

Policy Research on Science and Technology of North Korea in the Kim Jong-Un Era Based On BiG Data

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Abstract: Every society has a goal that it pursues. Kim Jong-un is also leading North Korea with a vision for the country. The national goal of North Korea is to build a strong socialist country. With this goal in mind, North Korea is striving to develop its science and technology. This study analyzes and evaluates the science and technology policies in the era of Kim Jong-un by examining North Korea's <Rodong Sinmun>. The role of <Rodong Sinmun> is to convey the thoughts of Kim Jong-il and Kim Jong-un to the North Korean people. Therefore, this newspaper is the most suitable resource to understand the policies of the North Korean government. For the same reasons, <Rodong Sinmun> is considered the most vital resource in the research of North Korea. In addition, as North Korea is one of the most secluded areas in the world, there is a lack of appropriate literature sources to understand North Korea, and thus <Rodong Sinmun> is necessary. The research objectives of this paper are to understand the science and technology policies of North Korea in the era of Kim Jong-un by analyzing <Rodong Sinmun>, which was selected based on past studies. The purpose of this paper is to analyze this using text mining.

Index Terms: Science and Technology, Big Data, North Korea, Kim Jong-un Era.

I. INTRODUCTION

Every society has a goal that it pursues. Kim Jong-un is also leading North Korea with a vision for the country. The national goal of North Korea is to build a strong socialist country. With this goal in mind, North Korea is striving to develop its science and technology. This study analyzes and evaluates the science and technology policies in the era of Kim Jong-un by examining North Korea's <Rodong Sinmun>. The role of <Rodong Sinmun> is to convey the thoughts of Kim Jong-il and Kim Jong-un to the North Korean people. Therefore, this newspaper is the most suitable resource to understand the policies of the North Korean government. For the same reasons, <Rodong Sinmun> is considered the most vital resource in the research of North Korea. In addition, as North Korea is one of the most secluded areas in the world, there is a lack of appropriate literature sources to understand North Korea, and thus <Rodong Sinmun> is necessary. The research objectives of this paper are to understand the science and technology policies of North Korea in the era of Kim Jong-un by analyzing <Rodong Sinmun>, which was selected

based on past studies. The purpose of this paper is to analyze this using text mining.

II. SCIENCE AND TECHNOLOGY POLICIES OF NORTH KOREA

The trends of existing research on North Korean science and technology policy can be categorized into two major categories. The first involves combining the development aspects of North Korean science and technology policy with topics such as politics, society, and the economy to conduct research from a historical perspective. The other category involves approaches from an institutional perspective, such as the science and technology administrative system and structure.

In 1956, North Korea began to worship Kim Il-sung as Khrushchev's criticisms of Stalin began the 'de-Stalinization' of international communism. As a result, North Korea established a one-party system, the Suryong system, which is a feature of a totalitarian state. Science and technology policies of North Korea are founded and maintained within the framework of the nation's Juche ideology. 'Juche Science' is closely related to the North Korea's ideology of independent foundation and Juche. It begins with the concept of 'Juche in science', striving to utilize the nation's own raw materials and fuels rather than indiscriminately importing advanced science from overseas.

In 1998, Kim Jong-il established the 'Strong and Prosperous Nation policy' to overcome the nation's crises, which is based on the foundations of a nation that is strong in terms of ideology, economy, and military power. In this policy, science and technology was adopted as the core method. Kim Jong-il strived to promote science and technology policy within the framework of the 'Strong and Prosperous Nation policy' to build a strong military nation as well as overcome the limitations of the extensive growth system that North Korea had pursued up to this point, and instead establish an intensive growth system to become an economic power. Since its inception, Kim Jong-un's regime has emphasized a knowledge economy age, and the science and technology that constitutes it. Science and technology are absolutely necessary to advance the economy and national defense.

In 2013, Kim Jong-un announced the 'Nuclear-Economy Byungjin Line'. This involved a strategy to strengthen national defense and use it as a foundation to build up the economy. Due to his failing health, Kim Jong-il did not have

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sufficient time to solidify a succession system, and thus was required to develop the economy in a short period of time. Efforts were made to apply the concept of ‘state of the art’ (a core concept in military science and technology) to the production sector for machinery remodeling and the construction of new production bases so that such aspects were fitting of a military power. In addition, North Korea strived to establish a self-sustainable production system that is capable of surviving any circumstances. These ideas were in response to sanctions against North Korea from the international community, which cut the supply of resources from external sources. In addition, these ideas established the strategy of developing the North Korean People’s economy ‘efficiently’ and ‘within a short period of time’ to meet the needs of the information age through ‘our strength’ and ‘our methods’.

III. RESEARCH QUESTION AND RESEARCH METHODOLOGY

A. Research question

This study focuses on the teachings (Kyoshi) of Kim Jong-il and Kim Jong-un in <Rodong Sinmun>. The objective of this research is to study the thoughts of North Korea’s Supreme Leaders on science and technology policy through their teachings in <Rodong Sinmun>. A feature of articles in <Rodong Sinmun> is the fact that many articles tend to open with teachings of Kim Jong-il and Kim Jong-un.

<Rodong Sinmun> serves to accurately convey the Supreme Leader’s thoughts on key national policies to the North Korean people, and systemize the role of the Suryong. The Suryong theory, which is at the core of the North Korean power structure, was systemized in the late 1960s. North Korea claims that the Suryong plays a ‘decisive role’ in the revolutionary struggle of the working class, and that the Suryong founded the working class’ party and nation, creates the party’s revolutionary traditions, and presents the ideal leadership for the party. In order to strengthen the power of the Suryong, it is necessary to spread their ‘teachings’. Furthermore, the teachings of the Suryong is the strongest commitment to policy in North Korea.

In North Korea, the words and teachings of the Supreme Leader holds more weight than any other standard, and <Rodong Sinmun> is the medium through which this is conveyed to the people. <Rodong Sinmun> directly quotes the teachings of the Supreme Leader and provides commentaries on the teachings. In other words, <Rodong Sinmun> is used as a medium to convey the intent of the Supreme Leader to the North Korean people. For this reason, it is possible to naturally read into the hidden implications of North Korean science and technology policy by analyzing the science-related teachings in North Korea’s <Rodong Sinmun>. Furthermore, by comparing the teachings of Kim Jong-il’s era and Kim Jong-un’s era, it is clear that the science policies of Kim Jong-un’s regime are different to the policies of Kim Jong-il’s regime. With this background, the following two research questions were established. (Research Question 1: What are the differences between the science and technology policies of Kim Jong-il and Kim Jong-un?) and (Research Question 2: What is Kim

Jong-un’s policy towards science and technology?) Through this process, this study aims to identify the science and technology policies of both leaders, with particular focus on ‘why’ and ‘how’ the new leader Kim Jong-un is striving to develop North Korea’s science and technology.

B. Research methodology

1. Analysis of news frame and semantic networks

Research methodologies of news frames includes text analysis research and message effectiveness research. While text analysis focuses on the structure of news content and the value system analysis of news text, message effectiveness research is based on the idea that the composition of news frames affects the cognition and execution of the audience. This study applied the semantic network analysis method, which utilizes text mining techniques based on text analysis research methods, to investigate articles related to the science and technology policies of Kim Jong-il and Kim Jong-un to derive frames in an inductive manner.

As the composition of words used in news frames are determined by the choice of vocabulary and the emphasis, semantic network analysis is effective for frame analysis. Semantic network analysis focuses on the patterns of words used in a text. It is an analytical method that examines the frequency of vocabulary use in addition to the semantic connection and relation of various words that appear simultaneously. This is an application of ‘social network analysis’, which uses the analysis framework (the network that is formed by continuous interactions between actors within a social phenomenon system structure) as the main structure.

In this study, the teachings of Kim Jong-il and Kim Jong-un in <Rodong Sinmun> articles with science keywords were derived using the semantic network analysis method. In addition, the differences of the Kim Jong-il and Kim Jong-un regimes were identified by comparing the semantic networks of <Rodong Sinmun> articles with science keywords of each era. Kim Jong-il died on December 19th, 2011. The 3 years in 2012~2014 were a period of post-death rule of Kim Jong-il. All teachings that appeared in <Rodong Sinmun> articles up to this point were teachings of Kim Jong-il, not Kim Jong-un. Teachings of both Kim Jong-il and Kim Jong-un were used in random until 2015. From 2016 and onwards, all teachings in <Rodong Sinmun> were Kim Jong-un’s teachings.

All <Rodong Sinmun> articles containing the word ‘science’ in the title that were published in the two-year period of 2009~2010 were gathered. From this collection of articles, articles with the teachings of Kim Jong-il were identified. In addition, all articles containing the word ‘science’ in the title that were published in the two-year period of 2016~2017 were gathered, and all articles with the teachings of Kim Jong-un were identified. Once the articles were identified, the teachings of Kim Jong-il and Kim Jong-un were categorized using the Microsoft Excel program.



2. Analysis method and process

First, all words in the teachings were implemented in code. After four stages of cleaning processes, words such as articles, conjunctions, suffixes, numbers, and location names were removed and the nouns were extracted. Words with similar meanings or contexts were unified into one representative word. Once similar words were unified, the frequency of each of the finalized words were identified.

Second, the texts of the collected teachings were subjected to an initial cleaning process and then saved in the text file format. An assumption data program from TEXTOM was used to conduct morphological analysis of the saved data, and the frequency of mutual words were calculated. Based on the extracted words and frequencies, the assumption data was subjected to modification and editing processes to form a list of key words of the final unit of analysis that were frequently used. <‘Word’ X ‘Word’> matrix data that quantified and presented the relationship of the words were analyzed.

Afterwards, the image conversion feature of TEXTOM was used to visualize the data. During the frequency setting process, the articles were analyzed by focusing on three criteria.

The first criterion is degree centrality. The structural position of each word was quantified and centrality analysis was performed. This type of analysis indicates the degree to which a single word is centered in the entire network. There are three indexes in centrality analysis: ‘degree centrality’, ‘betweenness centrality’, and ‘closeness centrality’. Degree centrality, which is used in this study, is measured by the number of different words directly linked to a single word. The equation to calculate degree centrality is as follows; Degree Centrality = Degree of Connection / (No. of Nodes in the Network - 1)

Second, the TF-IDF (Term Frequency - Inverse Document Frequency) was analyzed. TF-IDF is a weight of the importance of words that is commonly used in machine learning and information searches. It is a statistical value that indicates the degree of importance of a particular word in a document when multiple sets of documents are given. TF (term frequency) is a value that indicates how frequently a particular word appears in a document: the higher the value, the greater the importance of the word in the document. However, if the word appears frequently in the set of documents, this means the word is commonly used. This frequency is DF (document frequency), and the inverse of this value is IDF (inverse document frequency).

TF-IDF is the product of TF and IDF. Applying the TF-IDF model prevents words used as search index words in data analysis from being interpreted as important words due to high weight values according to how often the word appears.

Third, N-grams were analyzed. N-gram is a method that involves separating sentences into smaller strings of a predetermined length N and indexing words. If strings divided into N-grams appear as two words, the amount is used as a value and a co-word network is formed. Using this method, it is possible to identify pairs of words in a sentence that are closely related.

Table 1 Term frequency

Word	Term Frequency	Percentage (%)	Accumulation Rate (%)
과학	679	11.1585866886%	11.1585866886%
기술	468	7.69104354971%	18.8496302383%
건설	94	1.54478225144%	20.3944124897%
발전	81	1.33114215283%	21.7255546426%
위력	74	1.21610517666%	22.9416598192%
당	70	1.15036976171%	24.0920295809%
생산	69	1.13393590797%	25.2259654889%
부문	67	1.10106820049%	26.3270336894%
힘	66	1.08463434675%	27.4116680362%
연구	62	1.0188989318%	28.430566968%
농사	58	0.953163516845%	29.3837304848%
성과	58	0.953163516845%	30.3368940016%
농업	55	0.903861955629%	31.2407559573%
강국	49	0.805258833196%	32.0460147905%
중시	48	0.788824979458%	32.8348397699%
과학자	46	0.75595727198%	33.5907970419%
경제	45	0.739523418242%	34.3303204601%
사업	44	0.723089564503%	35.0534100247%
국가	44	0.723089564503%	35.7764995892%
인민	43	0.706655710764%	36.4831552999%
문제	42	0.690221857025%	37.1733771569%
전략	41	0.673788003287%	37.8471651602%
자강	39	0.640920295809%	38.488085456%
조국	36	0.591618734593%	39.0797041906%
기관차	35	0.575184880855%	39.6548890715%
지름길	35	0.575184880855%	40.2300739523%
수행	34	0.558751027116%	40.7888249795%
기초	34	0.558751027116%	41.3475760066%
...

3. In-depth interviews

In order to identify the unique characteristics of the science and technology policies of the Kim Jong-il era and the Kim Jong-un era, in-depth interviews that involved qualitative research methods were conducted with three experts on ‘North Korean science and technology’. Resources related to North Korean science and technology policy were sufficiently studied to ensure the objectivity of the research, and the three experts were selected based on this study. The in-depth interview process was conducted for approximately three months from June 2018 to October 2018 by visiting and consulting with expert researchers with Ph.D degrees in the field of ‘North Korean science and technology’ and at least ten years of research experience. After providing the interview participants with <Rodong Sinmun> analysis information and sufficient time to review the materials, the interview was conducted for one hour by asking the following questions. (1) What are the distinct features of science and technology policies in the era of Kim Jong-il? (2) What are the distinct features of science and technology policies in the era of Kim Jong-un? (3) What are the similarities and differences between the



science and technology of the Kim Jong-il and Kim Jong-un eras?

a greater emphasis on the economy instead of national defense.”

IV. RESEARCH RESULTS

We performed two analyses: one is comparative analysis of keywords of Kim Jong-il’s Era and the other is comparative analysis of keywords of Kim Jong-un’s Era.

Owing to the lack of space, we will only introduce the latter in this paper.

A total of 315 articles published in the era of Kim Jong-un (January 2016~December 2017) included the keyword ‘science’ in the title. This is a significant increase from the 165 cases from the era of Kim Jong-il. Analysis of the TF (term frequency) within this period produced the following results: ‘science’ (679 cases), ‘technology’ (468 cases), ‘construction’ (94 cases), ‘development’ (81 cases), ‘power’ (74 cases), ‘party’ (70 cases), ‘production’ (69 cases), ‘field’ (67 cases), ‘strength’ (66 cases) (Table 1).

The fact that ‘science’ was the most common word is the result of collecting the teachings of Kim Jong-il with the keyword ‘science’. Of the 315 teachings, some were a single sentence, and some were over three sentences long. Hence, there were sentences that did not include the word ‘science’ (the teaching was collected as the word ‘science’ was present in a different sentence). The relative importance of keywords that were spoken by Kim Jong-un can be represented with a TF word cloud (Figure 1). Key characteristics included the following: (1) compared to Kim Jong-il, words related to economic growth such as ‘economy’, ‘construction’, ‘development’, and ‘production’ were mentioned more frequently, (2) the ‘strong and prosperous country’, phrase used by Kim Jong-il was somewhat moderated to ‘strong country’, (3) mentions of the ‘party’ (Workers’ Party of Korea) were less frequent. Such trends can be easily seen from the TF ego network (Figure 2). Figure 3 is a visualization of the semantic network of words extracted from the teachings of Kim Jong-un in <Rodong Sinmun>. From the semantic network, one can see the contexts in which the words were used and the meaning the words carried. It is possible to see which aspects of science Kim Jong-un considered as important from the TF-IDF data, which is a statistical value that indicates the importance of a particular word in a document (Table 2).



Fig 1 TF word cloud

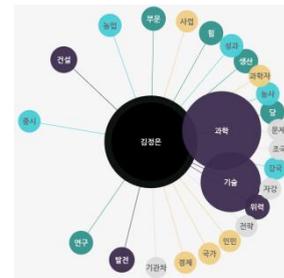


Fig 2 TF Ego Network

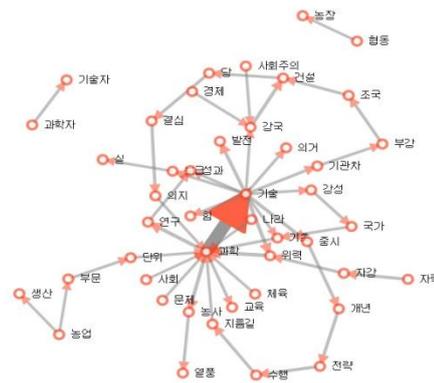


Fig 3 N-gram Network Graph

Table 2 TF-IDF

Word	TF-IDF
위력	143.9974
생산	123.6314
연구	120.6464
농업	114.3693
농사	112.8628
당	112.6607
발전	112.2898
체육	107.5172
힘	106.2229
건설	103.2696
사업	96.67788
과학자	95.65431

In-depth Interviews with Experts

(1) Dr. A: “The increase in the number of teachings related to ‘science’ in the era of Kim Jong-un is significant. Despite science and technology being an important aspect in Kim Jong-il’s era, national defense took priority. Kim Jong-un mentions ‘science’ more frequently as it produces results. The ‘Nuclear-Economy Byunjin Line’ produced results, and as such achievements expanded into the private sector, ‘science’ was mentioned with greater frequency.”

(2) Dr. B: “From the data we can see that ‘economy’ was used frequently. The frequent mentioning of the ‘economy’ indicates a level of confidence. The North Korean economy did in fact become substantially more stable under Kim Jong-un. This shows a strategy to improve the economy through science.”

(3) Manager C: “The trends show more focus on words like ‘production’ and ‘economy’, which is related to supplying the basic needs of life. Compared to the Kim Jong-il era, the trends seem to show



