# Korea Future Issues 2019 - Exploration of Changing External Environment

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#### Abstract

#### Background & Analysis Method

Korea Institute of S&T Evaluation and Planning (KISTEP) published the "Korea Future Issues 2015", which looks at important future issues in 2025. There has been a major change through events such as the 'Candlelight revolution,' the 'Inter-Korean Summit,' and 'U.S.-China trade war,' which requires a renewal of future issue report.

Based on "Korea Future Issues 2015," 28 new issues were identified. A survey of 500 experts from industry, academic, and research institute was conducted to analyze important issues and prospects for change in 2029. The importance, probability, and impact of the issues are compared with those of the year 2015. Among the issues that were identified as having high impacts 10 years later, two agendas were identified related to issues that were more likely to occur in comparison with the 2015 survey.

#### Analysis of Future Issues

Major issues are in the order of Low Fertility & Super-Aging Society, Social Instability by Inequality, Low Growth and Shift in Growth Strategies, Changes in Inter Korean Relations, Job Insecurity, and the importance of economic issues has increased in comparison with the 2015 survey.

The high-impact issues of Changes in Inter Korean Relations and Geopolitical Conflict with Neighboring Countries are likely to occur than 2015, and are expected to lead the new changes.

Two agendas related S&T were suggested from the issues of Geopolitical Conflict with Neighboring Countries and Changes in Inter Korean Relations, and future policy directions on two agendas were proposed.

#### Implications

It is time to revise the strategy to foster future growth engines in line with the changes in the global economic order and our comparative advantage that began to emerge as a U.S.-China trade war.

Since North Korea's S&T has different advantages from South Korea, it is expected to play a complementary role in South Korea's technological innovation through the conversion of defense technology to civilianization.

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#### Special Article

## 1. Background and Analysis Method

Korea Institute of S&T Evaluation and Planning (KISTEP) published "Korea Future Issues" in 2015 that predicts the future of Korea in the next 10 years with Ministry of Science, ICT and Future Planning to commemorate 70th anniversary of national independence with the aim of developing a shared view on the future of Korea (Future Preparatory Committee, et al., 2015). "Korea Future Issues 2015" differentiated itself from previous reports of this kind, which proposed measures for implementation to achieve goals within a specific timeframe (by 2020 and by 2040, etc.), as it identified future challenges by providing potential changes of key issues in next 10 years.

There has been a major change since the release of "Korea Future Issues 2015" through events such as candlelight revolution, inter-Korean Summit, and U.S.-China trade war that may affect future issues in a variety of ways and many argued the need to review and look at such changes. "Korea Future Issues 2019" is the revision of the 2015 report that adjusted 28 issues stated in previous one by referring to data and materials regarding their status at home and abroad and future prospects (WEF, 2018/OECD, 2018, etc.) to reflect changes of the times.

To be specific, the 'unstable life of future generation' and 'changes in traditional family system' are integrated into 'job insecurity,' and 'low fertility and super-aging society,' respectively. Also, 'credentialism & excessive competition in education,' 'food security,' 'nuclear safety' are included in 'social instability due to deepening gaps,' 'food safety,' and 'social disasters' for each.

The following table indicates changes in issue titles. 'Disaster risk' and 'climate change & natural disasters' are further classified as 'social disaster,' 'natural disaster,' and 'failure to mitigate climate change' in accordance with the standard classification of disaster.

'Unmanageable inflation,' 'damages due to terrorism,' 'weapons of mass destruction (WMD),' 'expansion of recycling paradigm,' and 'slumism caused by urban planning failure' are newly added.

Before Change	After Change	
Social inequality	Social instability due to deepening gaps	
Multiculturalism	Conflicts caused by the expansion of multicultures	
Fight against incurable diseases	Healthy life extension	
National security/unification	Changes in inter-Korean relations	
Global governance	Increasing uncertainty of global and local governance	
Energy shortage and resource depletion	Energy price shock	
Biodiversity crisis	Biodiversity crisis and ecosystem destruction	

# Table 1. Future Issues

Issue	Description		
Low growth rate and shift in growth strategy	Continued sluggishness in the economy, growth slowdown, weakening of values considering that economic growth is a key priority for national development, growth that takes into account both environmental and social values, inclusive growth, etc.		
Digital economy in hyper-connected society	The networked connection of people, process, data and things, creation of technology-based distribution channels by building a platform transcending national boundaries (platform economy,		

Issue	Description		
	sharing economy, etc.)		
Polarization of industrial structure	Widening gap between large firms and SMEs, resulting in social conflicts, establishment of mechanisms for taking advantages, hampering the growth of new companies, etc.		
Manufacturing revolution (Industry 4.0)	Manufacturing process changes with the adoption of new digital technologies, the 4th industrial revolution, servitization of manufacturing, individualized manufacturing through 3D printing technology, etc.		
Job insecurity	Lack of decent work and regular jobs, excess supply of self-employed business in small scale, deteriorating youth unemployment, etc.		
Energy price shock	Economic pressure on energy dependent industries and consumers caused by steep rise and fall of energy prices		
Unmanageable inflation	Rising costs of key products and services at unsustainable pace lead to the decline of industrial competitiveness and price instability		
Low fertility & super-aging society	Increase of one-person households, changing views on marriage, increasing burden and changing concepts of caregiving childcare, increasing number of older adults living alone, decrease of productive population due to changing population structure, increase of welfare spending, increasing interest in health, economic slowdown, downsizing cities, challenges of sustainable society, etc.		
Emphasis on quality of life	Work-life balance, pursuit of small but certain happiness, expanding a culture of wellness, increasing diversity of consumption, etc.		
Social instability due to deepening gaps	Rising income polarization, solidifying political inequality, decline of social mobility, rising social injustice and structural conflicts, increasing burden on young generation (competitive education and economic issues including employment and housing), increase of senior poverty, etc.		
Intensified gender conflicts	Problems caused by inequality in social conditions, position, rights, and obligations between men and women, Me Too movement, misogyny, misophally, etc.		
Cyber crime	Intelligent phishing, smishing, digital copyright infringement, personal data breach, cyber defamation, e-commerce fraud, creation of illegal website, fraud by cyptocurrency exchange platforms, etc.		
Healthy life extension	Significant increase of healthy and young life expectancy thanks to technological development and advanced medical systems including realization of personalized preventive care, finding cures for incurable diseases, transplantation of artificial organs, gene manipulation, etc.		
Food safety	Increasing issues related to food safety due to eggs contamination scandal, genetically modified organism (GMO), harmful microorganisms and environmental contaminants, prions causing mad cow disease (BSE), fear of avian flue and other disease infection, increasing import of agricultural and livestock products, etc.		
Geopolitical conflicts with neighboring countries	Conservative shift in Japan (amendment of Pacifist Constitution, issues of comfort women and other past affairs, Dokdo sovereignty claim), rise of China as a global hegemonic power (Chinese dream, Northeast Project, Belt and Road Initiative (BRI), growing economic dependence on China, the THAAD dispute), etc.		
Changes in inter-Korean relations	Efforts to release tensions between two Koreas, denuclearization and reducing WMD threats,		

Issue	Description	
	impacts of volatile inter Korean relations such as Panmunjeom Declaration, U.SNorth Korea Summit, etc.	
Increasing uncertainty of global and local governance	Multipolarization of the world such as economic blocs, Expansion of global governance and partnership owing to increasing interdependence in environmental issues, expansion of national-centrism, nationalism, self-determination in forms of Brexit, U.S-China trade war etc.	
Digital democracy	Changes in governance with citizen participation such as Candlelight Revolution and Jasmine Revolution, direct democracy supported by digital technologies, improved administrative services with the establishment of e-government, etc.	
Conflicts caused by expansion of multicultures	Increase of migrants and multicultural families in Korea, conflicts caused by accepting refugee (Yemeni refugees and others), discrimination against foreigners, ethnic and cultural conflicts religious conflict (Islamophobia), etc.	
Damage due to terrorism Acts by individuals or groups with the political, religious, and ideological goals injuries and physical damages, cyber terrorism, terror against non-targeted aud at Gangnam Station motivated by misogyny, arson on Sungnyemun, etc.), a a particular person, operation of foreign terrorist organizations in Ko		
WMD	Strengthening destructive power of nuclear, chemical and biological weapons for purpose of warfare and terrorism, missiles, etc.	
Social disaster	Prevalence of infectious diseases (swine flu, MERS), multiple types of accidents (oil leaks, chemical accidents, fire, explosion, collapse of buildings, etc.), infrastructure destruction (nuclear power plant, ICT, transport, healthcare), other other types of damages triggered by man-made causes, besides natural disasters	
Failure to mitigate climate change	Continued abnormal weather conditions, increasing frequencies of extreme weather events such as typhoon, flooding, drought, etc., international cooperation and intensifying efforts for GHG reduction, ecological changes to animals and plants, etc.	
Growing cross-border environmental impact	Increasing inflow of air pollutants such as fine dust and yellow dust along with industrializatio of neighboring countries, environmental concerns caused by increasing number of nuclear power plants in China, aggravating marine pollution in the West Sea, impact of marine oil spill on neighboring countries, etc.	
Natural disaster	Damages caused by extreme weather events such as typhoon, flooding, drought, occurrenc of damage with increasing frequency and intensity of earthquakes as in the case of Gyeongj earthquake	
Expansion of recycling paradigm	digm Global recycling crisis concerning plastics and vinyls, unstable supply of energy sources due to increasing demand for resources along with rapid industrialization of developing countries.	
Slumism caused by urban planning failure	Further worsening of poor and contaminated living conditions due to changes in population structure and aging infrastructure	
Biodiversity crisis and ecosystem destruction	Rapid changes of habitats for plants and animals due to human interventions (habitats development, man-made waste, etc.) and climate change, leading to further species extinction, decrease of wildlife population, ecological disturbance, crop diversity decline, etc.	

Sector	Classification of respondents by area			
	Academia	Research institute	Industry & others	Total
Economy, humanities, society	74 persons	71 persons	8 persons	153 persons
	14.8%	14.2%	1.6%	30.6%
Science & technology	177 persons	112 persons	48 persons	337 persons
	35.4%	22.4%	9.6%	67.4%
Etc.	9 persons	0 person	1 person	10 persons
	1.8%	0.0%	0.2%	2.0%
Total	260 persons	183 persons	57 persons	500 persons
	52.0%	36.6%	11.4%	100.0%

Table 2. Characteristics of Survey Respondents

We conducted a perception survey on the 28 revised issues listed above with the participation of 500 experts in each area including academia, research institute, and industry and analyzed likelihood, impact, and others with regard to issues deemed to be important in Korean society within next 10 years (by 2029) based on the result of the survey.

The result of analysis of likelihood and impact of issues confirmed changes in perception on certain issues. According to the 2015 survey, issues of 'National security/unification,' 'geopolitical conflicts with neighboring countries' and 'nuclear safety' were recognized to have a high impact, although likelihood is low. In the 2018 survey, however, the result found that 'changes in inter-Korean relations' and 'geopolitical conflicts with neighboring countries' are more likely to take place with a strong impact.

To be specific, 'geopolitical conflicts with neighboring countries' and 'changes in inter-Korean relations' were considered to have an impact on major ongoing issues and change concerning detail. With regard to the issue of 'geopolitical conflicts with neighboring countries,' 'U.S.-China trade war' not only brings about change in global value chain, but also it changes comparative advantage related to growth engines. Meanwhile, 'changes in inter-Korean relations' greatly affects the future society and economy, and it is a threat causing social instability as well as an opportunity. The issue also has a great effect on science and technology (S&T) cooperation between the two Koreas.

Hence, we intend to provide responsive measures on detailed issues related to 'geopolitical conflicts with neighboring countries,' and 'changes in inter-Korean relations,' which require preparations for the future as they are highly likely to take place with a high impact, based on analysis of media discourse and publications of specialists. This paper is meaningful in that it can serve as a base material for the establishment of related policies by providing strategic directions to minimize trials and errors during the policy development process.

# 2. Change in Future Issues and Introduction of New Agendas

In order to identify changes in future issues, we revised the list of future issues 2015 from the current perspective to include the ones that were considered to be important to Korea after 10 years (by 2029) and conducted the survey with these items. It was confirmed that the significance of economic issues has risen compared to the result of 2015 survey.

Issues such as 'low fertility & super-aging society,' 'social instability due to deepening gaps,' and 'job insecurity' have raised since 2000. The ranking of 'low growth rate and shift in growth strategy' went up and 'manufacturing revolution' and 'polarization of industrial structure' were newly added to top 10 issues, reflecting increasing significance of economic issues compared to the result of 2015 survey.

As for environmental issues, 'Growing cross-border environmental impact,' one of top 10 issues in 2015, was not selected as the top 10 this time, and the ranking 'failure to mitigate climate change' was improved, and 'natural disaster' was included in the top 10 list. It is considered that unprecedented environmental events such as earthquakes in Gyeongju (2016) and Pohang (2017) and scorching heat wave in East Asia (2018) changed relative importance of environmental issues.

'Changes in inter-Korean relations' was considered to be more important compared with the result of 2015 survey. From the economic perspective, it was deemed that the perception of specialists on the hope to improve the mood of peace on the Korean Peninsula that created again in 2018 with Inter-Korean Summit and U.S.-North Korea Summit to forge economic cooperation between two Koreas.

Table 3. Comparison of Top 10 Issues over Next 10 Years

Top 10 issues considered to be important in 2025 (2015)		Top 10 issues considered to be in 2029 (2019)	
<ol> <li>Low fertility &amp; super-aging society</li> <li>Inequality</li> <li>Unstable life of future generation</li> <li>Job insecurity</li> <li>Growing cross-border environmental impact</li> </ol>	<ul> <li>6. Cyber crime</li> <li>7. Depletion of energy and resources</li> <li>8. National security/unification</li> <li>9. Climate change and natural disaster</li> <li>10. Low growth rate and shift in growth strategy</li> </ul>	<ol> <li>Low fertility &amp; super-aging society</li> <li>Social instability due to deepening gaps</li> <li>Low growth rate and shift in growth strategy</li> <li>Changes in inter-Korean relations</li> <li>Job insecurity</li> </ol>	<ol> <li>6. Failure to mitigate climate change</li> <li>7. Manufacturing revolution</li> <li>8. Healthy life extension</li> <li>9. Natural disaster</li> <li>10. Polarization of industrial structure</li> </ol>





Likelihood

The result of the analysis on the likelihood and impact of future issues showed that likelihood of some issues, which were classified as black swans<sup>1</sup>) in 2015, was increased. A grey rhino refers to issues that have a major effect and of which likelihood is high. If there is no preparations from the long term perspective, they may become grey swan risks without solutions. A grey rhino is a highly probable, high impact yet neglected threat. The grey rhino was widely used since Michele Wucker commented the term for the first time in Davos 2013. The concept of grev swan was derived from black swan. It indicates an issue that is predictable, but have no proper solutions. The term became popular since it was first appeared in <sup>T</sup>Black swans turn grey: The transformation of risk\_ released by PwC (PwC, 2012).

The following indicate issues that are highly likely to turn into grey rhinos among the 28 Korea future issues.

Low fertility & super-aging society, low growth rate and shift in growth strategy, changes in inter-Korean relations, polarization of industrial structure, social instability due to deepening gaps, job insecurity, manufacturing revolution, digital economy in hyper-connected society, healthy life extension, emphasis on quality of life, geopolitical conflicts with neighboring countries, growing cross-border environmental impact, failure to mitigate climate change, Increasing uncertainty of global and local governance

The likelihood of 'inter-Korean issue' that was classified as a black swan risk in 2015 and 'geopolitical conflicts with neighboring countries' increased unlike other issues. Thereby, they emerged as issues that require preparations for the future.

Here, this paper intends to develop agendas on these issues stated above that require preparations for the future based on the perspectives of S&T provides implications on technological and innovation of Korea. 'Rebuilding future growth engines driven by U.S.-China trade war' and 'improving inter-Korean S&T cooperation' were selected as agendas with regard to the issues of 'geopolitical conflicts with neighboring countries' and 'changes in inter-Korean relations.' To be specific, U.S.-China trade war that may have an effect on S&T innovation policies by affecting domestic industries was chosen as the agenda related to 'geopolitical conflicts with neighboring countries.' News articles for the past 2 years (from July 1, 2016 to June 30, 2018) related each agenda were analyzed. After identifying the status related to each agenda, this paper provides future outlook and implications to set policy directions based on expert opinions.

# **3. Rebuilding Future Growth Engines** Driven by U.S.-China Trade War

#### 3.1 Background of Agenda Proposal

The U.S.-China trade war indicates changes in external environment to review directions for innovations in the context of increasing competition between the two great powers to dominate S&T. It is related to the issue of 'geopolitical conflicts with neighboring countries' that is more likely to occur and can be considered as a series of events caused by trends including multipolarization of the world economy along with the rise of new powers and their increasing impact on S&T.

<sup>1)</sup> Black swan: an event that has a major effect, although likelihood is low. The theory was developed by Nassim Nicholas Taleb in 2007



Figure 2. Monthly Rate of Media Coverage of Topics Related to U.S.-China Trade War

Currently, China is not only simply focusing on activities to increase the income level, but also it pursues Belt and Road Initiative (BRI), an approach to build the New Silk Road initiative in response to free trade driven by the West. In the meantime, the U.S. containment of rising China started in earnest by changing its economic policies since Donald Trump, who advocated protectionism, was elected as the president. Changing U.S. economic policies began to appear on news media more intensely since Trump won the presidency in November 2016. There have been active discussions on the U.S.-China trade war throughout the media as it may have a major effect on Korea in various ways including the North Korea issue, impact on stock market and business.

The U.S.-China trade war is related to the contest for supremacy in new technologies and industries. Hence, there is a need to analyze keywords to predict their future development and come up with responses as follows.

#### 3.1.1 Changes in U.S. Economic Policy

Changes related to the protectionism in the U.S. economy policy include withdrawal from the Trans-Pacific Partnership (TTP) and the renegotiation of North American Free Trade Agreement (NAFTA).

#### 3.1.2 Linking with North Korea Issue

As for the North Korea issue, the Trump administration goes after China over intellectual property by signing on an administrative order to probe its IP theft (August, 2017), which is considered to be related to the North Korea issue or launch of the U.S.-China trade war. The U.S. uses it as a tool to pressure China and accuses the country for its lukewarm attitude.



# Figure 3. Media Keywords Related to U.S.-China Trade War<sup>2</sup>)

## 3.1.3 Impact on Domestic Business

Concerns of Korean exporters for changes in U.S. tariff policy caused by the U.S.-China trade war appeared as keywords such as WTO litigation, steel, aluminum, dumping, etc.

#### 3.1.4 Impact on Korean Stock Market

Keywords reflecting uncertainty in Korean exports to the U.S. and China derived from the U.S.-China trade war include concern and easing concern for domestic stock market, New York stock exchange (NYSE), KOSPI, rise and fall in the stock index.

Also, the U.S.-China Economic and Security Review Commission warned the national security implications of China's telecommunications equipment and recommended to provide responsive measures in its 2018 annual report.

#### 3.2 Status and Future Outlook (Jang, Seok-In, 2019)

#### 3.2.1 The 90-Day Trade Tariff Ceasefire

Trump and Xi Jinping agreed to a 90-day trade truce on December 1, 2018, the U.S. decided to hold off on raising China tariffs and both agreed to negotiate on 5 trade areas for structural change. China vowed to end unfair trading practices and solve structural problems that the U.S. persistently argued, including forced technology transfers, protection of IPR, non-tariff barriers, cyber intrusion and theft, and opening of service and agriculture markets, etc. China took a more conciliatory tone

<sup>2)</sup> Keywords were sorted out from news topics for the 2 years from Jul 1, 2016 to Jun 30, 2018 by applying Dirichlet-multinomial regression (DMR) topic model.

and promised to buy a very substantial amount of agricultural products to reduce U.S. trade deficit with China, designate Fentanyl, a painkiller as well a anesthesia of which danger of abuse and misuse was pointed out, as a controlled substance, and open to approving the previously unapproved Qualcomm-NXP deal. The leaders of the two countries declared a 'temporary' truce for concerns over the impact of an expansion of the trad war on financial markets and their economies.

# 3.2.2 Amendment and Supplementation of China Manufacturing 2025

Also the U.S. argued to repeal 「China Manufacturing 2025 as unfair competition in the market based on the initiative caused damages to American business and China pledged to take alternative measures. The U.S. insisted that excessive goals of China Manufacturing 2025 led to unfair practices and competition in the market. For example, the Chinese government provides subsidies and other benefits to publicly-owned companies and forces foreign business operating in China to transfer cutting-edge technologies. In response, China plans to extend the timeline to achieve certain goals by 2035 and announce measures to induce fair competition between state-owned and private businesses including foreign enterprises under the principle of competitive neutrality that the U.S. stresses in trade agreements with other countries. Many argue that the basic stance of the U.S. is to curb the attempts of China to boost its high-tech industries that may threat the cutting-edge industries of the US. Hence, the contest between the two countries for supremacy over advanced technologies is the essence of the trade war.

#### 3.2.3 Possible U.S. Tariffs on Auto Imports

The U.S. Department of Commerce submitted a

report about Section 232 of the Trade Expansion Act\_ in February, 2019 to the White House that recommended unleash steep tariffs on imported cars and auto parts, arguing that 'auto imports posed a national security risk.' The report came as a surprise to the U.S.-China trade war that might fundamentally change its characteristics. The conclusion that 'auto imports posed a national security risk' provides legal grounds for the imposition of steep tariffs on imported cars and auto parts and the Trump administration has 90 days to decide whether to act upon the recommendations. Commenting on the U.S. auto trade deficit with EU and other countries, Trump is publicly warning the tariffs of up to 25 percent and it may lead to the expansion of trade war. Considering current situations, it is unlikely for the U.S. and China to conclude the trade negotiation by March and Korean industries may face a new challenge or opportunity depending on the result of negotiation.

#### 3.2.4 Further Development and Impact

The following indicates future scenarios of trade dispute between the U.S. and China.

- Scenario 1: Turning into a prolonged trade war (highly probable scenario)

It means the period of truce is extended for another 90 days as unfair practices and structural problems of China are not resolved to the extent that are sufficient enough to satisfy the U.S., although it accepts alternatives for <sup>C</sup>China Manufacturing 2025 in part.

The reason that the trade dispute may turn into a prolonged war is there are huge discrepancies in their current issue between the two leaders, and things get more difficult to close the gap during the 90-day negotiation window. As stated in the realization of the 'Chinese Dream', China hopes the great revival of the Chinese nation, and the U.S. technically wants to turn everything back for the declaration of surrender. Likewise, they are taking a markedly different stance. Considering damages to their economies and negative effects on the global economy that may occur when they proclaim to end the negotiation and continue the trade war, it is unlikely that the issues can be resolved easily.

- Scenario 2: Full-blown trade war

This scenario indicates a situation the U.S. increases tariffs on Chinese imports worth USD 200 billion from the current 10 percent to 25 percent with the breakdown of the 90-day negotiation. The trade dispute may turn into a full-scale war, considering that it is showing signs of competition between the two countries to dominate technology industries with restrictions on the use of telecommunications equipment and tech investment. Although the two sides conflict with each other over the imposition of tariffs and technology dominance on the surface, the trade war is basically an extension of competition to become a global hegemonic power in the end, and which reinforces the argument of a full-scale trade war. Furthermore, China has no intention to accept the defeat under the pressure of the U.S., despite the fact that the country is currently on the defensive. All of these serve as backgrounds that support the likelihood of a full-blown trade war.

- Scenario 3: End of trade war, return to the right track before the tariff

It refers to a situation that China agrees to comply with its pledges that it made when the country joined the membership of the WTO in 2001 and deals with pending issues with regard to revitalization of both economies. Although the chance is very slim, it may take place if surrounding conditions such as a potential slowdown in the global economy, increasing uncertainty, and decline in economic growth force the two countries to halt the conflict.

# 3.3 Implications on Technological Innovation in Korea (Jang, Seok-In, 2019)

Increasing uncertainty of domestic businesses about the prolonged trade war may cause them to avoid to make a bold investment in growth engines, leading to weakening of the growth potential. Also, slowdown in global market and stagnant demand may pose a threat to the fundamentals of the identification of such growth driver.

Sluggish corporate investment with uncertainty about the future may delay investment in the creation of industrial ecosystems such as fostering of talents in promising industries, materials and components, tools and equipment, causing the weakening of growth momentum. When the world economy enters into a structural recession, the government of each country may discontinue the implementation of measures and policies to identify and nurture future growth engines. Korea selected its future growth drivers by making investments in areas that enable to gain competitive advantages based on global demand and rapid growth. However, it is highly likely that such preconditions are hard to be met if the U.S.-China trade war continues for a long time.

If the trade war is protracted or the world begins to enter a new cold war due to the breakdown of negotiation, strategies that Korea pursued to discover, select, and nurture future growth engines become invalid as it has to decide one of bipolar markets.

Worsening of trade war or transition to a new Cold War system can lead to the creation of economic zones and technology innovation mechanisms by economic bloc, and Korea may face unfavorable conditions to choose between the U.S. and China with regard to the decision on technology innovation mechanism and market. It means that we should give up one side or accept restrictive trade, causing the loss of a momentum to foster our growth engines.

We need new approaches to develop growth drivers as it is hard to guarantee competitive edges on technology when the trade dispute is over. China dominated a global ranking of the most-cited research papers published in the 23 topics among the 30 hottest technology fields based on the data of the 5 years (Lee, Ha-Won, 2019). China also constantly and actively makes investment in the latest technologies. It is meaningless to argue comparative advantage over China as a precondition for identifying growth engines due to enhanced technology competencies of China.

## 4. Improving Inter-Korean S&T Cooperation

#### 4.1 Background of Agenda Proposal

There is an increasing demand on S&T innovation to assign new tasks such as pursuit of national prosperity along with changing external environment including the improvement of inter-Korean relations.

Inter-Korean S&T cooperation relates to changing inter-Korean relations that is more likely to occur and it is also related to trends such as the establishment of peace on the Korean Peninsula and increasing influence of S&T. Conflict and confrontation in the context of national threat were proper terms to describe the strained inter-Korean relations due to deteriorating stance of the international community on North Korea caused by its missile launches and nuclear tests, and the May 24 measures by the South after Cheonan sinking in 2010. However, there has been a complete turnover in the relationship between the two countries with the proclamation of a new era of peace through Panmunjom Declaration and resume of exchange and cooperation, opening a new opportunity for change of their relations.

Although it still takes time to create a mood for complete peace considering calls for denuclearization and sanctions against the North by the international community, it is certain that the inter-Korean relations are substantially changing from conflict and confrontation to peace and coexistence.

As for the inter-Korea S&T cooperation, there is a need to consider multilateral sides of the relationship such as sanctions against North Korea imposed by international bodies, exchanges between the two Koreas in terms of humanitarian aids, mutual efforts to improve their relations, and economic cooperation after the normalization of relations.



Figure 4. Monthly Rate of Media Coverage of Topics Related to Inter-Koreas Relations



## Figure 5. Media Keywords Related to Inter-Koreas Relations

#### 4.1.1 Security Threat

In response to North Korea's provocations including threat to attack U.S. territory of Guam (August, 2017) and the sixth nuclear test (September, 2017), Trump warned the North by saying that it 'will be met with fire and fury' and restrictions on the country still remain.

# 4.1.2 Inter-Korean Exchange

Although it is limited, the inter-Korean exchange has restarted in the form of unified teams and joint march at 2018 PyeongChang Winter Olympics and humanitarian exchanges such as reunions of separated families.

## 4.1.3 Inter-Korean Summit

Efforts to improve the relationship should be made by the two sides in accordance with Panmunjom Declaration at the April 2018 inter-Korean Summit, including a pledge to work towards the denuclearization for the peace on the Korean Peninsula and pursue dialogue, cooperation and consensus.

#### 4.1.4 Economic Cooperation

Expectations on the restoration of inter-Korean economic ties are reflected in keywords such as reconnection of inter-Korean railway, implementation of joint inter-Korean projects, regional projects, and Gaeseong Industrial Complex as their relations began to change positively.

#### 4.2 Status and Future Outlook (Choi, Hyun-Kyoo, 2019)

#### 4.2.1 Status of S&T in North Korea

North Korea aims to become an economic powerhouse and focuses on the need to harness technology to improve its economy. To this end, North Korea stresses that S&T should play a leading role in all sectors related to the development of society as stated in its  $\lceil$ 4th five-year S&T development plan (2013~2017)  $\rfloor$  that launched since Kim Jong-un became the leader of the country.

Characteristics of S&T in North Korea include that the National Academy of Sciences of the DPRK leads national R&D efforts, the nation focuses on fostering on science and technology talents, and having a cooperative network among the industry, academia, and research institute in order to provide technical support at sites. Kim Il-sung University, Kim Chaek University of Technology, and National Academy of Sciences are key S&T research institutes. Among them, National Academy of Sciences, having various organizations in its umbrella, engages in technological development activities in extensive areas. In order to make all citizens as S&T talents, the country emphasizes S&T education in elementary, middle, and high schools, implements measures to place colleges under the umbrella of universities and unify the system in an effort to reform higher education system. It also significantly increased the number of cyber universities to strengthen remote S&T learning for adults. North Korea underlines the industry- academia-research institute cooperation so that the number of support activities to sites by the academy reach 360 per year, and installs Technology Exchange Center in each agency for the development and distribution of cutting-edge tech products.

The result of S&T that the country achieved in R&D went back to 1980s or 1950s to the earliest. Although some of them in defense and basic science are outstanding sufficient enough to be considered as the world-class, S&T in North Korea is deemed

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to be lagging behind South Korea over 10 years in general (Nah, Seung-Hyeong, 2016).

#### 4.2.2 Status of Inter-Korean S&T Cooperation

Inter-Korean S&T cooperation in the early 2000s did not made great progress as it was implemented by focusing on providing assistant to the North and execution of government tasks indirectly for resource exchange, rather than joint research projects. Problems identified in inter-Korean cooperation process of the past are as follows: 1 lack of inter-Korean S&T cooperation channels; 2 lack of effects and knowledge-sharing synergy as cooperation attempts were made individually; 3 pursuit of unilateral approaches for cooperation due to lack of information and understanding about the North; ④ discontinuance of projects as they were implemented as one-time events; 5 restrictions on having contact with North Koreans, etc.

# 4.2.3 Prospect for Inter-Korean S&T Cooperation

As North Korea decides to end its dual policy and put every effort for 'economic development' in 2018, there is a possibility for the nation to start to engage in inter-Korean S&T cooperation activities actively focusing on areas that may provide a breakthrough of its poor economy. The S&T cooperation with North Korea can be classified as stages according to the resolution 3 of denuclearization issue and other political, systemic and infrastructure risks.

Table 4. Stages and Definition of Inter-Korean Exchange and Cooperation

Item	Short-term	Mid-term	Long-term
Definition	Maintenance of the status quo before the vitalization of inter-Korean exchange and cooperation	Vitalization and strengthening of inter-Korean exchange and cooperation	Advancement of inter-Korean exchange and cooperation and on the verge of integration
Description	• Withdrawal of sanctions on N. Korea	• Vitalization of exchange and cooperation by the North with the	Massive investment and building of work-breakdown structure in

	<ul> <li>Withdrawal of the May 24 measures</li> <li>N. Korea's rebuilding trust with the int'l community</li> </ul>		<ul><li>int<sup>c</sup>l community</li><li>Removal of multiple conditions regarding economic restrictions</li></ul>	industry, science and technology between the two Koreas
Political risk	c Partially removed		Mostly removed	Mostly removed
Systemicrisk	k Partially removed		Partially removed	Mostly removed
Infrastructure risk	k Exists		Exists	Mostly removed
Definition of risks (politics, systems, infrastructure)				
Political	risk	Both sides should still have a will to embark on exchange and cooperation as in the past and external restrictions should be removed considerably		
Systemic	risk	Issues raised with regard to inter-Korean exchange and cooperation including protection of investment capital, transfer of investment returns, and dispute settlement process should be resolved		
Infrastructur	Infrastructure risk Infrastructure should be established by stage during the process as it requires the government-supported development cooperation or aids by international bodies			the process as it requires the aids by international bodies

[Source] Business opportunity and strategy for entry into North Korea(Samjong KPMG, 2018), partially revised

In the preparation stage of inter-Korean S&T exchange and cooperation, activities including information sharing and trend analysis to have a better understanding of each other, joint study on topics of mutual interests or pending issues for which cooperation is required such as volcanic activities of Mt. Baekdu and DMZ ecosystem, academic seminar, and exchange programs between universities can be carried out.

Inter-Korean S&T Exchange and Cooperation Center, an organization that potentially takes charge of activities related to inter-Korean S&T cooperation, should be installed in order to pursue a stable and systematic exchange and cooperation unlike the past.

Activities that the center can carry out in the early stage include selection and preparation for planning of joint inter-Korean projects, collection of information and analysis of trend about North Korea's S&T, identification and selection of items for inter-Korean exchange an cooperation, investigation on North Korea's technologies and assessment on their value, and reorganization of related systems and institutions.

Activities that the center may conduct in the mid-term are providing measures to assist private and public cooperative projects in S&T special zones of North Korea such as Unjong High-Tech Development Zone that integrates research, development, manufacturing and export for the achievement of complementary cooperation, support for universities and research institutes in pursuing mid- to long-term joint studies, and help South Korean companies start business based on North Korea's technologies or collaborate with North Korean counterparts, and readily hire skilled North Korean workforce.

The efforts that can be made in the mid- to long-term stage of vitalization and advancement of inter-Korean S&T exchange and cooperation are the launch of training and education programs for North Korean scientists and engineers centering on government-funded research institutes, transfer of R&D support systems to the North, and installation of branch institutes in the country. Implementing cooperative projects such as technology transfer centering on tech-led businesses (Technology Exchange Center) can be an alternative approach. Also, main projects of the New Economic Map of the Korean Peninsula by the Moon administration can be introduced as a part of R&D efforts in the field of S&T.

# 4.3 Implications on Technological Innovation in Korea (Choi, Hyun-Kyoo, 2019)

It is necessary to understand North Korea's S&T as its areas of competitive advantages are quite different from those of South Korea. In general, North Korea's technological competencies are considered to be lagging behind South Korea for 10 to 20 years. However, the country has a competitive edge in basic science and technology areas based on applied mathematics and nuclear physics. Hence, it is deemed that S&T of the North may complement shortcomings in technological innovation of the South.

In South Korea, S&T is a powerful tool that drives export-led economic growth by making efforts to gain a competitive edge. In case of North Korea, however, it focuses on the revamp of technology from the maintenance perspective under the banner of self-reliance, rather than securing of competitive advantage. The revamp of technology refers to the effort to modernize manufacturing process by providing new tools, equipment, and technologies to businesses and factories. Also, heavy industries take account a large share of North Korea's production. Considering this, North Korea's technologies have a potential to be applied to manufacturing sites in related industries of South Korea and SMEs may use these technologies.

There is a possibility that technology transfer between the two Koreas may promote the innovation. North Korea has unique advantages in oriental medicine, information security and other IT sectors. For instance, 'Keumbitmal (Golden Horse)', a physical constitution analysis software based on oriental medicine, 'Unbyol (Silver Star)', a baduk (go) program that won the international baduk championship, and cyber capabilities rated as top 10 in the world are examples. such strengths can be utilized as well.

Also, it can serve as an opportunity to identify

new growth engines through inter-Korean exchange and economic cooperation. The North may provide more favorable conditions compared to the South as it is free of legacy such as restrictions and needs investment to build new infrastructure related to smart city and other areas of 4th industrial revolution as well. North Korea can also offer new opportunities to South Korea with increasing demand for various technologies while the country is experiencing economic growth. In particular, mechanical work and IT are more likely to be used in North Korea and they have a potential as input elements with economic value.

# 5. Implications

The likelihood of issues identified as black swan risks increases and practical preparations for the future to tackle such issues are considered more important than the past. To be specific, issues of 'low fertility & super-aging society', 'social instability due to deepening gaps', and 'job insecurity' have been raised constantly. As they are highly probable and have high impact, efforts should be made to prevent black swans from turning into grey swans. The significance of economic issues has increased and the likelihood of 'changes in inter-Korean relations' and 'geopolitical conflicts with neighboring countries' has risen as well. Hence, there is a need to develop agendas that require preparations for the future.

The U.S.-China trade war indicates conditions for nurturing the future growth engines of Korea have changed and we should take new approaches to achieve the same goal. If the U.S.-China trade dispute turns into a prolonged war or gets worse, the global market will be polarized centering on the U.S. and China. It means that the size of accessible market gets smaller. If the two sides resolve their differences, the comparative advantage over China's technological competence, a precondition for nurturing of growth engines will be invalid.

We need a proper understanding of North Korea's S&T systems in order to implement cooperation projects successfully along with improving inter-Korean relations. It is desirable to pursue inter-Korean S&T cooperation by phase in line with the elimination of political, systemic, and infrastructure risks during the process of denuclearization and withdrawal of sanctions on the North. North Korea and South Korea have different strengths in areas of science and technology. Hence, North Korea's technology may play a complementary role in South Korea's technological innovation through demand-side conversion of defense technology, etc.

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