hitting a world-leading 17.5% in 2011.

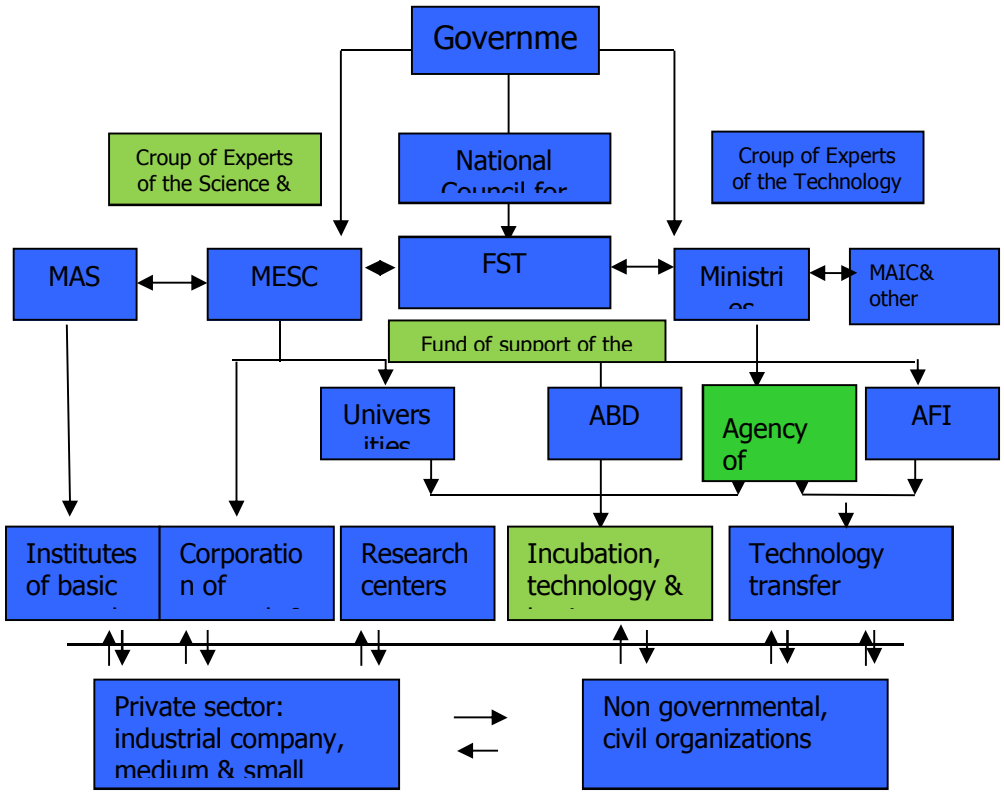
1. The R&D Development of Mongolia

The Mongolia is endowed with a comparatively strong S&T base but it has scarce financial resources and its scientific capacity is largely concentrated in the capital city. In 1990, after the fall of communism at an advanced stage of transition to a market economy Mongolia is in danger of seeing its S&T resources underutilized, dissipated or even lost.

The state policy to store and develop national innovation system is to form a triple helix between scientific, business and government organizations. In other words, research, business and policy are being brought together to form a harmony. The establishment of a triple helix, from one stand point, makes possible for the State to become a subject of cooperation. From another point of view, it makes possible for scientific organization and universities mandatory to coordinate with the business sector and transform knowledge and technology into a form of business. Additionally, it will be necessary for the business sector to compete within, based on science and technology. Generally science and technology is not just a knowledge producer and riches of the society. It is also one of the basic foundations of development of a State.

In order for Mongolia to develop the NIS, it is important that the issue be tied closely to the current administrative coordination of Science and Technology. This point is stated in developing the structure of NIS.

Figure 7. Structure of NIS of Mongolia



Source: Enktuvshin.B, NIS of Mongolia.

In order to establish innovation, the participation of research institutions and universities are essential. State involvement to execute, coordinate and provide assistance is also grand. However, business organization participation and initiation, as well as legal coordination and bonuses from state are needed when innovation surpasses the "valley of destruction". Therefore, the Mongolian NIS needs to be implemented and developed with a tight cooperation of public and private sector approach. Science- education- business chain of mechanism is required.

In order to fulfill the goals to establishing a development fund for innovation, provide specific amount of state savings to innovation are steps to increase economic competitiveness and provide sustainable development. The Fund will support the correlation of Science and technology discoveries and

innovation to national industry development and innovation infrastructure development.

Mongolia has founded the system basics to develop industrial scientific knowledge, transform acquired knowledge into new technology, new products and services in the 21st century. The Government of Mongolia is putting great emphasis in the scientific policy making by highlighting and storing NIS. The Parliament of Mongolia adopted the Law on Science and Technology in 2006. In this law, "innovation" is described as "transformation of the results and products of researchers and introducing the end product to industries and services.

In June 2007, with an active support of UNESCO the government of Mongolia has adopted the "Master Plan of S&T 2007-2020". Now this plan is used as the main tool to develop science and technology sector of Mongolia. The Master Plan had been programmed in Mongolia's Government Policy on Science and Technology (1998).

In 2013, the Ministry of Education and Science and the Mongolian National Commission for UNESCO organized a national forum six years into the plan, Mongolia has embarked on a review of its science and technology policy. Within this process, in collaboration with UNESCO, on The Perspectives for Science and Innovation Policy Development. Some 500 experts from Mongolia and abroad gathered in the capital city of Ulaanbaatar, to share their experiences and discuss the future of science, technology and innovation policy in Mongolia. Among those present were representatives of the National Science and Technology Council, government ministries, the Mongolian Academy of Sciences, research institutes, universities and the private sector. Topics for discussion included policy and regulation; state budget funding; the structure of the S&T sector; the quality of research, science management and human resources.

One key thrust of the Plan to 2020 is a strategy to align R&D on market demand and social needs, in line with a policy recommendation made by

UNESCO in 2000. Observing that most Mongolian exports have little technological content, whereas the reverse is true of imports, the Plan outlines a strategy for stimulating the share of non-government investment in science and technology, and for using economic stimuli to foster science–industry cooperation and joint research.

By 2011, the government was funding a lesser share of R&D (66%) than in 2005 (78%) but still performed three-quarters of R&D in Mongolia. Gross domestic expenditure on R&D (GERD) remained modest. By 2020, Mongolia hopes to have a competitive R&D sector and an effective national innovation system providing intellectual property protection. The country is also eager to develop international cooperation in science and technology.

1) The Mongolian R&D

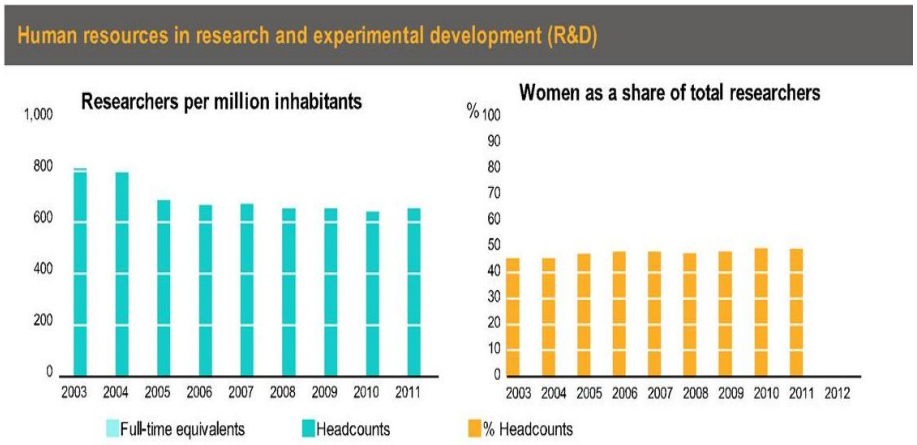
The S&T and innovation development determines Mongolian's economic development and its competitiveness in the global market. In the initial stages of transition to market, the main concern was to sustain a macroeconomic stability, whereas today, the top priority is to develop a basis for long-term economic growth. In today's rapidly developing world, ability to swiftly process information, identifying critical mass, and investing in intellectual properties have become crucial factors of effective organization and economy development. Investing in intellectual properties has become one of the most efficient ways to utilize capital. Intangible property as a percentage of total assets of firms and corporations is rapidly increasing. As the commercialization of S&T results becomes more active, the process of innovation cycle becomes more recurrent leading to accelerated production of innovation products and technologies.

There is still a lack of contribution of S&T sector to the national economic growth, and our country's innovation activities are still obsolete in the global and regional level.

Compared to lower-middle-income economies, the imports as a percentage of GDP of Mongolia is 2-4 times lower . This illustrates our economy's dependence on foreign countries with relatively low value added and trade ratio. Out of total export products of Mongolia, 45% is produced with non-technological content, 52% are low technology products, and 3% contain low-medium technology content.

One of the widely used indicators to evaluate S&T capacity is the "number of researchers per 1 million population". This indicator tends to decrease in Mongolia in the past ten years. The decrease in numbers of college and university students enrolled in natural science, technology and engineering fields could lead to shortage of skilled specialists in this sector.

Graph 4. Human resource in R&D



Source: UNESCO[41]

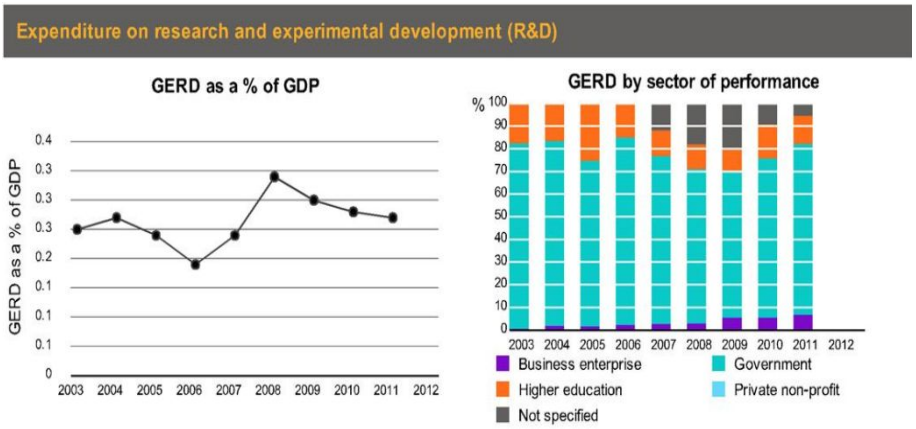
Until 2008, current S&T expenditures have increased by 5.6 times, and expenditures at 1995 prices have increased twice. As of 2008, S&T sector budget expenditure is 0.34% of GDP. According to statistics, 90% of funding

41

http://www.uis.unesco.org/das/country/science?code=4960&regioncode=40505&SPSLanguage=EN

for S&T sector is financed by government and 10% is generated from non-government sources.

Graph 5. Expenditure on R&D



Source: UNESCO[42]

When comparing S&T funding to other countries, it appears as if S&T sector activities of Mongolia are funded solely by the Government budget. This is due to a lack of research or detailed reports on source of funding, thus there are no available statistical data. The S&T expenditure has been rapidly declining since 1990. In 1990, 1.0% of GDP was contributed to S&T activities which was comparable to developed countries. However since 1990, the number has been reduced to 0.34% in 2008 which is comparable among developing countries.

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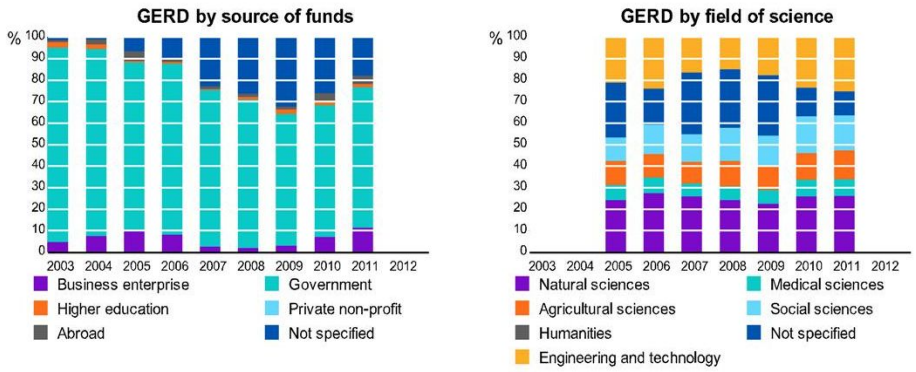
http://www.uis.unesco.org/das/country/science?code=4960&regioncode=40505&SPSLanguage=EN

Graph 6. GERD



Source: UNESCO[43]

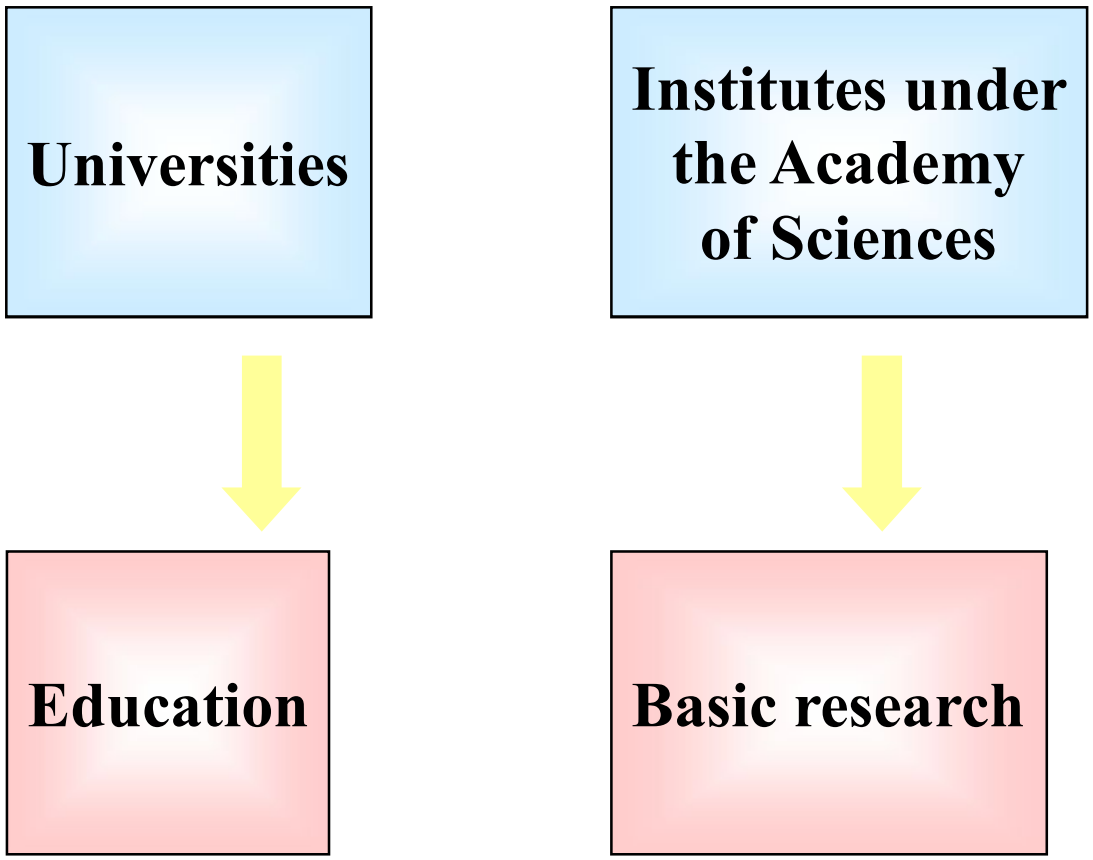
In the capital city located 90% of research institutes and 75% of S&T personnel consist of researchers. In recent years there has been considerable progress regarding the training of young researchers. As of 2005, 171 young researchers and scientists from 32 research institutes and universities of Mongolia are studying abroad in 25 countries. As of 2006, the percentage of research personnel with education degrees (ScD, PhD, master) is at 48.9% which is not a low number, even compared to other countries. One-third of research personnel are in natural sciences sector, and each of social sciences and engineering sectors contain one-fifth of research personnel.

Although scientific output of Mongolia was impressive through this period, the country's science system was economically unsustainable. This as largely because it was linked to an elite network of soviet science rather than being embedded in the cultures and practices of local production.

43

http://www.uis.unesco.org/das/country/science?code=4960&regioncode=40505&SPSLanguage=EN

Figure 8. Mongolian R&D system model (before 1990)



Source: Ayush.P, South Asian regional workshop on science, technology and innovation indicators: trends and challenges, 2010.

While the Mongolian government has instituted many reforms since the collapse of the communist system, the existing science and technology infrastructure, based on the old Soviet model largely, remains. From 1997, the Mongolian Parliament enacted several science and technology-related laws. These are: Constitution of Mongolia (1992), Law on National security (2001), National security policy (1994), Conceptions of Mongolian National Security (1994, 2010) Mongolian Foreign Affairs Policy (1994), Government policy on S&T (1998), Law on S&T (1998), Law on technology transfer (1998), Law on Legal Status of the Mongolian Academy of Sciences (1996), Law on

higher education (2002), Law on patent (1993, 2006), Law on copyright (1993, 2006) and Conceptions of development of high technology industry (2010) and National Plan for Promotion Science and Technology until 2010 (2000).

In the past years, the Government of Mongolia has developed several policy documents and national programs on S&T development, utilizing R&D results, enhancing industry's role in S&T, and establishing a structure and legal environment that meets the global demands, very few have come to realization.

Science and technology master plan of Mongolia 2007-2020 - The vision of the plan is Mongolian S&T in 21st century follows the primary principle to "be a nation developing the science based on new knowledge and progressive technology", to practice the national innovation system as a driving force for social and economic development for 2020, and to ensure the secure and quality living of the people continuously supporting the science and technology progress and development.[44]

State policy for science and technology - The parliament of Mongolia authorized in 1998. State Policy tend to define S&T policy principle, S&T policy trend, to build capacity for research work, to improve S&T structure and management, to support scholars and research work and to develop S&T foreign relationship.

Millennium development goals based on national development strategy of Mongolia - The objective of the MDG-based Comprehensive National Development Strategy of Mongolia is to protect and strengthen Mongolia's sovereignty, and develop it into a middle income country through achieving its MDG attaching high priority to promoting private sector-led dynamic economic growth, human development in Mongolia including education, healthcare, as well as sustainable development of science, technology and environment, strengthening intellectual development and human capacity; creating a knowledge-based economy sustained by high technology, which

[44] "Science and technology master plan of Mongolia 2007-2020", page 26.

respects environmentally friendly production and services; fostering a democratic system of governance, which serves its citizens, protects human rights and freedoms, and is free from corruption and red tape.[45]

Program for to develop national innovation system in Mongolia 2008-2015 - The program goal are to design national innovation system of Mongolia, to provide economic sustainable development, to define policy that to improve industrial competitiveness and S&T activity performance.

Industrialize program of Mongolia 2009-2016 - The program goal is to create economic diversification and to develop high technology industry in Mongolia in via to build high technology product and industry which can provide domestic demand based on comparative advantage of natural resource and raw materials as of domesticated with modern advanced technology, to build complex of infrastructure for technology, R&D and funding.

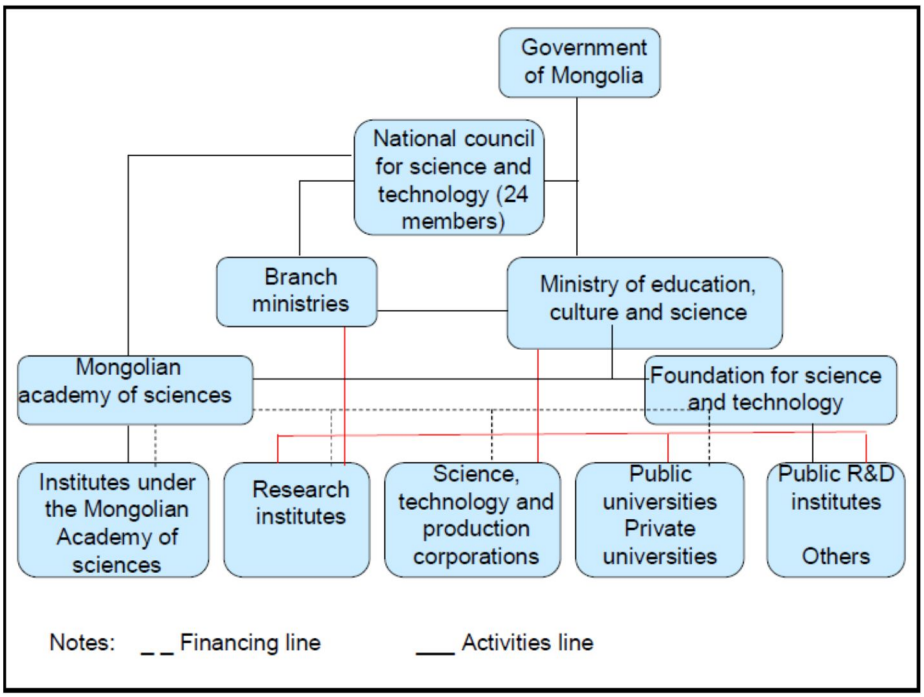
2) The Mongolian R&D Governance

In Mongolia, under the socialist system and with a small population and limited industrial structure, an impressive system of research institutions and universities was established through the 1960s and 1970s. This continued to expand until the collapse of the soviet system – a system that prevailed from 1926 to 1990 and was dominated by centrally planned economy, in which the state owned all means of production and provided all forms of social service. The backbone of the country's present science system was laid down through these years. The institute of science and higher education, with antecedents in 1921, became the Mongolian academy of sciences (MAS) in 1961. The national university of Mongolia established in 1942 provided the platform for development of other universities such as the agricultural university (1958), the medical university (1961), the university of humanities (1982) and the technical university (1990). These institutions became the hub of research science. Research science continued to develop so that various

[45] "Millennium Development Goals Based on National Development Strategy of Mongolia" page 2.

institutions in charge or different sectors were established. Some of these institutions include, institutes for the study of history, natural and social sciences. Moreover, these institutions prepared a national intellectual human resource. Now in Mongolia have basic research institutes and centers of MAS – 22, research and production corporations – 8, research institutes of public universities – 13, applied research institutes under ministries – 9, private research institutions – 4.

Figure 9. Organizational Structure of Mongolian Scientific sector (since 1990)



Source: MAS[46]

National Council for Science and Technology (NCST) is governmental agency at the cabinet level, and it is chaired by Prime Minister. The NCST's membership included each of ministers of ministries whose missions consist

[46] Mongolian Academy of Science

of activities related to research (MOSTEC, Ministry of Finance, Ministry of Infrastructure, MOFA and MTI), the president of MAS, the director of NSTF, the representatives from Association of scientific fields and Association of University Presidents. NCST has a responsibility for science promotion policy at the national level and defines national S&T goals. Because the members of NCST serve dual role in the government and in other sectors, each member can bring special goals and interests and as a result, its goal covers every area of economy.

Minister of education, culture and science (MESC) has a major role in planning and implementation of the S&T development policy, innovation and high-tech development policy, R&D of the country's development as a leading factor in the results; educational, cultural, scientific, economic, financial and investment policies to upgrade and expand in Mongolia. The MESC strategic goals are S&T to the development of research and policy analysis, legislation, policies, programs and legal document drafting, and provide policy guidance; innovation and development of high-tech system is established, legislation, policies, programs and legal document drafting, provide policy guidance and to ensure the development of information technology, industry statistics development and implementation, database to Mongolian government.

Foundation for Science and Technology (FST) is an Agency under MOSTEC in charge of funding of the whole governmental funded scientific activities in Mongolia. The main functions are: to draft financial proposals for each research fields to promote and fund R&D projects and assess the present status of the key equipment and facilities etc.

The Mongolian academy of sciences (MAS). The MAS with educational institutions will participate as major player within the framework of the sub-system to create knowledge and as partner with other sub-systems and there are 22 its research institutes and centers operating by MAS and 1042 employees working in MAS, of which 781 are researchers.

2. Designing Mongolian R&D Funding System

The purpose of thesis is to survey institutional structures and processes related to government funding for R&D in a selection country. This research should identify structures, policy measures, and examples of funding instruments that Mongolia might adapt. In addition, changes in these structures and their rationale should be explored. The research aims to elaborate key issues related to the trends towards globalization of R&D funding and their implications for developing countries especially Mongolia.

1) Designing Public R&D Funding Institutions

In general, most studies confirmed that Mongolian R&D support was directed improving capacity in the national basic research sector. Regardless of the current status of the Mongolian R&D capacity, most governments will on certain issues seek consultancy from reputable domestic scientists. Depending on the capability of the Mongolian national R&D system, such consultancy draws on a mix of domestic studies as well as the experts' knowledge of what has internationally been found. In most developing countries Mongolia too, currently, the focus still has to remain on the latter approach. In this respect, the Mongolian government's interest in learning from challenge oriented approaches like the Korean high-tech strategy is an important case in point – and has already had a strong impact on the Mongolian S&T master plan 2007-2020 that quite openly highlights national socio-economic challenges. In contrast to the situation in Mongolia, consequently, R&D and public R&D funding institutions adapted to the respective national innovation systems are important features of Mongolia. Although the Mongolian public R&D system continues to be the dominant R&D performer, and infrastructure development remains necessary before high quality research results can be obtained. However, in countries like Korea the public R&D sector is an important knowledge - and technology - provider for the business sector; the structural couplings between the two

sectors are comparatively strong and research and innovation policy implement quite a lot of initiatives to support science-business interaction.

As the literature suggests, the case studies confirm that foreign investment continue to play a strong role as drivers of innovations in the public and private sector of Mongolia. In a cases, moreover, they tend to be technologically more advanced than domestic universities, so that their regional science-industry co-operations tend to be limited on obtaining human capital. Small developing countries like Mongolia also rely on foreign direct investments, but the impact on the national innovation capability is not so pronounced as it is.

Key Challenges for R&D funding of Mongolia: Typically, there is a division of labor between at least two main funding institutions of which one focuses on promoting scientific research whereas another focus on boosting the innovative capabilities of the Mongolian R&D foundation. In Mongolia, funding for R&D and innovation is provided on different administrative levels such as national, regional, municipal. In many cases, similar types of funding are available in parallel – in particular in the field of innovation policy. In most systems, find that the different national funding institutions display a strong path dependency in following their individual political and institutional trajectories. The many socio-economic and even innovation related disparities in emerging economies amended by R&D funding institutions alone. As mentioned above, Mongolian funding institutions need to be embedded in a general research and education policy that invests substantially in infrastructure and human capital development. Only on that basis will many sectors of the economy be put in the position to make proper use of funds offered and managed by R&D funding institutions of Mongolia.

With regard to the most prominent challenges that the respective policy systems and R&D funding institutions of Mongolian are facing in terms of structural governance issues, institutional redundancies of public organizations, inadequately designed or implemented initiatives and support

measures, an insufficient adaptation of institutions to national and local needs, as well as a lack of orientation to regional economic development. Although some of their specific challenges regarding R&D and Mongolian innovation policy tend to focus more strongly on issues related to the knowledge-based society in general with priorities on aspects like researcher mobility such as attract highly-talented R&D workers, impact and quality of research, R&D infrastructure or the further development, adaptation and implementation of concrete innovation support measures by national or regional R&D funding institutions.

2) Mongolian R&D Funding Objectives

In general, less than satisfactory experiences have been made with broad "all embracing" missions. In particular, some countries reported the tendency that R&D funding institutions were gradually endowed with an ever broader mandate for which they were not necessarily well equipped as an institution. Mongolian government need to find that the organizational model of the institution should match its mandate, and that there is a limit to the breadth of the mission that can be effectively addressed by one organization. Naturally, therefore, both approaches have to rely on differently qualified employees, different processes for the selection of projects as well as, in consequence, different organizational and financial models. In practice, these different requirements imply that a Mongolian R&D funding organization should be set up with a clear specification in terms of either to promote scientific merit or to promote innovation. In line with this argument, several case studies suggest that good experiences have been made with focused missions by means of which the goals of the individual institutions have been clearly defined foundation like for science and technology of Mongolia. Before setting up a new funding organization or department, it is important to reconfirm the soundness of the assumptions motivating the set-up. On a global level, most organizations were found more or less well aligned with their respective countries' key challenges. On a practical level, however, some studies seem to

suggest that organizations were set-up too speedily with the result that their offers did not meet the factual needs of the research and/or the business sector.

Hence, focusing funding organization's mission on challenges relevant for the Mongolian national innovation system has proven to be useful. With a view to detailed priority setting, it should be borne in mind that a long time may pass between the governmental decision on priorities and the time when the new organization or department becomes operational. By this time, some of the originally defined priorities may be outdated. Instead, good experiences have been made with giving organizations the flexibility to adapt their missions in response to their experiences with the demand for their funding measures. Unfortunately, the observed flexibility cannot in all cases be considered as strategically planned and in some cases does not originate from within the support organization itself but takes the form of adapted guidelines from the responsible Mongolian government department. Nonetheless, the case studies can be considered as providing a sufficient basis to conclude that most flexible approaches towards strategic orientation are superior to closed and fixed orientation, as they may help to support a culture of self-reflexive discussions within the organization and its leadership as much as they provides the practical opportunity to keep R&D funding institutions relevant for evolving national innovation systems of Mongolia.

On the basis of the Mongolian funding institution’s missions will define by policy or the respective organizations being in charge of R&D funding, overall as well as detailed objectives have been formulated. When analyzing the different objectives it can be state that two types of organizations have been establish: on the one hand organizations which pursue a broad and quite general mission and on the other hand organizations with a focused and quite specific R&D mission.

3) Mongolian R&D Organizational Model

Regarding the organizational models of the R&D funding institutions in the Mongolia in my comparative analysis indicates that organization have to legally independent. The Foundation for science and technology of Mongolia for instance has a high degree of strategic and financial independence to sponsor R&D activities within broad parameters set by its authorizing legislation, the MAS and oversight authorities. In contrast to the independent support organizations of the technologically leading, many R&D funding institutions in emerging economies are organizational sub-units of ministries or other government bodies. Among R&D support agencies in developing countries, is the only organization which is constituted as a legal entity without a superior agency. In most other cases R&D funding organizations, even though formally independent, still report closely to public authorities. Most prominently, this is a well known issue with funding for innovation – that in many fields it touches on issues of industrial policy which are classically placed under the responsibility of national ministries. In fact, this structure of comparatively independent organizations which fund public research and comparatively dependent organizations which fund innovation that quite often the ministries directly, can be found in Mongolia.

In principle, a direct subordination to a Ministry of Education, Culture and Science of Mongolia could lead to a similar effect as it would in turn prompt a neglect of educational issues. Furthermore, there is tentative evidence that units of government tend to have a stronger tendency to apply mainly political rather than evidence-based criteria to the selection of projects – even though these two perspectives are not mutually exclusive. On that basis, i conclude that Mongolian R&D funding institutions should best be set up as independent organizations. As already mentioned under the heading of "missions", there is evidence of strong issues within "mega-institutions" that try to address too many objectives in parallel. As can be expected, it seems to prove quite challenging to set up processes and administrative logics that are equally

suitable to the very different tasks of supporting public research, innovation, or science-industry cooperation alike.

4) Mongolian R&D Funding Model

First of all, the case studies indicate indirectly that a critical mass of funding needs to be available to the R&D funding institution so that a meaningful model of allocation with a good balance between administrative cost and benefits allocated can be implemented. In situations, where it is both politically and administratively non-feasible to straightforwardly replace the existing funding structures, it can be expedient to pilot new approaches by setting up small-scale novel institutions besides the existing ones. Thus, their viability as well as strengths and weaknesses in the specific context can be tested and their legitimacy confirmed before more substantial allocations are diverted from the existing to the new structures.

The case studies indicate that a proprietary, independent budget is the key to a funding organization's strategic and operative flexibility. On the one hand, it allows the organizations' managers to flexibly adapt their portfolio of measures support according to the funds factually available while on the other hand it allows for example the individual case handlers to carry forward non-allocated funding into the next year and thus deal flexibly with the available resources. As the case studies illustrate this lesson have to take in Mongolia. When making decisions about the distribution of funding within the organization, several case studies illustrate that in certain fields of action national-level funding can and tends to be complemented with funding from other levels of government or from additional private sources of funding. Taking all options of such co-financing into account seems an important and appropriate basis for all financial models of national-level R&D funding organizations of Mongolia.

Finally, most case studies from emerging economies suggest that public R&D funding organizations are subject to public audit procedures – which are comparatively transparent and professionalized against the background of the

overall innovation systems that they are operating in. Nonetheless, they are not at all times sufficiently comprehensive and of a fairly technical nature. As such, they cannot compensate the lack of evaluations stated above.

5) Mongolian R&D Funding Instruments

According to their objectives, the analyzed Mongolian R&D funding organizations have implemented different schemes featuring specific characteristics both content wise and formally. Nearly all of the programs which focus on basic research are offering grants, either for individuals or public research organizations. The maintenance and operation of public R&D infrastructures of Mongolia is typically carried out on the basis of public calls or project-based, not so much within the context of institutional funding. Another popular funding mechanism are R&D loans which offer reduced interest rates when it comes to the financing of R&D projects. With a view to risky technology oriented projects in their early phase, special venture capital funding instruments have been implemented to reduce the risks for the company or the founder and at the same time make the company attractive for profit-oriented companies investing in the later phases. In general, the following types of funding actions can be distinguished:

• Loans for R&D projects

• Grants for R&D projects

• Funding for R&D projects in public research (grants)

• Investment in R&D infrastructure (project-based, rather than institutional-funding)

• Loans for joint R&D projects of public and private research

• Funding for organizations providing services

• Funding for venture capital

• R&D Contracts (public procurement)

A broad legal mandate gives the organization full leverage to deploy different types of measures in the combination that a particular problem in hand requires. To the extent possible, legal limitations on the type of support that an organization can provide should be avoided. If that opportunity is missed, there is a danger that in logical terms related activities will be artificially split between funding, a loan, and an institution. On the other hand, each individual support program should have a clear and recognizable character and not mix too many different objectives or types of support.

With a view to some types of funding such as continuous basic funding it should be duly considered if those can remain the task of government agencies and ministries and need not be part of the mission of independent R&D funding organizations. The reason for this is twofold. Firstly, the set of recipients of basic funding is typically either fixed or politically negotiated. A specific process and select from applications is thus not needed. Secondly, the allocation of continuous basic funding does not require monitoring in the same way than program funding. Instead, much of the negotiation related to basic research funding have a strongly political dimension that has to be communicated and executed by legitimate representatives of the state. In summary, the two main strengths of independent funding organizations: criteria-based selection and independent monitoring cannot really come to play while some key competences of public administrations are strongly required. As in other cases, this recommendation does not constitute a general norm but a point of consideration that may be considered in different ways under different framework conditions.

In principle, on the contrary, the idea of implementing a mix of different types of funding programs through the same institution seems warranted, even if this requires institutional capabilities that remain to be developed in a number of the surveyed organizations. On the one hand, hardly any "key challenge" within a national innovation system can be addressed

through one type of measure. On the other hand, however, measures that address the same challenge need to be coordinated which is best possible when they are administered within the same organization.

In any case, science-industry co-operation in Mongolia is one of the issues difficult to improve by public financial incentives alone – as in many cases complementary institutional reforms are required to make the process operational and effective. Still, the case studies repeatedly highlighted that support for science-industry co-operation was applied in a too simplistic manner for example by assuming that the mere participation of industrial partners in R&D projects guarantees technology transfer, and based on outdated spill-over and linear transfer assumptions that apply even less in emerging economies where the gap between research and innovation system is larger than elsewhere. Apparently, there is a need to improve and deepen policy makers' understanding of the preconditions for successful knowledge transfer – a process that seems to be underway in Mongolia.

In general, the range of programs should not become too broad and outdated or unsuccessful programs should eventually be discontinued rather than remain in a process of liquidation indefinitely. Otherwise, the funding institutions managers run the risk that their offer of support becomes unduly spread out and dispersed and unattractive to the potential beneficiaries. A number of case studies have illustrated cautionary examples where the co-ordination between different areas of funding has anything but collapsed so that more than once there are measures to the same effect under only marginally different headings – but each with a too small endowment of funding.

6) Mongolian R&D Funding Program Selection Criteria

Selection processes will have to vary with regard to the type of support provided and the degree of politicization o f the topic in question. As was to be expected, therefore, the case studies provide ample evidence of both structured tendering as well as of rather spontaneous allocations.

While that is logical, there are also common accounts of a lack of continuity within tendering procedures which could in principle be expected to be consistent. In this regard, it seems advisable to establish a clear approach towards assessment for each program and then stick to it unless good reasons – e.g. evaluations or real shifts in budget – suggest otherwise. If different objectives are to be aimed at, the more focused response might in some cases be to launch a new, substitutive program rather than to widen an existing one indefinitely. Otherwise the whole funding system of Mongolia may become confusing for its potential beneficiaries.

Furthermore, it has to be borne in mind that very often the volume of funding is less decisive than the fact of receiving funding – a fact reported from in both developed and developing economies. That of course only works if the selection process is both credible and transparent. Credibility, therefore, should be the concern of both the executive management and the individual case handlers in all Mongolian public R&D funding organizations. This is of crucial importance as it sets the organization apart from being just one more exchangeable source of public money. While projects should be checked for quality and originality, case studies, suggest that it is equally important not to set the initial threshold too high – to avoid that risky projects in their earlier stages have no chance of being funded. Instead, decisions on further – and potentially higher – allocations should not be made on a one-off basis at the beginning, but also be based on later interim evaluations and applications for renewal. Thus, the threshold can be gradually raised throughout the project.

Insofar as possible, central selection criteria should be based on the support programs' stated objectives. In general, therefore, they can only then

be precisely and suitably defined when the concerned support program has clearly stated objectives in the first place. The broader a program had been formulated, the more frequently did the case studies suggest that excellence was not always the decisive factor for project selection – arguably since vague specifications left too much room a for a personal, context-specific interpretation. For certain types of local-needs-based support programs, a bottom-up approach responding to the expressed needs of potential recipients is indispensable. Depending on the region, it is also clear that regional development based funding approaches will in emerging economies often be less excellence-based in a narrow sense.

From a technical perspective, access to the selection process should be flexible and open, so that applicants do not have to 'wait for the next opportunity'. To reduce administrative effort and cost, however, the actual decisions about allocations should be bundled and taken in regular intervals rather than continuously. Additionally, this process allows the experts to compare different proposals and to decide accordingly. When it takes more than a year for funding to be approved, the respective R&D project will oftentimes have succeeded or failed without it. In addition, several case studies highlight that overly complex and bureaucratic technical stipulations can be a hindrance to the targeted allocation of funding.

Summary of Chapter

Finally, in order to keep its geographical comparative advantage over the neighboring countries and to secure product competitiveness in the global market, it is essential to successfully develop and implement policies that foster technological innovation. Under the circumstances discussed above, Mongolian R&D funding related policies can be conducted using the following three strategies and the respective directions:

Firstly, the enhancement of domestic technological capability in major technological agents is crucial:

- budget increase in the S&T and R&D sector;
- adjustment and expansion of functions of research institutes and universities toward promoting industrial innovation; and
- developing the R&D funding systems of improved treatment and new incentive systems for researchers.

Secondly, the following infrastructure for domestic science and technology market should be expanded:

- incentive systems for major agents of science and technological innovation, such as universities, and research institutes,
- the technology market infrastructure, such as developing evaluation system and training human resources in the R&D funding institutions; and
- development and implementation of plans for technological start-ups, the spin off promotion program for individual researchers and innovation players like universities and research institutes.

Thirdly, market friendly institutional supports should be provided in the sense of minimizing the government's failure:

- legislation for R&D funding system;
- increasing the budget and the number of organization related to R&D funding;
- establishment of new programs for domestic R&D development to strengthen the ties between universities and industry, and research institutes and industry; and
- creating a new international R&D cooperation program and supporting more international projects.

Despite a possible financial burden, it is more advantageous to carry out the above mentioned policies and programs simultaneously in order to amplify the synergy of implementation, rather than to proceed one by one in a consecutive order. This kind of approach is good for policy implementation at each stage in consideration of the total cycle of the technological innovation from R&D to commercialization. However, such an approach can be impractical when applied to all the industries at the same time. It is, therefore, favorable to start from an area that has greater spillover effects in respect of policy effectiveness.

Increase of domestic R&D funding is very necessary to strengthen the infrastructure of innovative activity, to stimulate manufacturers to realize innovations as a way of competitive struggle. Absence of it results to unclaimed scientific and technical development. It is necessary to form competitive business environment in the regions to increase the quality of education and to provide preparation and retraining of personnel on innovative specialties, including experts on innovative management. In the development of NIS, the government should play an important role, giving scientifically proved reference points of innovative development of territories of the country.

3. Inviting Korean ODA

1) Korean ODA to Mongolia

The Country Partnership Strategy (CPS) for Mongolia aims to provide the overall policy direction of the Republic of Korea for its development cooperation with Mongolia. It outlines Korea's proposed partnership programs for its development cooperation during the period 2012-2015. The CPS aims to make a meaningful contribution to the poverty reduction and sustainable development of Mongolia in line with the Millennium Development Goals (MDGs)-based Comprehensive National Development Strategy of Mongolia. It also lays out a framework to expand the bilateral relationship through the further reinforcement of Korea-Mongolia partnership and cooperation. This CPS is based on mutual understanding and respect, and aims to enhance development effectiveness by linking Korea's development experience and comparative strengths to Mongolia's development needs.

Korea, as a member country of the Organization for Economic Co-operation and Development's Development Assistance Committee (OECD-DAC), is obliged to abide by international norms in shaping its development partnership. To that end, Korea will strengthen development cooperation not only among its relevant Korean agencies, but also with international partners, to overcome ODA fragmentation and enhance development effectiveness.

For the timely incorporation of internal and external changes of Mongolia, the CPS will be continuously revised and updated through mutual discussion and agreement between the governments of Korea and Mongolia. Accordingly, this CPS (2012-2015) aims to assist Mongolia in overcoming the barriers to development. The core principles of this CPS are in line with the mid-term national development plan of Mongolia and, as such, are based on Korea's comparative advantage. Korea would like to suggest the following four primary partnership areas:

- promoting the government and public service through digitalization;
- solving urbanization problems;
- developing agriculture; and
- improving education, science and technology.

These suggested areas will be narrowed down to three priority areas through policy dialogue with the Mongolian government. Korea will target its efforts toward rapid and balanced growth, ensuring that the efforts are in line with the national development plan of Mongolia, while placing emphasis on the proposed strategic priorities. In delivering the partnership program, Korea will work closely with experienced development partners and like-minded donors to increase collaboration and development effectiveness.

Overview of Korean Past Assistance 2006-2010[47]

- ✓ In total about US$100.6 million (US$74.3 million for grants and US$26.3 million for concessional loans) has been allocated to Mongolia for the period 2006-2010 (the average annual amount being about US$20.12 million).
- ✓ The volume of bilateral grants to Mongolia has been gradually increased (from US$5.93 million in 2006 to US$29.02 million in 2010) although loans have ceased since 2006. Development cooperation between the two countries has been enhanced through bilateral grants.

47 Source: Ministry of Finance, Mongolia, 2014

Table 3. Korean ODA to Mongolia for the period 2006-2010
(US$ MILLION)

Year	2006	2007	2008	2009	2010	Total
Loans	26.3	-	-	-	-	26.3
Grants	5.93	9.77	15.68	13.9	29.02	74.3
Total	32.23	9.77	15.68	13.9	29.02	100.6

- ✓ 18 projects and technical cooperation have been approved or implemented by EDCF and KOICA between 2006 and 2010.

Table 4. Types of support for the period 2006-2010 (US$ MILLION)

Types	Projects	Trainee Invitation	Volunteers	Feasibility Study	NGO	Others
Volume (US$ million)	59.8 (18 projects)	3.0 (516 trainees)	10.4 (270 volunteers)	4.2 (4 projects)	0.68	1.94

- ✓ Among the total ODA of EDCF and KOICA, environment and transportation, and e-governance sectors have received the highest amount of aid (81% of total ODA), followed by the agricultural sector.

Table 5. ODA disbursement by sector (US$ MILLION)

Sectors	Transport	Education	Agriculture	Health	Environment	Governance	Others	Total
Disbursement	18.81	4.93	6.95	2.03	29.79	17.02	1.34	80.87
%	23	5	9	3	37	21	2	100

Source: EDCF, KOICA statistics.

- ✓ Since 2006 many projects have been conducted in Ulaanbaatar due to its importance as the capital city (35% of total disbursement), and an agricultural project has been implemented in the Dornod region. Furthermore, ICT, governance and environment related projects have been implemented for all regions in Mongolia (33% of total disbursement).

2) Korean Partnership Strategy for Mongolia

This partnership strategy aims to support Mongolia's balanced development, poverty reduction and social integration in line with Mongolia's National Development Plan 2007-2021, which is MDGs-based Comprehensive National Development Strategy of Mongolia. It also aims to strengthen the bilateral relationship by furthering mutual friendship and cooperation.

For Korea, Mongolia is one of Korean most significant partner countries in development cooperation. Korea's development partnership strategy will strengthen the development foothold of Mongolia to achieve its sustainable growth and successful transformation to a modern industrialized country.

In particular, we have considered four cooperation areas in light of aid coordination with other development partners as well as Mongolia's development needs and Korea's strengths. Based on the four proposed areas, three areas will be decide through consultations with the Mongolian Government in full consideration of Mongolia's development challenges and Korea's relative advantages in respective areas. About more than 70% of our budget will be allocated to three priority areas during the period 2012-2015.

The four proposed areas are governance, urban development, agriculture, and education. The main goals to be achieved in regard to these engagement areas are as follows:

1) Enhancing the productivity and transparency of public administration through:

   - ✓ institutional reform and building a development master plan;
   - ✓ adopting an e-government system and providing service in key public sectors; and
   - ✓ capacity building in management and IT development.

2) Promoting balanced and sustainable economic development through:

   - ✓ supporting comprehensive urban development in accordance with the regional development plan;
   - ✓ solving the problems of urbanization and building socio-economic infrastructure in major cities including Ulaanbaatar; and
   - ✓ capacity building.

3) Increasing the population's income and improving agricultural productivity through:

- ✓ improving value chain on agriculture;
- ✓ developing inland water fisheries; and
- ✓ capacity building.

4) Improving the quality of higher education and technology for human resource development through:

- ✓ building an e-learning system and providing consulting services for the development of science and technology.

In addition, Korea will pursue five values

- efficiency,
- sustainability,
- harmonization,
- alignment, and
- ownership - in implementing the programs to enhance aid effectiveness.

Korea's partnership strategy for Mongolia also reflects international norms such as the MDGs, the Paris Declaration and DAC recommendations. Accordingly, the core principles of the CPS, Korea would like to suggest improving education, science and technology. Mongolian government has implemented a national education policy for the development of higher education, science and technology, it has made little progress in making improvements. In order to ensure the supply of the necessary human resources for Mongolia's economic growth and mining/energy and other sectors development, advanced technology and experts are required to meet the current demand. Mongolia can take support from Korea for enhancing human resources, especially for the improvement of higher education in the science

and technology sectors. The Korean support will be in line with the Mongolian national science and technology development plan.

VI. CONCLUSION

Based on a structured approach to identify lessons learned regarding public R&D funding in both single developed countries and emerging economies, the findings of the different case studies indicate that the interplay of various organizational characteristics contribute to the "success" or vice versa failure of an organization and possibly the national R&D and innovation system as such. However, this implies that certain "good-practice" elements of R&D funding organizations in several emerging economies have already been implemented, rather than being observable solely in developed countries.

The Korean experience shows that there are many things to consider for building a NIS, R&D funding and technological development, also business supporting factors are also important for the appropriate NIS to be developed. Furthermore, it indicates that R&D funding system building is a long term project and needs systematic approach. Mongolian R&D funding system seems to be in the early stage of development. With the experience of Korea and observation of Mongolian conditions, followings are suggested for the establishment of effective R&D funding system.

First, there is an urgent need to have the policy making capabilities in science, technology and innovation in Mongolia. The think-tank is like an infrastructure for the innovation policy. With internal policy making capabilities, the investment in national R&D funding would bring effective results. For this, the education and training of policy researchers is the first priority of issue.

Second, the transition to market driven economy has to be reflected in the NIS building. Currently, the innovation actors in the country are not linked through close incentive mechanism. There are many laws which aim at the promotion of national innovation activities. However, without proper incentive mechanism, innovation activities do not occur well. For the overall NIS, the innovation system has to include the market incentive mechanism.

With an in house policy making capability, it is necessary to make "Comprehensive National R&D funding Plan".

Third, the national innovation agency is needed for each region to implement region specific science and technology project or programs. The appropriate and qualified national agency is also the prerequisite for the national innovation policy to succeed. The management of national R&D programs and the coordination of innovation actors in the country require the existence of national agency.

Fourth, it is necessary to effectively use the scientific capabilities in the public sector including university, academy and enterprise. From the old Soviet system, Mongolia has accumulated large amount of scientific knowledge. However, scientists there are becoming old and scientific knowledge are losing its usefulness in the modern world. They have to work out for more commercial oriented technologies.

Fifth, the long term development of NIS should be based on the industrial needs and characteristics of the country. R&D separated from national needs may not be that effective. In this context, it is also important to pay attention to traditional industries like agriculture, commercial farming, foods, livestock industry rather than advanced technologies. The alignment with national industry also suggests that the government policy has to be changed over time, reflecting the changes in industrial conditions.

Sixth, it is about making good governance. The central government has the most power in policy-making and management of national science and technology programs and R&D funding institutions. However, it is desirable to give more power and budget to the national governments for the technological development and have them to make their own NIS. The Mongolian governments can also create the committee for national innovation and R&D.

Last but not the least, there seems to be the policy, governance, and management issues are often neglected in developing countries. Asian countries are relatively central government oriented societies and the policy and governance between interested parties seem to be more important than western countries in the long term for big development project of an innovation cluster.

There are many areas for collaboration between Mongolia and Korea for the NIS and R&D funding system building. The most promising area is in the training and education of Mongolia policy researchers and managers in technology agencies. Through this collaboration, Mongolia may upgrade its internal capabilities in policy making and managing national innovation programs. The Science and Technology University of Mongolia seems to be best candidate for such training program. After the training program, Mongolia may build a specialized research unit for science, technology and innovation policy.

Finally, are there any useful policy messages -for Mongolian policy makers- from the Korean experience? To start with, it should be emphasized that the Korean case is a unique one. An intensive and export driven industrialization process creates surplus for further expansion and diversification. A competent and powerful bureaucracy is coordinating this process with a rigid and vertically integrated governance structure.

Beyond these context specific characteristics, there are some useful insights for policy analysts. Firms involved in competitive markets respond to government R&D incentives very fast. That creates dual production structures and exposes the manufacturing base to exogenous shocks. Also, the strategic orientation of the local innovation system is an important dimension. An innovation policy geared to product development is, in the long run, undermining the accumulation of knowledge stock and its ability to adjust to generic technological change. Policy implementation is a third area which offers valuable insights. A top-down process in innovation policy increases

the speed of adjustment, mobilises the administration and succeeds in achieving quantitative targets. However, when it comes to learning and interaction, this rigid structure is finding it very difficult to respond to these challenges

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ABBREVIATIONS

BERD - Business Enterprise R&D Expenditure

BRICS - Brazil, Russia, India, China and South Africa

BT - Biotechnology

CIA - Central Intelligence Agency

CIDC - Committee for International Development Cooperation

CIS- Commonwealth of Independent States

CPS - Country Partnership Strategy

CRI - Creative Research Initiative

DAC - Development Assistance Committee

DAPA - Defense Acquisition Program Administration

EDCF - Economic Development Cooperation Fund

EPC - Excellent Performance Certification

EU – European Union

FDI – Foreign Direct Investment

FP - Framework Program

FYP – Five Year Plan

G5 – Group of five, (Brazil, China, India, Mexico, South Africa)

GDP - Gross Domestic Product

GERD - Gross Domestic Expenditure on R&D

GMPA – Global Master for Public Administration

GRL - Global Research Laboratory

GS - Good Software

HAN - Highly Advanced National Projects,

HEIs - Higher Education Institutions

HRST - Human Resources in Science and Technology

ICT - Information, Communication and Technology

IFC – International Finance Corporation

IMF – International Monitory Fund

IPRs - Intellectual Property Rights

ISTK - Korea Research Council of Industrial Science and Technology

ITEP - Korea Institute of Industrial Technology Evaluation and Planning

KCESRI - Korea Council of Economic and Social Research Institutes

KEIT - Korea Evaluation of Industrial Technology

KEMCO - Korea Energy Management Corporation

KIAT - Korea Institute for Advancement of Technology

KISTEP - Korea Institute of S&T Evaluation and Planning

KITECH - Korea Institute of Industrial Technology

KOICA – Korean International Cooperation Agency

KOITA – Korean Industrial Technology Association

KOSEF - Korea Science and Engineering Foundation

KOTEC - Korea Technology Credit Guarantee Fund

KRCF - Korea Research Council of Fundamental Science and Technology

KRF – Korean Research Foundation

KSP - Knowledge Sharing Program

L.D.C. - Less Developed Country

LDCs - Least Developed Countries

MDGs - Millennium Development Goals

MEHR - Ministry of Education and Human Resources

MEMS - Micro Electromechanical Systems

MESC - Minister of Education, Culture and Science, Mongolia

MFAFF - Ministry for Food, Agriculture, Forestry and Fisheries

MHW - Ministry and Health and Welfare,

MIC - Ministry of Information and Communication

MOCIE - Ministry of Commerce, Industry and Energy

MOD - Ministry of Defense

MOE - Ministry of Environment

MOST - Ministry of Science and Technology

NCST - National Council for Science and Technology, Mongolia

NSTC - National Science and Technology Council, Korea

NEP - New Excellent Product

NET - New Excellent Technology

NGOs - Non-Governmental Organisations

NIS – National Innovation System

NRF - National Research Foundation of Korea

NRL - National Research Laboratory

NSTF - National Science and Technology Foundation, Mongolia

NT - Nanotechnology

NT-BT - Nano-Bio Technology

NTRM - National Technology Road Mapping

ODA – Official Development Assistance

OECD - Organization for Economic Co-operation and Development's

PCST - Presidential Council on Science and Technology

PEF - Private Equity Fund

PPP - Purchasing Power Party

PRFS - Performance-Based Research Funding Systems

PSROs - Public Sector Research Organisations

R&D - Research and Development

RD&E - Research, Development & Engineering

RDA - Rural Development Administration

ROs - Research Organisations

ROW - Rest of the World

RTOs - Research and Technology Organizations

SERI - Samsung Economic Research Institute

SMBA - Small and Medium Business Administration

SMEs - Small and Mediumsized Enterprises

STEPI - Science and Technology Institute

TNC - Transnational corporations

TRIPS - Trade-Related Intellectual Property Rights

U.S – United States

UK – United Kingdom

UNCTAD – United Nations Conference on Trade and Development

V-KIST - Vietnam-Korea Institute of Science and Technology

WTO - World Trade Organization

국문초록

한국의 대외개발원조를 통한 R&D 재정 지원 시스템 개발 경험의 몽골 이전에 대한 연구

Khishigjargal Tserendorj

글로벌행정전공

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기술과 혁신은 국가 발전을 위해 가장 중요한 요소로 인식되고 있다. 몽고는 지식사회 이니셔티브를 지원하고 R&D 지출을 확대하는데 중점을 둔 효과적 혁신 정책을 위한 노력을 지난 시간 동안 기울여왔다. 경제 침체기 동안 기타 공공부문의 대규모 예산 삭감에도 불구하고 기술정책은 경제 회복을 위한 주요 원동력으로 여겨졌다. 현재 몽고는 타국을 역할모델로 한 따라잡기 국가라는 위치에서 타국에 의해 면밀히 연구되는 위치로 변화해 오고 있다.

원칙적으로 혁신 시스템의 제도적 및 조직적 구조는 일반적 정책 이슈와 혁신정책의 우선순위들에 의해 형성되고 있다. 실제로, 많은 국가들은 이미 정치적 토론, 문화 및 사회적 발현 또는 역사상 특정 시점에 이루어진 일시적 결정의 결과로서 일련의 제도들을 가지고 있다. 정책과 구조는 명확하게 상호 간 영향을 주는 상호작용을 가지고 있다. 조직 목표를 달성하기 위해 조직 구조와 미션은 정책 대상집단의 개인적 및 집합적 수요에 상응하는 방향으로 설계되어야 한다.

본 연구는 전반적인 혁신 정책 개발 분석과 혁신 시스템 내 조직과 각 조직의 정책 도구 분석을 통한 시스템적 접근을 활용하여 주요 연구 결과를 도출하고 있다. 또한 사례연구 방법론을 이용하여 R&D 연구자의 수요와 각 국가간 연구자의 혁신 활동을 지원하기 위한 활용 가능한 도구와 공공 재원 조달방법에 대해 연구하고 있다.

본 연구는 몽고의 R&D 재원조달시스템을 정의하는데 중점을 두고 있다. 이는 몽고의 국가 혁신 시스템을 구축하기 위한 프로그램, 몽고 혁신법, 목표 및 달성 수단/재정적, 법적 규정과 결과를 자세히 기술한 과학기술정책 종합계획과 밀접한 관련을 가지고 있다. 또한, 몽고는R&D 재원조달 시스템과 혁신 기술에 대한 투자를 적극적으로 지원할 필요가 있으며 이는 몽고의 지식기반 경제 개발을 위한 필수적 요건에 해당한다. 본 연구는 연구 대상 국가의 R&D 재원조달 시스템과 관련한 제도적 환경과 절차들을 조사하는데 그 목적이 있다. 따라서 본 연구는 몽고가 채택할 수 있는 이해관계구조, 정책수단, 재원조달 수단 사례를 파악할 필요가 있다.

본 연구는 R&D 재원조달 시스템의 세계화 추세에 관련된 핵심 이슈들에 대해 다루는 것과 몽고와 같은 개발도상국에 대한 시사점을 파악하는 것을 목적으로 하고 있다.

이를 위한 연구문제는 다음과 같다.

1) R&D 잠재력은 무엇인가? 기술이전에 영향을 미칠 수 있는 R&D 해외 재원조달 시스템-공적 개발원조에서 획득 가능한 주요 잠재적 이득으로서-을 어떻게 구축할 수 있는가?

2) 국가발전을 위한 가장 바람직한 R&D 유형은 무엇인가? 비용과 편익은 무엇이며 국내 정책과 수혜국이 어떻게 경제적 효과와 비용 및 편익의 배분에 영향을 미칠 수 있는가?

R&D를 통하여 무엇이든지 가능하다는 넓은 시야감각을 통해 지식과 세계에 대한 이해를 증진시킴으로써 우리가 현재 당면한 핵심적 문제들을 해결하는데 도움이 될 수 있다. 본 연구는 비교 연구를 통한 교훈을 바탕으로 정의한 몽고의 R&D 재원조달 시스템에 대한 정책 가이드라인을 통해 몽고 정부에 대한 제안을 제시하고 있다. 이는 몽고 국내로 도입이 가능한 타국 사례를 포함하고 있으며한국 ODA의 효과적 실행을 위해 어떤 부분을 도입해야 하는 지에 대한 것 또한 다루고 있다.

한국 사례는 적절한 국가혁신시스템 개발을 위해 R&D 재원조달, 기술 개발, 비즈니스 지원 요소들에 대한 많은 고려가 필요함을 보여준다. 또한, R&D 재원조달시스템 구축은 장기 프로젝트로서 시스템적 접근이 필요함을 시사한다.

키워드: 과학기술 정책 및 개발, 국가 혁신 시스템, R&D 개발, R&D 재원조달 및 시스템, 국제개발원조, 한국의 국제개발원조

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