

## A Glance at the Trend of National Investment on Nuclear Policy Studies during 2006 to 2016

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### 1. Introduction

The nuclear policy of Korea is at a crossroad. On June 19, the newly elected President Moon has announced at a ceremony marking the permanent shutdown of Kori Nuclear Power Plant Unit 1, his administration's decision to phase-out nuclear energy which signaled a stark change in nuclear policy of Korea. In such a transitional period, the policy communities also diverge between pronuclear and antinuclear, depending on their various interests. In some sense the remark of the new president-elect, initially set the national agenda for nuclear energy and S&T.

From a policy studies standpoint, a policy decision is a result of dynamic interactions among numerous actors.[1] In the process, distinguishing which actor is most interconnected becomes the key research question in identifying the main actor that directly influences policy decisions. In this sense, bureaucrats are major actors that possess longevity, expertise and diverse human resource network. According to Kingdon, bureaucrats have the resource to initiate the *softening* process that selects floating ideas and alternatives to solve the policy agenda [2]. In other words, the government officials who are working in the ministerial bodies are the ones who choose the policy agenda as well as draft the policy itself.

In this vein, this paper initially started out to explore the nuclear policy trends of Korea by analyzing the 10 year history of policy research support program. Based on the needs of the relevant government official and his or her department in the ministry, policy research projects are outsourced to the non-governmental research sector for in-depth research. In other words, investigating the altering orientation of the policy research projects signifies where the interests of the government officials lie and moreover is a great indicator for analyzing the policy trends of the government.

Based on the above assumptions, this paper investigates the trends of the (nuclear related) policy research projects implemented by the Ministry of Science and ICT (former Ministry of Science, ICT and Future Planning) from 2006 to 2016. Such efforts will not only delineate the nuclear policy trends of Korea, but also demonstrate how well the government policy makers

have interpreted the dynamic nuclear environment of home and abroad into policy research projects.

Computational network analysis was performed using Microsoft Excel and Cyram Netminer 4.2(ver.) for conducting statistical analysis as well as visualizing the topical network.

### 2. Background and Literature Review

#### 2.1 Bureaucrats in Nuclear Science Policy

Bureaucrats formulate and implement science and technology (S&T) policies to enhance national technological innovative capabilities and moreover to better the livelihoods of its citizenry. In such process, maintaining a high level of expertise is the key quality for bureaucrats, which induces a tendency to create policy making communities based on technocrats and experts.

Such characteristics become more prominent when it comes to nuclear S&T policy. There are three distinctive qualities when it comes to nuclear S&T; big science qualities, social qualities and international qualities. Nuclear S&T falls under the category of big science, which requires large scale and long-term budget investment with high social responsiveness. At the same time due to its trans-boundary characteristics it is subject to influence of international regime and law. Consequently, the three major traits of nuclear S&T resulted in a government-led top-down model of policy formulation and implementation based on the expertise of the government. Cho&Oh (2002) state that previous nuclear policies were devised and enforced on Decide-Announce-Defend basis but this fails to reflect the current pluralistic societal conditions.

In reality due to the unique trait of nuclear policy, they are formulated within a closely related small network of technocrats and experts instead of a wider and comprehensive group involving people from numerous areas such as the media, non-governmental research and other stakeholders. In such circumstances exploring the role and influence of the bureaucrats is very significant for nuclear S&T policy research as they become powerful actors.

## *2.2 Literature Review on Nuclear Policy Research*

The existing literature on nuclear policy is mainly concentrated on the qualitative analysis of the chronological trend of nuclear policy from a historical neo-institutionalist spectrum.

Past studies have signified that path dependence exist in nuclear policies and emphasize that the structure of Korea's nuclear policy making and implementation process is a government-led and government promotion based structure.

Such literature is meaningful in that case studies on nuclear policies were implemented on the basis of policy theories, yet it lacks empirical analysis on the micro level, which can trace the flow of the budget related to nuclear policies. In this respect Kim (2017) applied network analysis technique to examine the research tendencies of social scientists as agenda setters of the non-governmental sector.

This paper, however, is distinctive as it applies network analysis technique to observe the policy trends and the policy implementation tendencies of the bureaucrats.

## *2.3 Review on Government Policy Plan during 2006 to 2016*

The decade from 2006 to 2016 was a transformational period in terms of nuclear policies. Within the decade, two focusing events arose, namely, the export of Korea's SMART to the UAE in 2009 and Fukushima Daichii accident in 2011. These events had a far-reaching effect on Korea's nuclear policy, amplifying domestic interest for nuclear S&T and heavily influencing diverse areas including domestic nuclear legal system, government organizational structure and research environment.

The change in the government's nuclear policy direction is conveyed in the Comprehensive Nuclear Energy Promotion Plan, the highest periodical national strategy for nuclear energy. The third and fourth Comprehensive Nuclear Energy Promotion Plans, which fall under the period of analysis, manifests a number of interesting traits about the government's interest in nuclear S&T during the period.

The policy features exhibited in the third and fourth plans are as follows. First, from changes in the objectives and the visions of the two plans, it becomes apparent that the Korean government continuously supported the use of nuclear energy but highlighted its effort to strengthen nuclear safety related policy framework. From this, we can infer the government's intent of securing nuclear safety to guarantee the sustainability of nuclear energy. Second, the transition

from technology and export oriented strategies and projects to a safety and public trust orientation convey the government's evolving thematic interests in nuclear S&T. Third, numerous criteria and factors in from the third to the fourth plans show Korea's rising awareness of the global society and its need for changing role to a leading nuclear state.

## **3. Data and Methodology**

### *3.1 Nuclear Policy Research Support Program*

According to the regulations of the Ministry of Science, ICT and Future Planning (MSIP), policy research projects are contract projects implemented with the role of devising policies or planning, researching and analyzing current policy related issues. (MSIP, Policy Research Project Management Regulations, Article 2) The public notice for nuclear policy research project of the MSIP states 'nuclear policy research projects are implemented in order to utilize the results of the study to devise and improve national nuclear policies,' making its role manifest. In short, the projects are in fact preliminary in character, as they are used as a feasibility study for creating nuclear policies.

This paper is also partly carried out as a 'nuclear research planning assessment project' assigned to the national research foundation (NRF) by the Korean government.

### *3.2 Data and Methods*

This paper selected the 235 policy research projects that were funded for the Nuclear Policy Research Project from 2006 to 2016, for analysis.

Based on the literature information contained in the project, descriptive statistics and network analysis technique is applied to examine the characteristics and trends of the Nuclear Policy Research Projects. The network analysis uses keywords co-occurrence data for reading the general picture of accumulated knowledge from 10 years of government's investment into nuclear science policy research.

The keyword is provided by each project's manager (or leader). This PM provided keywords in the bibliography are an index that provides future users with acquired information and knowledge, connotatively. The jaccard coefficient algorithm applies for building the keyword network of co-occurrence frequency [4].

## **4. Analysis Results**

### *4.1 Descriptive Statistics*

The literature information of the targeted projects for analysis provides several distinctive characteristics. First, for the past ten years 238 policy research projects were funded by the government, which amounts to an average of roughly 23 projects funded annually. 2006 had the highest number of funded projects.

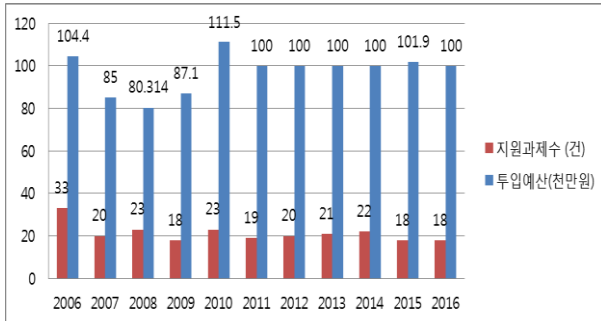


Fig. 1: Trend of number of funded projects and budget

Second, the total amount of budget invested within the period of analysis totals 10.7 billion won and about 1 billion won in budget is injected annually except for the three years between 2007 and 2009. The average budget for each project equals to 4.5 million won. The Korea Institute of Nuclear Safety (KINS) carried out the highest budget project in 2011 and the lowest budget project by NRF in 2006, amounting to 160 million won and 4 million respectively.

Third, from examination based on the types of institutions, there are 50 performing institutions in total and the type of institutions that had the highest performance was government-funded institutes accomplishing 122 projects. Next is cooperating groups with 60 projects, universities with 26, private institutes with 16 and academic societies with 11. When categorized in industry, university and institute, the number of implemented projected equal to 144, 40 and 24 respectively. The results convey that the policy research funding has been consistent in terms of size and the majority of the projects were executed by government-funded institutes.

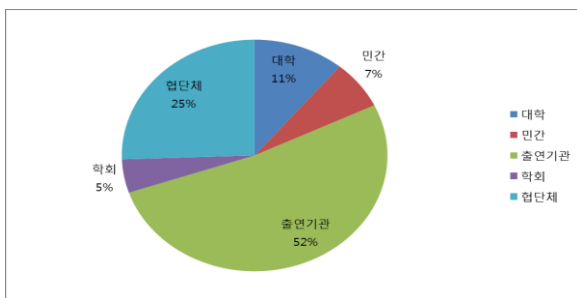


Fig. 2: Nuclear Policy Research Projects categorized by types of institutes (2006-2016)

Fourth, observation based on the types of project show 227 unit projects and 8 contracted projects. During the decade there was one comprehensive project conducted by KINS. The ‘Research on raising the efficiency of the nuclear safety regulation implementation system’ was the only comprehensive project with numerous minor projects implemented by both KINS and Kyunghee University.

#### 4.2. Knowledge Network

The knowledge network supported by the government program during 2006 to 2016 is visualized as Fig.3 shows. The network map shows that the government research supports have been clustered into four major sub-networks and separated topics. Four major groups have set centered topics such as ‘Nuclear safety’, ‘Radioactive Industry’, ‘Nuclear Security’, and ‘Nuclear Waste management’. Other separated topics consisted of policy planning process, public acceptance and management of nuclear-related technologies such as nondestructive, bio, and medical technology, etc.

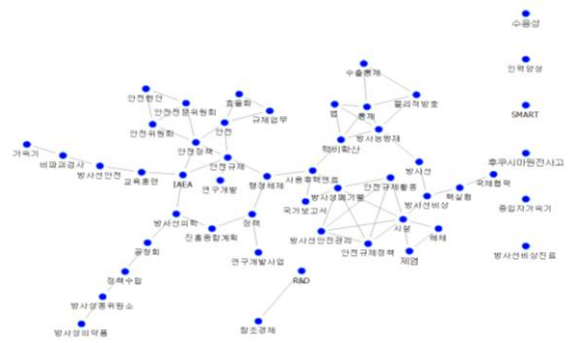


Fig. 3: Visualized Knowledge Network Map of Government-supported Nuclear Policy Research in Korea (2006-2016)

Comparing two different knowledge networks of published socio-nuclear research in the same period shows that the bureaucratic-driven researches had been managed within smaller boundary of topics.

Table 2: Network Properties of Government-supported Knowledge and Civil Socio-nuclear Keyword Networks

	Government-supported Knowledge	Civil Research (in Social Science)
Degree	62	166
Density	0.051	0.027
Average Degree	1.24	1.495
Centralization Index (%)	9.609	4.637
# of Clique (min. size: 3)	11	34

#### 4.3. Centrality

The centrality index is a milestone that guides the central concepts in a visualized knowledge map. This research applied degree centrality that shows what kinds of nodes have the most links with others. [5]

The higher node in degree centrality is a research topic representing its sub group. The central theme of the government's policy research projects was nuclear safety policy. The safety of the nuclear facilities and safety regulations on radioactive waste were the topics most researched upon. There was a particular interest on the issue of nuclear nonproliferation.

Research of the non-governmental sector was more theme specific dealing with the current policy agendas more in depth. The diverse research areas included nuclear liability, reprocessing and conflict framework relating to nuclear safety. There was a distinct focus on case studies on a diverse range of countries which naturally led to comparative case studies on different policy agendas.

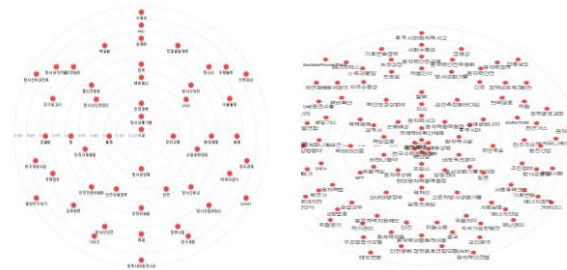


Fig. 4: Centrality Knowledge Network Map of Government-supported Nuclear Policy Research in Korea (2006-2016)

### 5. Conclusion

A number of policy implications are derived from the results of the analysis. Foremost, the government's policy research projects are mainly implemented by government-funded institutes. We can infer that close interconnection between the bureaucrats and the researchers of the government-funded institutes exist. This substantiates in part the hypothesis of policy network theory that bureaucrats and their network play a critical role in the policymaking process. Thus nuclear policy research were mainly conducted by the government-funded research institutes which possess a strong interconnection with the bureaucrats  
Second, the emphasis on strengthening safety regulations to achieve sustainability of nuclear energy exhibited in the Comprehensive Nuclear Energy Promotion Plan was faithfully reflected in the policy research projects. Thus, TSOs such as KINS have

received the largest proportion of the budget in conducting research and research related to safety was highest in numbers.

Third, both governmental and nongovernmental research had a common theme of nuclear safety. Yet the two diverge on the sub-themes as the former focuses on the safety of the facilities and the latter focuses on wider area of topics with more detail. Based on the assumption that actual policies are formulated after a softening process where diverse collection of ideas of the society is fine tuned into actual policies, the numerous research of the society are also adjusted and combined through the policy research projects to influence government policies.

This paper is an exploratory study for further studies analyzing the themes and results of the past decade of policy research projects of the Korean government. In order to identify what kind of influence and role the bureaucrats have on policy formulation, interviews and close observations of the stakeholders are imperative. Such tasks are left untouched for future studies.

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