

Current Status of Software Research and Development in North Korea

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Introduction

The twenty-first century will be characterized by informatization, globalization, and openness. In particular, the rapid development of the Internet is playing a great role in globalization, in that information flows on it across national boundaries, without time or content constraints.

It is anticipated that North Korea, riding this world-wide tide, will open its tightly closed doors, and that peaceful reunification, strongly desired by the 70 million Korean people, will be achieved sometime in the future.

Already a milestone in this regard has been set. The International Conference on Computer Processing for Korean Language was held annually for three consecutive years beginning in 1994, at Yanbian, China, with scores of North Korean scholars participating each year. Paper presentations and discussions were conducted in a very warm atmosphere, and a joint agreement among the South Korean, North Korean, and Chinese delegates was achieved in 1996 in four areas — information processing terminology, keyboard arrangement, Korean character ordering, and a coding system for Korean characters.

Nevertheless, when we consider that even postal letter exchange is not permitted between the South and North at present, it is clear that

there are still many hurdles to cross toward the goal of reunification. Still, we should invest great effort in preparing for such an event. In particular, it is important to understand the degree of informatization in North Korea in order to formulate proper policies toward both reunification and the coming "information society." We should learn from the experience of Germany, which faced many difficulties due to the difference between East and West in the levels of telecommunications technology, even though they had had significant information exchange before reunification. The German experts regretted that they had not narrowed the gap before reunification. It will definitely help Koreans to reduce such future problems if we understand the current status of information technology in the North and pursue mutual cooperation in order to bridge the differences between South and North.

In this paper the current status of software technology in North Korea is described.

Trends in North Korean Information Technology

Current Status of Information Technology

National policies on science and technology. The fundamental policies on science and technology in North Korea are based on articles 27 and 51 of the Constitution of the Democratic People's Republic of Korea, which state that science and technology are essential for the nation's economic activities. These provisions further declare that science and technology will free the workers from labor and reduce the differences between physical work and mental work. The nation's technological development will be promoted by strengthening creative cooperation among scientists, technicians, and producers.

The North Korean government has been driving very hard to promote the so-called Three Great Revolutions of Ideology, Technology, and Culture, which are considered to compose the foundation for the construction of socialism. In addition, North Korea has put great emphasis on the goals of self-reliance (*Juche*), modernization, and scientification.

As far as information technology is concerned, the North Korean

government realized its importance and started to establish a master plan after Kim Il Sung toured Eastern Europe in 1984. He found that electronics-related high-technology was key to economic development, and technical cooperation contracts were signed with many of the countries visited. Also, North Korean students were sent to those countries to learn modern technologies. In 1988, a three-year plan for the promotion of science and technology began, and the government started massive funding for information science and industry.

The first three-year plan (1988 - 1991) emphasized the production of semiconductors, the establishment of a computer network centered around the Korea Computer Center (KCC) as a part of the computerization of economic sectors, the promotion of the software industry, and manufacturing of hardware and automation components. The second three-year plan (1991-1994) aimed to computerize all national sectors by the year 2000 and to industrialize the production of IC chips. The government developed 16-megabit IC chips, produced 32-bit microcomputers, and carried out research and development (R&D) on 64-bit microcomputers.

In addition, through the International Cooperation Bureau of the State Commission of Science & Technology (SCST), North Korea has been asking for help from United Nations organizations such as UNDP and UNIDO. Also, the DPRK signed a Memorandum of Understanding with the United Nations University/International Institute for Software Technology (UNU/IIST) on a joint effort for software development. North Korea is stressing software sectors more than hardware development due to its poor economic situation and difficulties in importing advanced equipment. This policy is clearly reflected in a letter sent by Kim Jong Il to the Pyongyang Informatics Center (PIC) on its tenth anniversary in July 1996. The president of the PIC, together with many researchers, received the national medal of honor.

Status of hardware development. Although North Korea started very early in building digital computers such as the "Jeon Jin-5500," its first-generation digital computer, in the late 1960s, and the "Yong Nam San 1," its second-generation computer, in the late 1970s, significant progress was made after an 8-bit PC prototype, the "Bong Wha 4-1,"

was built in 1982. North Korea is now manufacturing 16-bit and 32-bit PCs. In the semiconductor area, 16- megabit IC chips have been developed, and an IC pilot plant has been constructed at the Electronics Research Institute of the Academy of Sciences. Although its experts are trying hard, it is very difficult for North Korea to fully fund a complete hardware industry including semiconductor production. Therefore, funding was requested through UNIDO in May 1992. For example, they asked for \$2.4 million to produce 20,000 units of 32-bit PCs annually.

It is very difficult to learn exactly what types of computers are being used in North Korea. However, it would be very difficult to import computers on a large-scale basis, due to the COCOM regulations. It is understood that KCC, PIC, and Kim Chaek Technical University have many recent-model workstations and PCs, including DEC products with ALPHA chips.

Status of software development. Since the software industry does not require a huge amount of capital compared to the hardware industry, but rather human brains and creativity, North Korea has been emphasizing the software field. In order to raise software consciousness in the minds of the people the government has been carrying out an annual competition on programming technology.

For example, December 17-19, 1990, the first National Programming Contest was held in Pyongsong. About 440 programs developed by scientists, engineers, teachers, and students were submitted in the areas of application programs, service programs, and system programs. Some of the top-quality programs were an accounting program by a bank employee, an academic administration program by a Kim Il Sung University professor, and an automatic design program for printed circuit boards by a scientist at the Control Machinery Research Institute of the Academy of Sciences. Also, a student at Pyongsong Science College submitted an expert system for medical diagnosis, and a researcher at the Mathematics Research Institute of the Academy of Sciences developed a compression program for data storage.

The most recent national competition and exhibition of computer

programs was held in Pyongyang December 8–10, 1997, an important occasion in the development of North Korea's computer programming techniques and technical revolution. According to official reports, many new and efficient computer programs were presented. The prize-winners in the competition were "Chang-Duk 5.0," for editing documents in Korean *hangul*, from the PIC; "Sindong," for memorizing Korean characters, from Kim Chaek University of Technology; and "Memory Pen," a program directly reading Korean characters, from the Unbyol (Silver Star) Computer Technical Trading Center. According to a North Korean scientist, programmers who win the awards at the contest receive various benefits. For example, if a high school student receives the best award, he can easily enter the college of his choice.

North Korea is also striving for international cooperation in the software area. Professor Dines Bjorner, director of the UNU/IIST, was invited in October 1993 and May 1994 to give lectures on software technology in the DRPK. Also, a couple of outstanding North Korean scientists were sent to the IIST, located in Macau. A Memorandum of Understanding was signed between Professor Bjorner and Dr. Hong Ryun Gi of the DPRK SCST on October 25, 1993, which contained the following agreements:

- Immediate Action — IIST extends an invitation for two DPRK computer scientists to a software workshop in Beijing in November, 1993
- Short-Term Action — IIST invites two computer scientists to an advanced seminar on programming methodology in January, 1994
- Medium-Term Action — Professor Bjorner revisits Pyongyang in May 1994, to give a formal lecture on RAISE (Rigorous Approach to Industrial Software Engineering) and visits the Academy of Sciences, Kim Il Sung University, Pyongyang Informatics Center, and Telecommunications Technical Center, to explore possible future cooperation

- Long-Range Action — IIST conducts a two-week training course on RAISE and Duration Calculus in Pyongyang, carries out a joint project lasting one to two years, and invites four or five DPRK computer scientists to Macau for training one or two times, for typically nine months each. Also, IIST and DPRK jointly establish a software laboratory, which may contain a library, workstations, CASE tools, various PCs, and other peripheral devices so that researchers from other institutes and universities can use them.

The major organizations in software development are KCC, PIC, Unbyol Laboratories, the Department of Computer Science under the Academy of Sciences, the Computing Center of Kim Il Sung University, Kim Chaek University of Technology, and Pyongyang College of Computer Technology. Their products will be discussed in a later section. Regardless of the organizations that produce them, programs are developed for IBM PC compatibles, NEC PC9801 series, and Macintosh computers. The products are aimed for domestic uses and foreign exports. They include many edutainment programs and some software products utilizing highly advanced technologies, such as fuzzy theory, expert systems, and other AI techniques.

Telecommunications status. According to the 1997 World Almanac, in North Korea there is one telephone per 21 persons, one television set per 11.5 persons, and one radio per 9.2 persons. The Internet is not used in the DPRK at this time. However, when we consider the situation in China, where most major universities are now connected to the Internet, it may be only a matter of time before North Korea opens up to the Internet as well. A professor at Kim Chaek University of Technology who attended a workshop in Beijing in 1993 mentioned that the North Korean government had made a successful test of an Internet connection with Australia, but the government was not planning to implement a full connection at that time. There are several Web sites operating in Japan for North Korea, such as the Korean Central News Agency, Kumgangsan International Group, and Chosun Shinbo.

It is well known that North Korea is greatly interested in optical communications. A master plan has been established for the installation of an optical fiber cable between Pyongyang and Hamhung, and for training of technical manpower in cooperation with the International Telecommunications Union (ITU) and UNDP. The Low Voltage Engineering Institute (LVEI) was placed in charge of the project; however, it did not materialize, due to lack of digital communications and semiconductor technologies. Recently the Loxley Company of Thailand has begun installing optical fiber cables in Rajin-Sonbong Free Economic and Trade Zone.

Information Technology Education

General education system. The education system in North Korea consists of a one-year kindergarten, a four-year elementary school, a six-year high school, and a four- to six-year college education. The eleven years of primary and secondary education are mandatory. There are also graduate schools in research institutes and universities that grant master's degrees and doctorates.

About ten years ago, North Korea started to designate a First High School for gifted children in each city and province, to foster development of scientific manpower. The graduates of these schools now play leading roles in the advancement of science and technology in North Korea. Among them are several hundred Ph.D.s and doctoral candidates. The Mangyongdae Children's Palace, which directs extracurricular activities for bright students, has a computer activity room equipped with tens of PCs for computer education. There are two scrolls on the wall, one saying, "We should use computers for computational tasks in order to compute fast and reduce our labor - Kim Il Sung," and another reading, "We are in an era of science and technology. We cannot advance even one step without knowing science and technology. Therefore, everyone should learn modern science and technology — Kim Jong Il." These words show how North Korea is stressing the application of computers and the importance of science and technology. A pamphlet on Mangyongdae published in 1995 indicates the great improvement in their computer applications (such

as computer-aided design) when compared with the resources described in 1990, including only character generation.

Educational organization. Computer education and manpower development for computer specialists started immediately after North Korea began to produce computers, in 1983. The electronics engineering curricula in various universities were expanded, and computer research institutes were established in the Academy of Sciences and Kim Chaek Technical University. In 1985 the government also established colleges of computer technology in Pyongyang and Hamhung. Kim Il Sung University separated computer studies from the mathematics department to set up a computer science department. Most computer education in secondary schools is carried out at the First High Schools.

Realizing that a regular university education is not enough to satisfy the needs of computer specialists, KCC, PIC, the Academy of Sciences, and the Computer Training Center have created programs to educate and train computer specialists. In particular, the PIC, in cooperation with the Osaka Information Center (OIC) in Japan, established the O&P Training Center in April 1996, in order to train the general public and company workers. Many scientists from the OIC regularly travel to North Korea to teach in the training center. As mentioned earlier, UNU/IIST conducted intensive courses on software technology in Pyongyang in 1993, 1994, and 1998. The main subjects were those related to RAISE.

Research and Development in Software Technology

DPRK Academy of Sciences. According to a brochure published by the Department of Computer Science (DCS) under the Academy of Sciences, the DCS was established in 1970 for the purpose of theoretical and practical research in computer science. The long-term plan is for the development of computer programs for domestic use and export, manpower training in software fields, distribution of software technology and products, and integration of software technology into

various economic sectors in North Korea. TABLE 1 shows a partial list of software packages developed.

Current theoretical research includes Korean character recognition, machine translation, data compression, error analysis for input data, and relational database systems, while applications research includes program development for office automation, accounting systems, bank management systems, and computer-assisted Korean-English translation systems. The Paeksong Trading Corporation is attempting to export software developed by DCS. International cooperation is also sought by DCS in fields such as joint research on software technology, mutual exchange of scientific developments, commercialization of developed software, and other related subjects.

Korea Computer Center (KCC). The KCC, established in 1990 to promote computerization, has developed many application programs for IBM PCs and compatibles, including the following:

KORYO Acupuncture

An expert system for traditional Korean medicine, which may be used for education and treatment of more than ninety kinds of disease using acupuncture.

ISDM (Integrated Service Digital Medicine) System

A system used for diagnosis and treatment of disease by Koryo-medicine. It consists of predictive diagnosis, diagnosis, and the Koryo medicine system. Even a layman can use the system, which supports Korean, English, Japanese, Chinese, Russian and Arabic.

**TABLE 1. Program Packages Developed by DCS
(For IBM PC compatibles or NEC 9801 series)**

<i>Name</i>	<i>Brief Explanation</i>
KORYO	Korean electronic dictionary with 40,000 words
DOVE	Electronic conversation dictionary for travelers. Korean-English, English-Korean, Japanese-English, English-Japanese
Word-Mate	Korean and Japanese word-learning software using games(Korean-Japanese, Japanese-Korean)
Pearl	Word-processor to be used with mixture of Korean, Japanese, and Chinese characters
Eagle	Automatic recognition of Korean characters
Rainbow	Computer-assisted Japanese-English translation system
Study Tetris	Educational computer game for learning English words, physics formulas, etc.
Business	Expert system to aid in writing business letters in English
Hand	Korean chess program
Free Ball (Tree Frog 1)	Computer program for intelligence development for children, series 1. To catch a ball in a Brownian movement
Colcon (Tree Frog 2)	An intelligence game to arrange rectangles with colors
Magic Box (Tree Frog 3)	A game to arrange colored boxes horizontally, vertically, or diagonally
Dragon (Tree Frog 4)	To guide a dragon moving freely on a display into a fence
Foods-300	Electronic cookbook for more than 300 traditional Korean dishes

Color-matching System and CAD/CAM System for Textiles
A textile pattern-design system which is used to produce small quantities of any pattern at a reasonable cost.

KCR-HOPE

A Korean character-recognition program which can also recognize English, Japanese, Chinese, and Russian characters. The recognition rate is five to ten characters per second, with an accuracy of over 99 percent.

MFP-V (Mini-automatic Fingerprint Identification System)

An automatic fingerprint identification system with CCD camera input. It is fast, as it utilizes parallel distributed processing algorithms which can identify a fingerprint within three seconds, with an accuracy of 99.2 percent.

MOHO-37

A fuzzy-based computer control system for ore-dressing processes, which helps to reduce cost, manpower, and chemicals used.

Dancing Fountain

A computer-controlled device which can be used indoors or outdoors for decoration. Also, it can be connected to a cassette player, tape recorder/player, or computer music system to change height and color of water with the music. A Karaoke system may also be connected.

Recently the KCC also announced development of application software utilizing an automatic fingerprint identification program such as "Golden Horse," a habitude classification and diagnosis system, and an automatic identification system for bank customers. The air traffic control system developed by the KCC is said to be better than a similar product produced in Russia and has been operating at the Pyongyang International Airport since 1993. According to a KCC scientist interviewed on a visit in China, KCC has also been carrying out international projects such as a Web browser program for Japan and development of a patent database system for UNDP.

Pyongyang Informatics Center (PIC). PIC, established in 1986, is the leading institute in Korean language processing and word-processor development. The "Chang-Duk" word-processor developed by PIC is the most widely used program in North Korea. PIC comprises more than a hundred research scientists, with 1.5 computer units per person, on average. A partial list of software developed by PIC follows:

DTP System

An electronic publishing system developed for PCs and Macintoshes.

Multi-lingual Word-processor

Korean, English, Russian, German, French, Spanish, Latin, and Portuguese are supported by the system, in which several different sizes and calligraphic styles of characters may be combined in a document.

Korean DOS

MS-DOS modified to work with Korean language.

Tangun for Windows 95

A front-end processing program which permits a user to do Korean input/output on top of Windows 95 functions. It supports not only North Korean codes but also South Korean KS codes for Korean characters.

Chang-Duk for MS-DOS and Windows

The original Chang-Duk, greatly improved to respond to the demand of users who wanted a faster and simpler editor.

Others

At the COMDEX-Asia exhibition, held in Singapore in September 1996, PIC also demonstrated GOHYANG, a database management system, DEUL, a 2-D CAD system, SANAK, a 3-D CAD system, and a Korean character-recognition system.

A recent brochure discloses that the PIC has developed a production control system, a management activities analysis system, an office automation system, and a computer-aided dress-design system.

Computing Center, Kim Il Sung University. The Computing Center, established in 1985, has developed many programs in cooperation with faculty from computer science, natural sciences, and social sciences departments of the university. Recent techniques in software development are being applied. Some of the programs developed by the center are listed below.

- Intelligent Locker (hard disc protection program)
- Worluf Anti-Virus (broadband anti-virus program)
- Source Master (high-level programming language conversion program)
- SIMNAS (simulation and analysis system)
- COMSAT (computer-aided teaching system)
- War Game Program
- Hepatitis Diagnosis and Prescription System
- XFC 2.0 (highly portable C++ program development tool)

Unbyol (Silver Star) Laboratories. Established in 1995, Unbyol Laboratories is very active in producing and marketing its software products. The company has a branch office in Gifu, Japan, which promotes and distributes its products. According to the Korean Central News Agency, Unbyol researchers, who studied at the prominent universities such as Kim Il Sung University after graduating from Pyongyang First High School, are 26 years old, on average, and very competent.

Unbyol's "Silver Baduk" (a Go Game program) won first prize at the Fourth Fost Cup World Computer Go Championships held in Japan in 1998. The CD-ROM containing the program is sold in Japan at 9,800 yen. Other multimedia programs, such as Taekwon-Do and North Korean postage stamps (3,700 of them, from 1946 to 1996), are also available in Japan. Details may be found on the Unbyol home page, <http://www.ggf.ilc.or.jp/user0/silver>.

Conclusion

Since North Korea is a tightly closed country, it is very difficult to obtain exact information, especially if it is related to high-technology

such as information technology. Thanks to the Internet, we can obtain certain facts through the reports, now available on the World Wide Web, of those who have traveled to North Korea, including some who have worked on a project in North Korea carried out by the Federation of American Scientists. Also, there exist several North Korean homepages, such as those of the Korean Central News Agency and the Kumgangsan International Group, whose Web sites are located in Japan.

As far as information technology is concerned, both South and North Korea realize its importance, and both have strong national development projects. While North Korea has emphasized software development, the South has put significant effort into memory semiconductors, and has become one of the leaders in the world market. The South's software industry has been comparatively very poor.

Manpower development is also stressed in both countries, although the South is numerically much stronger. North Korea has disadvantages such as difficulty in accessing up-to-date high-technology information, because of the collapse of the Soviet Union as well as the lack of an Internet connection. However, software technology in North Korea has advanced remarkably in the last few years. For example, programmers were largely dependent on BASIC, COBOL, and FORTRAN several years ago, but now they are using C++. Some research institutes are equipped with late-model PCs and workstations. However, the South is much stronger in numbers and types of computers.

Although North Korea is far behind South Korea in terms of hardware, applications software development for PCs, such as word-processors, is rapidly catching up with the efforts in the South. For example, the latest version of the Chang-Duk word-processor is very similar to a South Korean word-processor in its functions. Recently the North developed Chang-Duk and Tangun for Windows 95, which may indicate that Windows 95 is also popular in the North. Many of the software programs developed by KCC and DCS of the Academy of Sciences are edutainment, teaching subjects through games. Some programs employ advanced technology, such as fuzzy theory, expert

systems, and other AI techniques. Though it is not possible to confirm suspicions of many observers, North Koreans may have developed military-oriented software, such as remote sensing programs, which are required to develop guided missiles.

A wide gap between the levels of information technology existing in the South and North, respectively, could bring many problems after reunification. Differences in thinking and concepts could add more problems. Information technology specialists in North and South Korea should try to meet each other more often, exchange information, and cooperate to lessen their differences. Restoration of homogeneity and trust in Korea will be best achieved through people-to-people contact rather than by government programs.

As we have seen, reunification in Germany came much earlier than most anticipated. We do not know exactly when Korea will be reunited. However, we should do our best to be ready for reunification and proper settlement of an information society in Korea in the twenty-first century.