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THE INFORMATION TECHNOLOGY INDUSTRY IN NORTH KOREA

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1 INTRODUCTION

The damage caused by a computer virus known as “WannaCry” in May 2017 sent shockwaves throughout the world. After infecting a computer, the WannaCry virus encrypts the files on the computers in order to render them inaccessible until a ransom demand in bitcoin currency is paid. This novel cyberattack technique came under close scrutiny, and in June 2018 the United States government charged a North Korean government affiliated company and an employee with responsibility.¹ North Korean offensive cyber capability has been floating around especially since Sony Picture Entertainment was compromised in 2014.

This study was made to estimate the offensive cyber capability and capacity, a task which is fundamentally difficult. There are more than 45 countries that are suspected to have offensive cyber capabilities (GIP, 2019). All of them employ a variety of concealment techniques designed to maintain strategic superiority over their opponents. Furthermore, the Democratic People’s Republic of Korea (Hereinafter “North Korea”) is known as “one of the hardest intelligence targets in the world” (Jun, 2015: IV) and “estimates on what capability is in existence are akin to playing Blind Man’s Buff” (Feakin, 2013: 64).

This paper describes the history of the development of the North Korean information technology (IT) industry since the 1980s in an attempt to identify the background issues that can be used as a first step toward understanding the current IT-related threats. IT development is not necessarily linked directly to

offensive cyber capability. Nevertheless, a country without any IT technology at all cannot develop the ability to launch cyberattacks. Thus, IT technology can be thought of as the soil from which offensive cyber capability grows.

This paper focuses on the development of IT technology in North Korea, an issue that has garnered little attention in the context of North Korean regional studies.² We argue that Kim Jong-Il, the second “Supreme Leader” of North Korea, did not advance a government IT policy purely in order to develop the country’s nuclear missile capabilities. His goal was to establish a nation that was completely self-sufficient in all aspects of the technology, including hardware and software. In seeking out this goal, North Korea’s IT industry archived number of notable successes, Such as: through trial semiconductor production, hardware technologies were accumulated; a nation-wide communications infrastructure was established even in a serious economic crisis, and many highly skilled workers were trained. However, these efforts failed to create an industry that would contribute to the domestic economy. As a result, there was a surplus of engineers. The argument made in this paper is that this surplus of highly-trained engineers may have caused increases in cyberattacks and other activities that led to increasing instability in the region.

This paper is structured as follows: section 2 is a description of the path North Korea took starting in the 1980s that may have led to its establishment as an IT technology player. This section point out that North Korea secretly shifted its policy goals from hardware to software. To do so, this paper describes how development was influenced by international politics through an examination of the creation of a massive fiber optic cable network, the Internet, and cellular networks. Section 3 is a discussion of North Korea’s future.

This paper describes the enormous role that Kim Jong-Il played and develops discussion of the issues the country faces in the current era of Kim Jong-Un’s rule by focusing on the following three area: 1) relaxation of controls on freedom of speech, 2) overseas expansion, and 3) strengthening relations with China.

2 INFORMATION AND TELECOMMUNICATIONS IN

NORTH KOREA

2-1 NORTH KOREAN INFORMATION TECHNOLOGY INITIATIVES

Since the 1970s the objective of North Korean IT policies has been to create a domestic computer network that would serve as the basis of this larger goal: establishing itself as an economic and military power through IT technology.

The North Korean IT initiatives are believed to have started in earnest in 1984, around the time of Kim Il-Sung's visits to the Soviet Union and Eastern Europe. Kim Il-Sung saw the IT-related developments being made in Eastern Europe, and the following year he began sending exchange students to the Soviet Union and Eastern Europe in order to import those technologies (Vladimir, 2003). In 1987 the third Seven-Year Plan was launched; one of its major initiatives was "the computerization of industry." Here, the use of the term "computerization" referred to the rationalization of the infrastructures of daily life through the use of IT in factories, on farms, and in other areas.

The operation plan that was designed to realize the targets of the third Seven-Year Plan was part of the first Science and Technology Development Three-Year Plan that was drawn up the following year (1988). This plan listed as its goals the industrialization of the production of large-scale integrated (LSI) circuits and advanced semiconductor production, as well as the computerization of the major economic sectors.

The second Science and Technology Development Plan was put into effect. In addition to continuing with the industrialization of LSI production and the automation of all economic fields covered by the plan, it also indicated as one of its goals the production and development of computers. Thus, documents approved by the Workers' Party of Korea began mentioning IT technology in the latter half of the 1980s. However, before then, underground initiatives were already under way. Below I trace the progress of three fields: semiconductor manufacturing, software development, and the creation of an IT network.

2-2 THE CHALLENGE OF SEMICONDUCTOR PRODUCTION

In Japan, semiconductors were referred to as “the rice of industry,” acknowledging the semiconductor’s importance as one of the main pillars of Japan’s economic growth. The United States, South Korea, China, and Taiwan all had similar policies on the development of the semiconductor industry in their economies. For a time, North Korea also dreamed of becoming a semiconductor powerhouse.

In 1979 the United Nations Development Program (UNDP) began operating in Pyongyang, which allowed North Korea to receive the same UN support that other developing nations enjoyed. At this time, North Korea requested that an integrated circuit (IC) factory be built. This was a massive project to construct an IC plant and related processing facilities and train semiconductor engineers. Companies located in Western countries hesitated to bid on this project due to concerns that it would be in violation of the Coordinating Committee for Multilateral Export Controls (COCOM). As a result, a company with strong ties to the government of India won the contract. In the winter of 1986, ownership of the plant constructed by the Indian company was transferred to North Korea.

Previous studies reported that this plant succeeded in producing small-scale IC (Mansourov, 2005). However, despite the fact that semiconductor production managed to get under way, it ended without ever producing any economic benefit (NTI, 2003). The UNDP Project Report noted that steady production was made difficult by, among other things, the North Korean engineers’ language skill, which hindered communication with the Indian engineers, and the instability of the electric power supply.³ But these could hardly have been the only reasons. Another is the fact that the semiconductor business cannot be completely restricted to a single country. Equipment and raw materials need to be procured from overseas, and a market for the mass consumption is essential. While North Korean semiconductor production may have succeeded on a technical level, as a business it was a failure.

It is not clear when North Korean authorities recognized that geographic and environmental restrictions made the semiconductor business difficult. In January

2001 Kim Jong-Il visited the Pudong New Area in Shanghai, China. During his tour of the area, he visited a Japanese company engaged in the manufacture of semiconductors there (Mansourov, 2011: 28). Five years later, in April 2006, he announced at the fourth session of the 11th Supreme People’s Assembly (SPA) a long-term vision called “A Scientific and Technological Major Power.” This laid out a policy of software development that was described as “making advances to improve programing technology and create an information network that reaches every part of the country and, at the same time, make North Korea into a major software developer.” Unlike the Science and Technology Development Three-Year Plan mentioned above, this document did not place significant expectations on the manufacture of semiconductors. Thus, it can be inferred that at some time between 2001 and 2006 a policy change was quietly made to abandon the semiconductor manufacturing business. Although North Korea has Printed Circuit Board facilities (Ministry of Unification, 2019), they still heavily rely on foreign market to procure electronic parts such as analog/digital ICs, ASICs, Memory and CPUs.

2-3 THE CHALLENGE OF OFFSHORE SOFTWARE DEVELOPMENT

The previous section outlined how the plan to earn foreign currency through the manufacture of semiconductors was quietly replaced with a plan to turn the country into a major software developer.

It is not difficult to begin developing software in the context of the IT industry. Unlike the manufacturing of hardware, software development does not require a large-scale facility, and it does not require the import of raw materials, making storage and other tasks unnecessary. To put it in the simplest possible terms, one can launch a software development business with only a few highly skilled programmers. North Korea used India’s experience as a roadmap as it strove to become a “near-shore software development center” that could take software outsourcing orders from neighboring countries such as Japan, China, and South Korea.

2-3-1 DEVELOPMENT OF DOMESTIC SOFTWARE AND THE SUBCONTRACTING BUSINESS

In July 1986 the Pyongyang Program Center (also known as the Pyongyang Information Center, or PIC) was established (Mansourov, 2005 and Vladimir, 2003). During this period, a government organization known as the IT Bureau was also created (Ministry of Unification, 2019), and with that the North Korean software technology initiatives formally began. The PIC developed Windows-based software such as word-processor for the Korean language and Korean-language input method. A PIC brochure produced soon after the PIC was founded stated that it was “the organization with the most computers in North Korea” (Vladimir, 2003). The PIC procured computers and software mainly from Japan and other neighboring countries, and could have served as the supplier of this equipment to the city of Pyongyang.

In 1988, two years after the PIC’s founding, the head of the PIC went to Japan, where he inspected their newly founded office. Gradually, the facet of the software development business aimed at the Japanese market, began to expand. In 1993, the software development business consisted of software for publishing, hotel reservation management, container management at ports, and insurance management, as well as other types of software that were worth total sales of USD 200,000 for the year (Vladimir, 2003). One of the companies that the PIC did work for was a Japanese automobile company. The UNDP provided financial support to the PIC totaling USD 690,000 for “the use of IT and automated production in the management of North Korean domestic industries.” A previous study indicated that that money had no apparent effect on North Korea’s domestic industries during that time, and that the PIC used that money to obtain foreign currency through its software development subcontracting business (Mansourov, 2005: 80).

A few years after the PIC was founded, the Korean Computer Center (KCC) was established as part of the first Science and Technology Development Three-Year Plan that was mentioned above. The establishment of KCC was ordered in 1990 directly by Kim Jong-Il. In 1996, the KCC was formally promoted to a ministry-level organization. To this day KCC is consistently recognized as a key player in the IT field.

The KCC is well-known for having developed the Red Star OS, its own Linux-based operating system distribution. It has also developed software for the board games *go* and *shogi* (*Japanese chess*). These programs are among the most technologically sophisticated in the world, as shown by the *go* program's ability to capture first prize in the World Computer *Go* Championships held in Japan in 1998.

In June 2000 South Korean president Kim Dae-Jung and Kim Jong-Il held an inter-Korean summit. At that summit, South Korea promised to provide increased economic assistance to the North, a pledge that resulted in greatly improved relations between the two countries. During this time, North Korea received support from the South in a variety of ways. One of these was the establishment of the Korean Computer/Samsung Software Joint Cooperative Development Center in Beijing, China, which resulted from a March 2000 joint venture agreement between the KCC and the South Korean company Samsung Electronics (Lee, 2001). One of the tasks undertaken by the Joint Development Center was the development of software for use in mobile phones.

The KCC has a strong relationship with Japan as well. It established an associated company in Japan sometime between 1996 and 1997. In June 2017 the United States Treasury Department denounced the fact that the KCC engaged in arms-related transactions despite being the target of United Nations sanctions. In September of that same year, North Korea was the target of additional unilateral economic sanctions by the United States under Executive Order 13810.⁴

2-3-2 SECURITY SOFTWARE

Among the many types of software developed by North Korean companies were those related to the field of cybersecurity, including encryption software and virus detection software. The knowledge required to develop software in this field is nearly identical to the knowledge required to launch cyberattacks. Therefore, an understanding of their efforts in this field is essential to understanding North Korea's offensive cyber capability.

According to Tija (2006), the Kwangmyong IT Center, a KCC-related organization, was founded no later than 2006. The Kwangmyong IT Center

specialized in networks and security, and it was engaged in the development of virus detection software, data encryption software, data recovery, and fingerprint authentication software. A company known as STS Tech-Service was also involved in the development of software in this area. The virus detection software was celebrated in North Korea for having been produced domestically with the help of both the Kwangmyong IT Center and STS. However, according to a specialist who analyzed the copy of this software, it was nothing more than a pirated version of a virus detection software produced by a major manufacturer outside of North Korea. Thus, it could hardly be called an example of North Korean domestic technology (Lechtik and Kajiloti, 2018).

What becomes clear through an examination of the history of software development⁵ in North Korea is the high level of skill possessed by North Korean engineers. They were strong when a competition is about superiority or inferiority of the algorithms. In the latter half of the 2000s, North Korean *Go* and *Shogi* programs were recognized as being among the best in the world, but this did not result in success in overseas markets.

2-4 ESTABLISHMENT OF A COMMUNICATIONS NETWORK

Foreigners who have visited Pyongyang within the last few years often mention their surprise at the widespread use of mobile phones. This surprise is likely due to the deep-rooted assumption that in North Korea it is impossible to use mobile phones or access the Internet. In this section, I will describe how cellular network has spread not only within Pyongyang but also in provincial cities. I will also describe how the country manages to remain closed off to the outside world while maintaining a domestic network that allows Intranet access.

2-4-1 FIBER OPTIC CABLES AND TELEPHONES THAT LINK URBAN AREAS

The aforementioned First Science and Technology Development Three-Year Plan (1998) is the document that marked the start of the national IT initiative. It indicates that its goal is the creation of a communications network: “The creation of a computer network spearheaded by KCC.”

In August 1990 the laying of a fiber optic cable that linked Pyongyang to three major cities was completed with assistance from the UNDP (Mansourov, 2011: 8). North Korea not only requested UNDP assistance related to the laying of the fiber optic cable network but also requested that the cable be manufactured domestically. This request was granted, and two years later, construction of the Pyongyang Fiber Optic Cable Plant was completed. This provided the country with a domestic cable production system. Thereafter, North Korea expanded the area covered by its fiber optic cable network. During this expansion, the city of Hamhung (September 1995), the city of Sinuiju (February 1998), the major cities of the region north of Pyongyang (March 2000), and the city of Nampo (2001) were all connected to Pyongyang via fiber optic cable. Experts believe that in the early 2000s, over 50 cities and provinces were connected via fiber optic cable.

In August 1993, during the effort to lay fiber optic cable throughout the country, Kim Jong-Il sent a document titled “Work as Fast as Possible to Modernize Telecommunications” to the National Information and Communication Conference. Around 1994-1995, it was a period referred to as the “Arduous March,” as North Korea experienced massive loss of life due to famine and flooding. And that did not stop fiber cable installation. Other than this national level network installation, another regional/local construction project took place (Choi, 2016).

The fiber optic cable network was further expanded to copper network that linked businesses and private homes. According to a report that North Korea filed with the International Telecommunication Union (ITU), the total number of telephone lines in 1998 was 1.1 million (Vladimir, 2013).

As part of the creation of the domestic telephone network, international telephone lines were introduced, in the following manner. Relations between North Korea and the rest of the world worsened after North Korea’s announcement that it was pulling out of the Nuclear Non-Proliferation Treaty in March 1993, and after its test launch of its Rodong-1 missile. The following year, in June 1994, discussions were held between former US president Jimmy Carter and Kim Il-Sung, and in October of that year, the so-called Agreed Framework between the United States and North Korea was signed. These developments led to an easing

of tensions between the United States and North Korea. In January 1995 the US State Department gave US communications companies permission to provide services to North Korea. It was unclear whether this approval was included in the Framework, but AT&T received government authorization to begin, in April 1995, providing commercial long-distance service to North Korea. As a result, it became possible to place international telephone calls to North Korea.

Observation of the process by which international telephone service was achieved in North Korea shows that network interconnectedness between nations is greatly impacted by international politics.

2-4-2 THE INTERNET

The Internet in North Korea is infamous for being closed off to the outside world. There is a network called “Kwangmyong” that research and government organizations use domestically, and reportedly this network is disconnected from the Internet. Access to the Internet is not widely spread, however the engineers in 1990s finished all the technical preparation for it. In 1994 Kim Chaek University of Technology succeeded in accessing an Australian network. In 1996 the Korean Central News Agency (KCNA) launched its website. In 1995 an optical cable linking North Korea with the rest of the world connected the Rason Special Economic Zone to Hunchun, China, through a joint venture between North Korea and Thailand. In terms of the technology, it seems that the Internet technology available in the West in the mid-1990s was being utilized within North Korea. Since then and to this day, North Korean engineers have been waiting for an order from their supreme leaders to connect the domestic network to the rest of the world.

This isolated status is probably seen as necessary for maintaining domestic control. As the country entered the 2000s, keeping its IT technology completely isolated became increasingly difficult. In the Chinese city of Shenyang, in (or near) a hotel funded by North Korea, is an Internet server under North Korean control. This server plays a lone point of access to the outside world. Email and other services are operated at this location. ⁶ And a very few in North Korea buying

sneakers from an online shop, enjoying online game and trying to mine crypto currencies (Recorded Future, 2017).

2-4-3 THE MOBILE PHONE NETWORK

In North Korea, buying and selling on the black market, as well as viewing foreign TV programs or listening to foreign radio programs, had long been strictly controlled. These controls began to loosen in the mid-1990s with the advent of widespread famine. Decreased levels of loyalty led to a decline in the number of citizens who reported on other citizens. According to *A Quiet Opening: North Koreans in a Changing Media Environment* (Kretchun and Kim, 2012), starting in 2000, citizens began to sense more connections among themselves, and the walls that kept out the outside world were no longer so impermeable. This was mainly due to the mobile phones that citizens possessed.

Second-Generation Mobile Phone Service (up to 2004)

In January 2001 Kim Jong-Il returned home from his tour of the Pudong region of Shanghai, China. He then directed the Science Education Division to lead an IT revolution and create a mobile phone network in the Pyongyang area by the 90th anniversary of the birth of Kim Il-Sung in April 2002. Thus, in 2002 a joint venture with a Thai company began providing mobile phone service. This network utilized digital signals known as the “second-generation mobile system” (2G). They chose GSM over CDMA. One reason for this choice was that the North Koreans did not want to use a system that was compatible with the CDMA system used in South Korea.⁷ Another reason was that the export of CDMA networks to North Korea was prohibited by the US Trading with the Enemy Act and the Wassenaar Arrangement (Mansourov, 2011: 18). The mobile phone service that was launched in 2002 was not widely utilized by the citizens of North Korea, and service was discontinued in May 2004. This discontinuation of service was prompted by a rumor that an April 2004 train explosion was caused by a mobile phone used as a triggering device.⁸

Third-Generation Mobile Phone Service (as of 2018)

Subsequently, in 2008, the Egyptian firm Orascom⁹ and the North Korean firm Korea Post and Telecommunications Corporation (KPTC) put up financing in

a ratio of 75% to 25% to fund a joint venture known as Koryo Link. Koryo Link was the company that established a 3G mobile telephone network with official government approval. The fact that 3G service started around the same time in both North Korea and China suggests that there was technical cooperation between the two countries. According to data released by Orascom in 2012, the company had over 1 million phone contracts in North Korea, which is approximately 5% of the population.

No later than 2015, a new mobile phone company known as Star Network started providing cellular service. Currently, this company is in competition with Orascom within North Korea. A survey of North Korean defectors¹⁰ indicated that approximately 70% had mobile phones prior to their defection. This indicates the speed with which mobile phones became commonplace in North Korea. There are also indications that among young people, having a mobile phone confers a certain degree of status. It is impossible to make international calls or access the Internet using mobile phones, and therefore citizens use short message services (SMS) to stay in touch with each other.

According to a 2015 questionnaire survey of North Korean defectors and people who traveled to North Korea, the systematic censorship of communications became even stricter once Kim Jong-Un took power. One way the government dealt with the transmission of “illegal contents” in North Korea was by updating, in the latter half of 2013, the Android operating system used with mobile phones and tablets, introducing a signature system (Grunow and Schiess, 2017). Devices with this version of Android operating system were only able to handle government-approved apps, and users could only view files that were approved by the government.

North Korea takes three measures to strictly control the flow of information domestically. One is blocking Internet communications through periodic disconnections, another is restricting the use of contents considered inappropriate through the use of a signature system, and the third is traditional government surveillance.

A look back at the path North Korea took toward establishing its communications networks serves as a reminder of just how dependent network connections are upon international politics. One example of this is the sudden initiation of international voice-calling services immediately after the Agreed Framework between the United States and North Korea was signed. Networks are not established simply on the basis of repeated successes achieved by the domestic political system alone.

2-5 TRAINING IT PERSONNEL

New technologies require personnel who can develop and promote them.¹¹ Kim Jong-Il declared 1999 the “Year of Science,” and he included it among the most important goals of the country, stating “the three pillars of our strong and prosperous nation are our ideology, our arms (military power), and our science and technology.” In order to honor the Supreme Leader’s expressed sentiment that science and technology were equal in importance to the ideology that formed the basis of the North Korean *Juche* idea and the military power that the country viewed as its “lifeline,” education would have to be improved.

First, institutions of higher education improved their information and communications technology curriculums. In North Korea — where, as a general rule, Internet access is impossible, it is difficult to acquire personal computers, and permission to possess a computer must be applied for (Ishimaru and Lee, 2012) — it was impossible for individuals to learn programming techniques by studying on their own, unlike in other countries where this practice is commonplace.

In 1997 the Computer Information Center was established at Kim Chaek University of Technology, and computer education began in middle and high schools the following year. In 1999 the College of Computer Science was established within Kim Il-Sung University. Kim Il-Sung University is considered the “gateway” to an executive position in the Workers’ Party of Korea. This marked the first time that a college had been established within the prestigious Kim Il-Sung University, and the fact that a college focused on computer education underscores the importance that was placed on that field of study. In the same

year, a programming course was begun at the Kim Chaek University of Technology. In 2001 “computer prodigy training squads” were set up at four locations in Pyongyang, including Mangyongdae Children's Palace. These “squads” provided special education to particularly gifted children.

Mirim University ¹², or Automation University, is known as a center of special education for gifted children. In the 1980s, during a period of increasingly close relations with the Soviet Union, North Korea asked the Soviets to help it establish a facility to train officers for electronic warfare. In 1984 Mirim University was founded with support from the Soviet Department of Defense via Frunze Military Academy (Yoon, 2001). Mirim University is a five-year university that trains commanding officers who participate in information warfare. According to Jang Se-Yul, who defected to South Korea in 2007, 100 out of the more than 5,000 applicants are selected each year to study at the university in order to master a variety of operating systems and programming languages. In addition to pure IT, there are also majors in study areas such as “cyberwarfare simulations.”

On the basis of the time period when these educational institutions were founded and the number of matriculated students, it is possible to estimate the number of graduates up to the year 2018. These estimates are shown in Figure 1. Even if only three universities are considered, it can be estimated that approximately 7,000 highly skilled IT engineers were deployed by 2018.

IT engineers received a variety of privileges, such as the potential for a large salary and permission to live in central Pyongyang. Another driver is *chulsin-songbun*. This ascribed status affects access to higher education or senior role in North Korean society. In the IT and others, *chulsin-songbun* does not affect much. Academic performance weights more. The fact that applicants did not need to be from good *songbun* family, made becoming an engineer an attractive career choice for young, gifted students.

University (academic dept.)	Year of founding	Period of study	No. of students per school year	Estimated no. of graduates
Mirim University	1984	5 years	100	2,900

Kim Chaek Univ. of Tech. (Department of Programming, Computer Information Center, Kangdong Campus)	1990	5 years and 6 months	180 (estimated to be one-tenth of the total) ¹³	2,160
Kim Il-Sung University (College of Computer Science)	1999	Unknown	150–200 (estimated to be one-tenth of the total)	2,250–3,000

Figure 1: Estimated number of personnel educated in the field of IT technology in North Korea

In comparison with other fields evaluated above, personnel training in this field proceeded smoothly. The government authorities needed engineers in the field of IT, and thus talented young people committed to the challenge of this new field. However, there were side effect to rapid personnel training. This will be discussed in detail in Part 3-2, “Problems Remaining for Kim Jong-Un.”

3 FROM KIM JONG-IL TO KIM JONG-UN

3-1 PROBLEMS LEFT BEHIND BY KIM JONG-IL

In the previous section, we reviewed the process by which IT technology got its start in North Korea. In this section, we will discuss the involvement of Supreme Leader Kim Jong-Il in this process. Then we develop a discussion on several points with a potential influence on IT governmental policy and cyber security in North Korea, as well as the issue of cyberwarfare.

There are many anecdotes that seem to support the idea that Kim Jong-Il had a personal interest in IT. I am not arguing here that the national leader’s interest in computers was the main propelling force behind the IT policies of North Korea. However, it must be recognized that Kim Jong-Il did indeed serve as a major decision-maker in the field of information and communications. As mentioned in Section 2 above, initiatives that were made as preparations for use far into the future, such as the IC plant and the fiber optic cable network, were begun during Kim Jong-Il’s rise to power as the successor to his father, Kim Il-Sung. In the 1980s North Korea suffered from a lack of basic necessities, such as clothing, food,

and shelter. Even under these circumstances, Kim Jong-Il was anticipating the coming information age. The evidence for this is the fact that projects such as the laying of fiber optic cable were continued even during the “Arduous March.” (The South Korean Ministry of Unification estimates that from 1995 to 1997, between 700,000 and 800,000 people died annually.)

Another example is the fact that Kim Jong-Il went on inspection tours of the IT industry throughout China. These were not junket. During his four trips to China, he toured facilities in the communications equipment industry, such as semiconductor manufacturing plants, PBX manufacturing plants, software research labs, fiber optic cable companies, and military satellite communications facilities as well as home appliance (e.g., television) manufacturing facilities, facilities developing software for the financial sector, and SIM card and other plants in the smart card manufacturing industry. These visits led to concrete results, such as the construction of a television factory in North Korea by a Chinese-North Korean joint venture after Kim Jong-Il’s visited the Chinese electrical appliance manufacturing plant.¹⁴ In May 2011, six months before his death, Kim Jong-Il visited an IT company and a home appliance company located in the southeast of China. Even shortly before his death, he continued to take a strong interest in the development of IT in North Korea.

Kim Jong-Il was not held in as high esteem as Kim Il-Sung, who was known among the citizens of North Korea as the “Great Father of Nation.” One reason for this was Kim Jong-Il’s enthusiasm for public projects such as statues and monuments, which seemed to indicate that he was uninterested in directly improve the people’s daily lives. His policy of focusing on the field of IT as an investment for the future – which is argued in this paper – may serve as one of the best examples of this. The following three points were indicated as the “Revolutionary Heritage of Kim Jong-Il” at his funeral in December 2011: (1) nuclear weapons and satellites, (2) an industrial revolution for the new century, and (3) the mental and spiritual strength of the North Korean people. The abundance of highly skilled software engineers and a network that connected the entire nation were the legacy of Kim Jong-Il.

3-2 PROBLEMS REMAINING FOR KIM JONG-UN

In April 2012, Kim Jong-Un delivered a speech at the military parade commemorating the 100th anniversary of the birth of Kim Il-Sung. It was the first speech he delivered as the Supreme Leader of the country. There, he urged that no changes be made to the nation's military-first policies, saying, "All aspects of the military have to be improved" (Hiraiwa, 2013). Without a doubt, the main issues he faced were the military's ability including cyber security. I would like to develop my argument on issues in the field of IT by including some elements that contain predictions for the future.

3-2-1 RELAXING RESTRICTIONS ON FREEDOM OF SPEECH

In order for the authorities to maintain the system in North Korea, it is necessary to restrict freedom of speech. However, a certain degree of freedom would contribute to the economy and is essential to the country's further development. The *Go* software developed in North Korea that was mentioned in Section 2 illustrates this perfectly. While their rivals were utilizing cloud technology via Internet networks and thereby utilized an enormous amount of machine learning to improve performance, North Korea was left behind (Ha, 2017).

There were, however, clear signs of increased openness. I have already discussed the provision of mobile phone services to foreign-affiliated companies. By 2016 there were 26 economic development regions in North Korea that accepted foreign investment from countries such as China and South Korea. At these locations, "international telecommunications" were guaranteed by law. It was recognized that networks were essential to economic development, and therefore approval for networks began to be granted in limited areas. In other socialist countries such as China and Vietnam, the loosening of restrictions on freedom of speech and economic development went hand in hand. It is highly likely that North Korea used the experiences of these countries as a guide for its own forays into loosening restrictions on freedom of speech. Currently, debate is focused on when and to what degree the restrictions on freedom of speech should be loosened.

3-2-2 THE SPREAD OF IT TECHNOLOGY OVERSEAS

The economic sanctions imposed on North Korea by the UN and western countries as a result of North Korea's repeated nuclear test are becoming increasingly strict. These circumstances have naturally had an effect on IT. In February 2017, a panel of experts on the United Nations Security Council Committee on North Korean Sanctions concluded that a Malaysian corporate group was actually a front for the North Korean Reconnaissance General Bureau (RGB). In January 2018, an IT company that was a Chinese-North Korean joint venture was removed from the corporate registry by the Chinese government. A former member of an expert panel indicated that the economic sanctions were hardly comprehensive (Furukawa, 2017), but that they had likely made it increasingly difficult for North Korean overseas IT bases of operations to remain openly active.

As one way to avoid the effects of the economic sanctions, North Korea recommended that individuals go abroad to work. A report by the Organization for Security and Co-operation in Europe (OSCE) estimated that over 50,000 North Korean workers were working in 16 countries, mainly in Europe, and that they were sending amounts of money back to North Korea that totaled between USD 1.2 and 2.3 billion.¹⁵

As mentioned in Section 2-5, starting in the latter half of the 1990s, there was a surplus pool of personnel in North Korea who had been educated in the field of IT technology. However, it became difficult to send these people to work overseas once the economic sanctions took effect. One factor that should not be overlooked is that these people were sent abroad to defraud people out of money through cyberattacks¹⁶ and engage in cyberattacks against nations for economic gain.

3-2-3 STRONGER RELATIONS WITH CHINA AND THE BREAKAWAY FROM DEPENDENCE

After Kim Jong-Un took power, Jang Song-Thaek, who was Kim Jong-Un's uncle and who served as an important intermediary between North Korea and China, was purged. After this event, relations between China and North Korea soured. In December 2017 Wang Yang, a member of the Chinese Politburo

Standing Committee, stated in a discussion with a Japanese Diet member: “Previously, (North) Korea was a country with which we had a friendship that was sealed in blood. Now, we have an adversarial relationship.” One view, put forth by Nakazawa (2018), is that “China completely lost face as a result of North Korea’s repeated nuclear tests.” However, others see the situation as Takesada (2014) expresses it: “Rather than a deterioration in the relationship between China and North Korea, [it is a situation in which] North Korea is correcting its position of over-dependency on China.”

This situation changed at the start of 2018. Kim Jong-Un participated in three summit meetings between North Korea and China, including one that was held during his first visit to Beijing. It is possible that cooperation in cyber fields will begin. One point worth noting is the renewal of the Sino-North Korean Mutual Aid and Cooperation Friendship Treaty, which is scheduled to occur in 2021. This treaty was first signed in 1961 and is automatically renewed every twenty years. It has been renewed twice to date. An “automatic mutual defense clause” (stating that when one partner is attacked and involved in a war, the other partner must provide military support) is included in this treaty. This clause forms the basis for the alliance between China and North Korea. When the treaty was renewed in 2001, cyber security had yet to be seen as a problem, and thus there was ostensibly no discussion at the time over how the clause would be interpreted in the event of a cyberattack. Over the last dozen or so years, multiple nations, NATO, and others have indicated that they believe collective defense is applicable to a cyberattack. Perhaps the respective militaries of China and North Korea will examine a Sino-North Korean cooperation proposal on cyberattacks and cyber-defense as part of the process of renewing the treaty in 2021.

Although it may seem paradoxical, Kim Jong-Un believes that avoiding dependence on China is as important as strengthening relations between China and North Korea. In September 2012 North Korea and Iran entered into a science and technology accord (Torbati, 2012). In the latter half of 2017, North Korea began connecting with the overseas Internet via Russia. It is likely that North

Korea will continue to expand its cooperation with more and more countries in much the same way.

4 CONCLUSION

In 2013, Kim Jong-Il reportedly addressed his military commanders with the following words: “If warfare was about bullets and oil until now, warfare in the twenty-first century is about information.¹⁷” The South Korean intelligence agencies have reported that Kim Jong-Il views his country’s cyber abilities as his “Magic Weapon” (Song, 2014). Kim has made other statements expressing the view that cyberattacks and cyber defense are major issues. The problem is determining which of those cyber-related issues North Korea views as its top priority.

North Korea is still viewed as a high-tech country, but viewed as a country of closed networks. However, as stated in Section 2, the country has been steadily working since the 1980s on domestic projects such as semiconductor manufacturing, software development, and the development of fiber optic cable networks.

Further, as indicated in Section 3, North Korean IT engineers have been provided with incentives to expand their bases in foreign countries. In order for international economic sanctions against North Korea to have an effect, more effort is required from neighboring countries such as Japan and China.

The outside world still thinks of North Korea primarily as a country that has suffered oppressive rule and famine, and as a developing country in which information from the outside world is completely excluded. However, North Korea has succeeded in developing nuclear technologies as well as ICBMs. In fact, it is a dynamic technological country that has become a de facto nuclear-weapons state. The world must accept those abilities for what they are, and face them appropriately if it wishes to ensure the security of the region and cyberspace.

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Notes

¹ Approved on June 8, 2018. According to the indictment made public on September 7 of that year, WannaCry was involved in the improper transfer of payments from foreign currency accounts at the Bangladesh Central Bank and the hacking of Sony Pictures Entertainment, which were launched from a base of operations at the Korean Expo Joint Venture Company in Dalian, China.

² Tsutsumi (2016) and others have published outstanding discussions of the shift toward computerized numerical control (CNC) (a technology that uses computers to control the production of industrial goods), which took place at nearly the same time as IT technology was being developed. Therefore, this paper was limited to IT technology alone, as it has not previously been treated in detail.

³ The UNDP’s Project Closing Report is unavailable, because it is classified. Mansourov (2005) obtained information on the successful production of small amounts of IC before this information was classified.

⁴ US unilateral sanctions were imposed because of ICBM tests on July 3 and 28 of the previous year and nuclear tests on September 3. The industries targeted by the sanctions included “IT technology.” KCC is among the targets listed on the Specially Designated Nationals and Blocked Persons List (SDN) of the US Office of Foreign Assets Control (OFAC).

⁵ An order of the Supreme People’s Assembly in June 2003 enacted the “Computer Software Protection Act.” There is a record of the enactment of the “Software Industry Act” of June 2004. At this writing, there are no known materials that show the details of these laws. I look forward to the time when they are publicized by researchers who understand Korean.

⁶ In an August 2018 interview, an anonymous official of an ASEAN member states who was stationed in Pyongyang told the author of this paper: “Connecting to the Internet is extremely expensive, because it has to be done via a dial-up connection using an international call to an Internet service provider in China. Therefore, it is popular to purchase satellite mobile phones.”

⁷ In June 2002 a conference was held with government officials from both North and South Korea, as well as a telecommunications carrier. One issue discussed was the method to be used for mobile telephones in North Korea. According to Park (2015), a scenario in which the North and South would use the same method was considered.

⁸ The use of a mobile phone as a detonator was mentioned by Mansourov (2011), Ishimaru and Lee (2012), and Yamaguchi (2013). Although the author of this paper was not able to confirm the details.

⁹ The head of Orascom visited North Korea on many occasions, and there are photographs with this person with Kim Jong-Il and Jang Song-Thaek. See p. 18 of Mansourov (2011).

¹⁰ Kretchun and Lee (2015) wrote of the use of the Internet by citizens in North Korea based on a questionnaire survey of 350 defectors, refugees, and travelers that was conducted in 2015 as well as 35 interviews conducted in May and June 2016.

¹¹ This paragraph mainly describes higher education in the IT area. According to Ministry of Unification (2019), mandatory computer education for junior high school students began in 1998. Followed by several institutionalization of education.

¹² In 1984 it was referred to alternately as the Mirim Training School, the Kim Il Military Academy, and the University of Automation, but in the interest of consistency, I am using “Mirim University” throughout this paper.

¹³ Author of this paper recognize numbers on the table requires further reviews. For example, South Korean Ministry of Unification estimates 10% of 12500 students at Kim Chaek Univ. of Tech. attend the computer-related department(s).

¹⁴ Kim Jong-Un also visited Beijing under extreme secrecy in March 2018. On the day after his discussion with Xi Jinping, he traveled to Zhongguancun, which is known as “the Silicon Valley of China.” He toured an exhibition of projects created by students at the Chinese Academy of Sciences. In contrast to Kim Jong-Il’s tour that he “looked for what he wanted to see,” it seems likely that Kim Jong-Un’s tour was that he “was shown what China wanted to show.”

¹⁵ See Ono (2017). The money sent back to North Korea was not limited to that earned by workers in the field of IT. According to Yamaguchi (2013), the newspaper *Chosun Ilbo* reported that “50,000 workers are sent to 40 countries throughout the world, and they earn nearly USD 300 million per year.” Although there are discrepancies among the various dollar amounts reported, this figure can serve as a general reference.

¹⁶ Some of the engineers whose activities were restricted had already used cloud-sourcing services such as Freelancer.com and Guru.com, and they converted their skills into cash without revealing their identities. See p. 2 of Berger et al. (2018).

¹⁷ See Kindle location 2206 of Sanger (2018). Kim Jong-Il also “used to say modern warfare is electronic warfare”, according to Mansourov (2014: 4).